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Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies

Edited by

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Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies

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This e-book is a compilation of resource text obtained from various subject experts of ICAR-CIWA, Bhubaneswar & MANAGE, Hyderabad on **Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies**. This e-book is designed to educate extension workers, students, research scholars, academicians related to agri-allied sector. Neither the publisher nor the contributors, authors and editors assume any liability for any damage or injury to persons or property from any use of methods, instructions, or ideas contained in the e-book. No part of this publication may be reproduced or transmitted without prior permission of the publisher/editor/authors. Publisher and editor do not give warranty for any error or omissions regarding the materials in this e-book.

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MESSAGE

National Institute of Agricultural Extension Management (MANAGE), Hyderabad is an autonomous organization under the Ministry of Agriculture & Farmers Welfare, Government of India. The policies of liberalization and globalization of the economy and the level of agricultural technology becoming more sophisticated and complex, calls for major initiatives towards reorientation and modernization of the agricultural extension system. Effective ways of managing the extension system needed to be evolved and extension organizations enabled to transform the existing set up through professional guidance and training of critical manpower. MANAGE is the response to this imperative need. Agricultural extension to be effective, demands sound technological knowledge to the extension functionaries and therefore MANAGE has focused on training program on technological aspect in collaboration with ICAR institutions and state agriculture/veterinary universities, having expertise and facilities to organize technical training program for extension functionaries of state department.

Agriculture, the base of Indian economy provides employment to nearly 50 percent of work force, which again consists of 70 percent women. These women farmers act as primary food producer, dedicate maximum time to agriculture but remain unreported in statistics. To owe justice to their heavy work, their energy to be properly channelized. One of the medium for that is agripreneurship. Women agripreneurship is a medium for women empowerment by making them self sufficient, economically stable, independent decision taking, better purchasing power, and socioculturally more active. There are various opportunities in agriculture and allied sectors which are needed to be explored more and practiced to get a sound economic benefit. The women farmers need to be motivated by organizing them into cooperatives, Self Help Groups (SHGs), providing them land ownership, attracting them towards Micro, Small and Medium sized enterprises (MSMEs) and policy implementation by government to make agriculture more attractive and remunerative for them and the future generations.

It is a pleasure to note that, ICAR- Central Institute for Women in Agriculture, Bhubaneswar and MANAGE, Hyderabad, Telangana is organizing a collaborative training program on Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies from 14-18 September, 2021 and coming up with a joint publication as e-book on **Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies** as immediate outcome of the training program.

I wish the program be very purposeful and meaningful to the participants and also the e-book will be useful for stakeholders across the country. I extend my best wishes for success of the program and also I wish ICAR- Central Institute for Women in Agriculture, Bhubaneswar many more glorious years in service of Indian crop-livestock-fisheries sector ultimately benefitting the women farmers. I would like to compliment the efforts of Dr. Shahaji Phand, Center Head-EAAS, MANAGE and Dr. Lipi Das, Principal Scientist (Agri. Extension), ICAR-CIWA & Nodal, AICRP (Women in Agriculture) for this valuable publication.

Dr. P. Chandra Shekara
Director General, MANAGE

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Foreward

ICAR-Central Institute for Women in Agriculture (ICAR-CIWA) is an institution first of its kind in the world that is exclusively devoted to gender related research in agriculture. ICAR-CIWA has a mandate of undertaking research on gender issues in agriculture and allied fields, gender-equitable agricultural policies/ programmes and gender-sensitive agricultural-sector responses and co-ordinating research through its AICRP centres spread across 12 states in India. Working through its mandate, the Institute has the vision to emerge as a leading centre for gender research and serve as a catalyst for gender mainstreaming and women empowerment in agriculture to realize enhanced productivity and sustainability of agriculture.

Women form the major workforce in agriculture. The increasing male migration has led to feminization of agriculture. But they still reel under poverty because of various socio-political, economical and technological constraints. Agripreneurship is considered as one stop solution for many economic problems like poverty, urbanization, unemployment and economic development. Agriculture with its diversity is now seen as an enterprise with good profit which is possible by changing the way it has been practiced. The major concern is proper utilization of the existing resources. Women farmers need to be made aware, motivated and trained about these diverse agripreneurial opportunities to adopt them as their alternate livelihood options. The major opportunities in agriculture, livestock and fishery sectors are enterprises involved in production, service, input supply, processing, value addition and marketing. Strategic implementation of gender sensitive entrepreneurial models will ultimately improve the participation of women in diversified farming with integrated approach and postharvest activities making them self sustainable (*Atma Nirbhar*).

In order to realize this vision, the extension functionaries need to be updated on women friendly and gender sensitive technologies in agriculture and allied sectors as they are the bridge between research institutions and farmers and farm women. The training elaborates on some very important aspects of rural women entrepreneurship development like food and nutritional security through agriculture and allied sectors, livelihood improvement of farmwomen through adoption of scientific technologies in agriculture and allied sectors, extension strategies for entrepreneurship development among farm women, gender sensitive family farming through agriculture, leadership and entrepreneurship development etc.

I appreciate the team of ICAR-Central Institute for Women in Agriculture, Bhubaneswar for organizing this collaborative training program with MANAGE, Hyderabad, Telangana on **Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies from 14-18 September, 2021** and bringing out the publication which would prove beneficial to the stakeholders for promoting entrepreneurship development among rural women.

Dated: 10-09-2021

(Anil Kumar)

Preface

This e-compendium is an outcome of the collaborative online training programme of ICAR-CIWA, Bhubaneswar and MANAGE, Hyderabad on **"Promoting Women Agripreneurship through Crop-Livestock-Fisheries Technologies"**. The compendium will serve as a guide to scientists, faculty members, entrepreneurs, extension functionaries and all others who are stakeholders in promoting rural women agripreneurship. Agripreneurship is the talk of the day and Government of India is also giving immense thrust to schemes promoting entrepreneurship. Innumerable technologies have been developed in India by the vast Network of ICAR Institutes and SAU's. But rural women need to be updated with the technologies that have been developed in agriculture, livestock and fisheries sectors.

The content of the e-compendium is built in such a way that updated information on technological advancements and entrepreneurship development could be gained by the stakeholders. The compendium highlights the contributions of ICAR-CIWA in women empowerment and gender mainstreaming. The compendium gives an insight into the gender dimensions which is a pre-requisite for successful implementation of any programme/ project with an aim towards empowerment of women. The importance of management of family resources for successful women entrepreneurship is mentioned holistically in the compendium. The topics like gender sensitive farming system models will be helpful towards framing projects/ programmes focusing livelihood enhancement together with nutritional security. This includes horticulture, agriculture and livestock farming systems. Entrepreneurial avenues through post-harvest processing and engineering existing in agriculture, horticulture, fisheries, poultry, goat farming and farm machinery and power are dealt in detail in the compendium. The benefits of association of women into collectives like FPO's in transforming gender relations has been dealt well in the topics. Other topics covered include the importance of digitization of technologies in agriculture, business plan development and the incubation process for carving out women agriprenuers.

Valuable suggestions for future improvement are always welcome.

10 September, 2021 **Editors**

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Women in Agriculture - Current Scenario & Critical Analysis

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Introduction

Workers play a pivotal role in driving economy of any country. They are the catalysts for change in any sector of the economy. A skilled, motivated workforce is an asset to the nation. It is essential to keep track of the workforce for implementing policy framework according to their active participation.

The exercise of counting workers was initiated with the first census conducted in 1872. Over the years there have been gradual improvements in approach towards collecting information on workers. Collection of Information on workers including those in agriculture is done by Census exercise every ten years and by National Statistical Office (NSO,) every five years. The methodologies of data collection by the two agencies are different. While census follows the head count method, the NSO uses sampling estimation method.

It is important to know how many of them are there, status and the engagement of workers in agriculture and women in agriculture in particular. The condition employment can be assessed through the social construct i.e. employment, unemployment, underemployment, dependent population to understand the magnitude of the problem which is the primary steps in finding a solution for it. With a realistic picture of the above scenario, an assessment could be made to know the surplus workers and formulate policies to rehabilitate them in alternate remunerative vocation.

Enumerating workers and women in agriculture: agencies involved

1 **National Statistical Office (NSO):**

In 1970, the Planning Commission established a "Expert Committee on Unemployment Estimates" (the Dantwala Committee) to undertake employment and unemployment surveys and determine the country's employment and unemployment condition. The first quinquennial survey on employment and unemployment, performed in the NSS 27th round (Oct 1972 – Sep 1973) was based on the concepts and terminology provided by this committee.

Objective of the employment and unemployment surveys conducted by NSSO are:

a) To get estimates of level parameters of various labour force characteristics at the national and State/UT level

b) To defining the labour force and measuring participation of the labour force in different economic activities

c) To capture activity participation of the people which is not only dynamic but also multidimensional (varies with region, age, education, gender, level of living, industry and occupational category)

d) To generate estimates for labour force participation rate, worker population ratio, unemployment rate, extent of underemployment, wages of employees, etc.

e) To generate estimates for *indicators of the structural aspects* of the workforce such as status in employment, industrial distribution and occupational distribution of the worker

f) To collect data on the particulars of enterprises and conditions of employment, the aspects of employment in the informal sector and informal employment

2 Census of India

The censuses continue to collect data on the population with the limited goal of defining people as workers into the following categories: i) cultivators, ii) agricultural labourers, iii) workers in the home industry, and iv) other workers. Workers are further divided into two categories: primary and marginal workers. Non-workers are defined as people who did not fall within the category of workers.

Women in agriculture: A critical Analysis

A. Women in agriculture as workers

The census gives data in narrow sense for agriculture because it take into account cultivators and agricultural labourers only and remains silent about those in other sectors of agriculture. NSO, on the other hand consider agriculture in broad sense considering all sectors of agriculture and allied activities.

The number of female workers according to NSO survey and the Census exercise is given in Table 1. According to NSO the total female workers numbered 128.9 m (21.9 % of total female), whereas the Census data gives the figure of 149.9 m (25.5 %). In rural areas the number of workers as per NSO was 100.8 m (24.8 %) compared to 121.9 m (30.0 %), whereas the workers in urban area were 26.6 m and 28.0 m in NSO and Census, respectively.

The workers in principal status (NSSO) and main workers (Census) were almost similar in rural, urban and total. However, there was great variation in subsidiary status (NSSO) and marginal (Census) workers, which resulted in variation in total workers. Whereas there were 34.1 m (5.8% of population) ss workers in NSSO, there were 60.6 m (10.3%) marginal workers (Census). In rural areas, there were 29.5 m (7.3 %) ss status workers (NSSO) as compared to 54.1 m (13.3 %) marginal workers (Census).

Table 1: Female workers as per in NSSO survey and Census data

	Workers - total					
	NSSO (ps+ss)	**Census** (main+marginal)	**NSSO** (ps)	**Census** (main)	**NSSO** (ss)	**Census** (marginal)
All	128.9 *(21.9)*	149.9 *(25.5)*	94.9 *(16.2)*	89.4 *(15.2)*	34.1 *(5.8)*	60.6 *(10.3)*
Rural	100.8 (24.8)	121.9 (30.0)	71.4 (17.6)	67.8 (16.7)	29.5 (7.3)	54.1 (13.3)
Urban	26.6 *(14.6)*	28.0 *(15.4)*	22.8 *(12.6)*	21.6 *(11.9)*	3.9 *(2.1)*	6.5 *(3.6)*

Figures in ( ) indicate percent of respective total population

The number of female agricultural workers according to NSO (broad and narrow definition) and Census are given in the Table 2. The broad definition of agriculture according to NSSO includes all those working in agriculture (including animal husbandry), forestry and fishing. The narrow definition of agriculture limited to cultivators and agricultural labourers can be derived from the sub classes (Division 011: growing of non-perennial crops and Division 015: Mixed farming) of NSO survey to make a comparison with the Census data.

Table 2. Female agricultural workers as per in NSO survey and Census data

	Agricultural workers - total					
	NSSO (ps+ss)	**Census** (main+marginal)	**NSSO** (ps)	**Census** (main)	**NSSO** (ss)	**Census** (marginal)
Female agricultural workers (broad definition)						
All	80.9 *(13.8)*	97.6 *(16.6)*	56.9 *(9.7)*	53.8 *(9.2)*	24.0 *(4.1)*	43.9 *(7.5)*
Rural	75.6 *(18.6)*	94.3 *(23.2)*	53.2 *(13.1)*	51.6 *(12.7)*	22.4 *(5.5)*	42.6 *(10.5)*
Urban	2.9 *(1.6)*	3.4 *(1.9)*	2 *(1.1)*	2.1 *(1.2)*	0.9 *(0.5)*	1.2 *(0.7)*
Female agricultural workers (narrow definition)						
Female	66.5 *(11.3)*	97.6 *(16.6)*	50.2 *(8.5)*	53.8 *(9.2)*	16.3 *(2.8)*	43.9 *(7.5)*
Female	62.5 *(15.4)*	94.3 *(23.2)*	47.3 *(11.7)*	51.6 *(12.7)*	15.2 *(3.7)*	42.6 *(10.5)*
Female	1.9 *(1.0)*	3.4 *(1.9)*	1.4 *(0.8)*	2.1 *(1.2)*	0.5 *(0.3)*	1.2 *(0.7)*

Figures in ( ) indicate percent of respective total population

B. Females engaged in specified activities (not counted as workers)

A person is considered as worker if s/he is engaged in economic activity. An activity is considered as economic activity if it results in production of goods and services that add value to national product. A vast majority of females, although they are engaged in specified

activities which keeps the home and family running, their toil does not fit into the classical definition of economic activity and thus they are not counted as workers. Table 3 shows the distribution of female population according to their principal activity status. In the principal status, only 94.9 m (16.2 % of total female) are considered as workers, 3.7 m (0.6 %) unemployed and a vast majority of 489.0 m (83.2 %) are not in labour force (Table 3).

However, of the 489.0 m female, 49.5 m (8.4 % of total female) are below the age of 4 years and another 182.0 m (31.0 % of total female) are not in labour force because of attending to educational institutions, being old age etc. A significant number of females 257.5 m (43.8 % of total female; 52.7 % of female not in labour force) attend to domestic duties. They remain engaged for a significant number of hours to keep the home and family running. Besides the household chorus that they attend to, 169.9 m (28.9 % of total female / 34.7 % of female not in labour force / 66.0 % of those attending to domestic duties) carry out a large number of specified activities.

The NSO survey (Indian System of National Accounts, ISNA) considers *production of only primary commodities for own consumption* as economic activity. It *does not consider processing of primary products* for own consumption as economic activity. However, the UN system of National Accounts (SNA-2008) consider *production of any good for own consumption; own account processing of primary products* as economic activity.

Table 3. Distribution of females according to status in principal status

	Status	Total	Rural	Urban
a)	**Working**	**94.9**	**71.4**	**22.8**
		(16.2)	*(17.6)*	*(12.6)*
	Self employed	47.2	38.2	8.4
		(8)	*(9.4)*	*(4.6)*
	Regular wage/salaried	15.8	5.4	11.1
		(2.7)	*(1.3)*	*(6.1)*
	Casual labour	31.8	27.8	3.3
		(5.4)	*(6.8)*	*(1.8)*
b)	**Unemployed**	**3.7**	**2.1**	**1.6**
		(0.6)	*(0.5)*	*(0.9)*
c)	**Not in labour force**	**489**	**332.4**	**157.3**
		(83.2)	*(81.9)*	*(86.6)*
	Attended to domestic duties	257.5	171.2	87.1
		(43.8)	*(42.2)*	*(48)*
	Not in labour force- others	182	125	57
		(31)	*(30.8)*	*(31.4)*
	Not in labour force- 0-4yr	49.5	36.2	13.1
		(8.4)	*(8.9)*	*(7.2)*
	Total	**587.5**	**405.9**	**181.6**
		(100)	*(100)*	*(100)*

Work participation in states and UTs of India

The work participation in different states is not uniform in diverse country like India. Different sectors contribute unequally to the economic growth. Agriculture sector continues

to provide employment to a large section of the society especially in rural India. Work participation – total and agricultural work participation were calculated for men and women based on Census 2011 for all the states and the highest and lowest WPR are reported.

Work participation (total) and Agricultural work participation (rural+urban)

The overall WPR in India was 39.8 percent (Table 4). Among states and UTs, Himachal Pradesh had the highest WPR (51.9%) followed by Sikkim (50.5%) and Daman and Diu (49.9%) and Lakshadweep the lowest (29.1%) followed by Uttar Pradesh (32.9%) and Delhi (33.3%). Twenty One states and UTs had WPR more than the average of India (39.8%).

Table 4: Work participation (WPR) (total) and agricultural work participation (AgWPR) in different State/UT of India (rural + urban)

	WPR			AgWPR		
State	**Person**	**Male**	**Female**	**Person**	**Male**	**Female**
Andhra Pradesh	46.5	58.4	34.6	28.9	31.9	26.0
Arunachal Pradesh	42.5	49.1	35.4	24.5	24.0	25.0
Assam	38.4	53.6	22.5	18.9	26.5	11.0
Bihar	33.4	46.5	19.1	24.5	33.7	14.5
Chhattisgarh	47.7	55.6	39.7	35.6	37.2	34.0
Goa	39.6	56.8	21.9	4.0	4.6	3.4
Gujarat	41.0	57.2	23.4	20.3	25.1	15.2
Haryana	35.2	50.4	17.8	15.8	21.0	9.9
Himachal Pradesh	51.9	58.7	44.8	32.6	29.0	36.3
Jammu & Kashmir	34.5	48.1	19.1	14.3	17.8	10.4
Jharkhand	39.7	49.8	29.1	25.0	27.4	22.5
Karnataka	45.6	59.0	31.9	22.5	26.0	18.9
Kerala	34.8	52.7	18.2	6.0	8.8	3.4
Madhya Pradesh	43.5	53.6	32.6	30.3	34.3	26.1
Maharashtra	44.0	56.0	31.1	23.2	24.7	21.6
Manipur	47.9	54.0	41.8	25.3	27.2	23.4
Meghalaya	40.0	47.2	32.7	23.4	25.7	21.0
Mizoram	44.4	52.4	36.2	24.7	27.4	22.0
Nagaland	49.2	53.4	44.7	30.4	28.4	32.4
Odisha	41.8	56.1	27.2	25.8	32.3	19.2
Punjab	35.7	55.2	13.9	12.7	20.4	4.0
Rajasthan	43.6	51.5	35.1	27.1	27.1	27.0
Sikkim	50.5	60.2	39.6	23.5	23.6	23.4
TamilNadu	45.6	59.3	31.8	19.2	21.0	17.4
Tripura	40.0	55.8	23.6	17.7	23.6	11.5
Uttar Pradesh	32.9	47.7	16.7	19.5	28.1	10.2
Uttaranchal	38.4	49.7	26.7	19.7	19.9	19.4
West Bengal	38.1	57.1	18.1	16.8	25.5	7.5
Andaman and Nicobar	40.1	59.6	17.8	5.6	8.1	2.8
Chandigarh	38.3	56.5	16.0	0.4	0.6	0.2
Dadra & Nagar Haveli	45.7	61.6	25.3	13.4	12.3	14.8
Daman and Diu	49.9	71.5	14.9	1.3	1.2	1.3
Delhi	33.3	53.0	10.6	0.4	0.7	0.2
Lakshadweep	29.1	46.2	11.0	0.0	0.0	0.0
Pondicherry	35.7	54.4	17.6	6.4	8.6	4.4
Telangana	46.7	55.0	38.4	26.0	25.9	26.2
India	**39.8**	**53.3**	**25.5**	**21.7**	**26.6**	**16.6**

The overall male WPR in India was 53.3 percent. Among states and UTs, Daman and Diu had the highest male WPR (71.5%) followed by Dadra & Nagar Haveli (61.6%) and Sikkim (60.2%) and Lakshadweep the lowest (46.2%) followed by Bihar (46.5%) and Meghalaya (47.2%). Twenty Three states and UTs had male WPR more than the average of India (53.3%). The overall female WPR in India was 25.5 percent. Among states and UTs, Himachal Pradesh had the highest female WPR (44.8%) followed by Nagaland (44.7%) and Manipur (41.8%) and Delhi the lowest (10.6%) followed by Lakshadweep (11%) and Punjab (13.9%). Eighteen states and UTs had female WPR more than the average of India (25.5%).

The overall AgWPR in India was 21.7 percent. Among states and UTs, Chhattisgarh had the highest Ag. WPR (35.6%) followed by Himachal Pradesh (32.6%) and Nagaland (30.4%) and Delhi the lowest (0.4%) followed by Chandigarh (0.4%) and Daman and Diu (1.3%). Seventeen states and UTs had AgWPR more than the average of India (21.7%).

The overall male AgWPR in India was 26.6 percent. Among states and UTs, Chhattisgarh had the highest male Ag. WPR (37.2%) followed by Madhya Pradesh (34.3%) and Bihar (33.7%) and Chandigarh the lowest (0.6%) followed by Delhi (0.7%) and Daman and Diu (1.2%). Twelve states and UTs had male AgWPR more than the average of India (26.6%). The overall female AgWPR in India was 16.6 percent. Among states and UTs, Himachal Pradesh had the highest female AgWPR (36.3%) followed by Chhattisgarh (34%) and Nagaland (32.4%) and Delhi the lowest (0.2%) followed by Chandigarh (0.2%) and Daman and Diu (1.3%). Eighteen states and UTs had female AgWPR more than the average of India (16.6%). Figure 1 shows the Work participation ratio (persons) and agriculture work participation ratio in different state/UT of India including rural and urban areas.

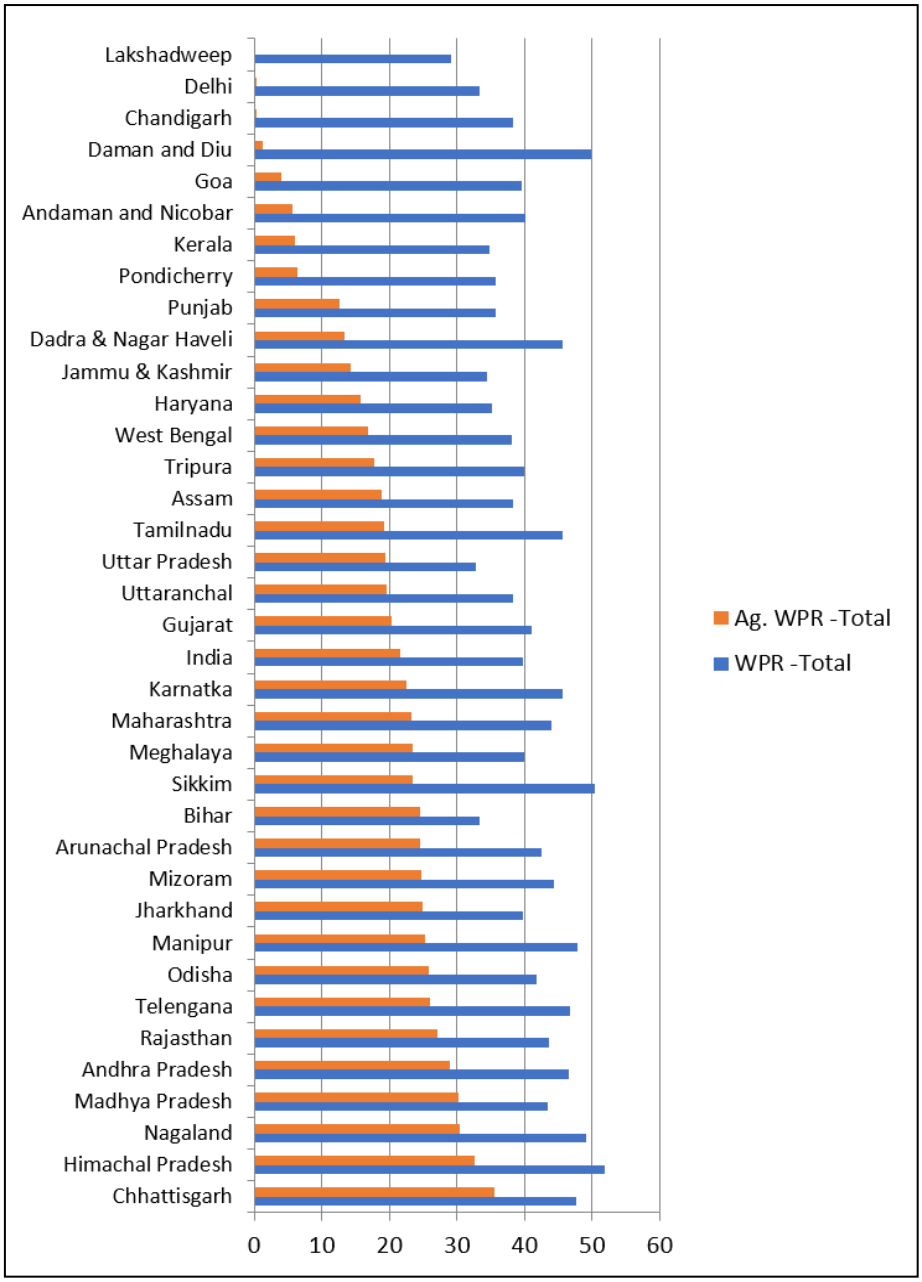

Figure 1: Work participation ratio (persons) and agriculture work participation ratio in different state/UT of India (rural + urban)

Conclusion:

Workers are the most important stakeholders for economic activities. To make wise use of this resource, it is necessary to know the number of workers in various areas of the economy. This is especially true in the agriculture sector, as it is this sector that has absorbed the majority of India's surplus employees, resulting in underemployment. Knowing the quantity of workers and other types of individuals is necessary for enacting policies that benefit them. There is also a need to quantify the work that women do in the process of nation building, even if society cannot afford to pay them their fair share.

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Gender Sensitive Agri-Nutri Farming System Model and Value Chain Analysis in Crop-based Farming System for Entrepreneurship

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Women farmers are one of the major stakeholders of the agriculture sector and play a predominant role in various on-farm and off-farm activities. They have abundant roles and responsibilities in the sector and can play instrumental in transforming the face of agriculture. According to (OXFAM 2018), the agriculture sector in India employs 80 per cent of all economically active women. In India, farm women comprise 33 per cent of agricultural labour force and 48 per cent of self-employed farmers. Nearly, 85 per cent of rural women are engaged in agriculture but on an average only 13 per cent of them own land. But, women centric agricultural policies, Research, and training and capacity building programs are often ignored. The magnitude of women's work participation in agriculture is often curtailed by prevailing socio-cultural taboos which create perceptible gender disparity. The traditional patriarchal customs, norms and taboos have relegated women to a secondary status within the household and workplace which has resulted in a huge gender gap.

India slips to 140th Rank on Gender Gap Index…

As a matter of concern, India despite of achieving high rates of economic growth in recent year was ranked at **140th position among 156 countries** in **Global Gender Gap Index in 2021** as against **112th rank in 2020**. The gender gap in India has widened to **62.5%, largely** due to women's inadequate representation in politics, technical and leadership roles, decrease in women's labour force participation rate, poor healthcare, lagging female to male literacy ratio, income inequality.

The report is a measure of gender gap on four parameters: economic participation and opportunity, educational attainment, health and survival, and political empowerment. The index has benchmarked 156 nations across the globe in 2021. The data show that it will take 135.6 years to bridge the gender gap worldwide and the pandemic has impacted women more severely than men. The gap represents an **'extremely high'** level of gender inequality thereby resulting in its poor performance on gender related assessments despite being a large geographical entity with enormous natural resources.

Identification of the Problem

- Agricultural interventions in India from the 1960s till the early 1990s were focused on increasing food grain production and productivity to attain self-sufficiency and address more important issues like food shortage and hunger.
- But however, self-sufficiency in food production has not translated into nutritional security, indicating missing link between agriculture production and nutritional security.

The 2 Big Questions ??

1. Why a Country like India which is having agriculture as the predominant occupation and surplus in food grains production, is having significant share of malnourished people?
2. Why there are missing links between agriculture and nutrition?

Conceptual Approach

1. **Need to focus on the nexus between Agriculture, Nutrition and Gender**

Considering the significance of holistic development of agriculture, ensuring gender equality and equity is critically vital. Hence, it is imperative to identify and assess critical gender gap indicators which will serve as a fundamental basis on which gender-sensitive programs and approaches can be designed.

There are five core areas that run through the SDGs which nutrition can contribute to, and in turn, benefit from:

1. Sustainable Food Production
2. Strong Systems of Infrastructure
3. Health Systems
4. Equity and Inclusion
5. Peace and Stability

The nutrition needs of a family are not often kept in mind in deciding the cropping pattern. If agriculture is to be integrated with nutrition, automatically multiple cropping, crop rotation, integrated farming system would emerge, which also provide solution for many of the farmers problem today.

Nutrition-sensitive agriculture is an approach that seeks to maximise agriculture's contribution to nutrition. It encompasses more than just cereal crop production—from horticulture to forestry and fisheries, agriculture should be seen not only a means but, it is an essential process for improving the quality of foods available to the community and ensuring healthy soils and ecosystems for farming in the future. Nutrition-sensitive agriculture also

leads to targeting poor households, promoting gender equity, and providing nutrition education.

Gender Gap in Health and Nutrition

In the context of Health and nutrition security aspect, the dominant gender gap assessed was BMI (Body Mass Index) related issue, wherein the majority of farm women (92.5%) reported that the BMI (Body Mass Index) of a female is not at par with the recommended BMI, followed by higher nutritional deficiency-related problems among them.

One third of women of reproductive age in India are undernourished, with a body mass index (BMI) of less than 18.5 kg/m^2. In rural areas 40.6% women compared to 25% in urban areas are undernourished. The rates of under nutrition is three times higher in low income groups compared to high income groups.

Malnutrition has intergenerational consequences because undernourished women give birth to low-birth-weight babies. Such children can face cognitive and other limitations all their lives, making it difficult to escape from poverty. When women face food discrimination on a national scale, the human capital of the nation is put at risk.

In spite of vulnerability to malnutrition, women are in a unique position to improve nutrition in their households. They are often primarily responsible for growing, purchasing and preparing foods and child-rearing although they have limited access to nutrition information and the resources they need to improve food security, such as income, land, equipment, financial services and training. Despite these extensive roles, most developing countries' extension systems do not sufficiently address the needs of female farmers or rural workers.

The concept of nutrition-sensitive agriculture was initiated for promoting gender equity and providing nutrition education by targeting poor households. Introducing gender and nutrition as a new cross-cutting theme of Agricultural Extension helps to build more robust, gender-responsive and nutrition-sensitive institutions, projects and programmes to assist in considering and responding to the needs of both men and women of a community.

Recommendations suggested that to prevent malnutrition a family approach rather than a group or individual approach was required, along with more efforts to sensitize grassroots-level workers about nutrition; sensitization of more women and men Village Level Workers (VLWs) about gender and nutrition perspective.

We also know there are three main pathways that potentially improve nutrition: agricultural production, agriculture-derived income, and women's empowerment. Extension workers are often considered as a promising vehicle for the delivery of nutrition knowledge and practices to improve the nutritional health of rural communities because they reach and interact closely with farmers in different settings and act as significant service providers of crop, livestock, and forestry aspects of food security, consumption and production.

Approaches

1. **Food-based approaches** can focus on cultivation and availability of nutrition-rich crops at the farm level, linking farmers to markets and value chains at the farm gate level, knowledge for preservation of nutrient content of food through cooking, storing, and processing at household level.

2. **Non-food based approaches** such as providing women with the gender-friendly tools and technology to improve their own livelihoods and reduce their labour and time, generating income through raising livestock by improved husbandry practices, and by adopting sustainable agricultural practice which have a direct impact on nutrition and health.

The 3 Es' Concept of Women Entrepreneurship

With the prevailing trend of feminization of agriculture, the changing socio-cultural-economic scenario of our country has realized the significance of women empowerment in agriculture. As a result, there have been several facilities created to uplift the socio-economic status of women farmers but the quantum of farm women evolving as successful agri-entrepreneurs is very scarce due to several reasons among which collaboration among the developmental organization and failure of industrial linkage are some of the lesser visible but critical causes, which can play as a game changer in empowering the women farmers. Thus, a novel approach is required to promote agri-preneurship among the budding women farmers through development of agricultural value chain by converging all the developmental stakeholders in a single platform to ensure holistic entrepreneurship coverage to the concerned women farmers.

Closing the gender gap in agriculture would generate significant gains for the agriculture sector as well as society for whole by bringing EQUITY, promoting ENTREPRENEURSHIP and realization of EMPOWERMENT (**3 Es'** Concept).

Why Do Gender Inequalities in Agriculture Persist?

There are five dimensions to gender inequality in agriculture: land rights, productive resources, unpaid work, employment and decision making (Sexsmith, 2017).

First, women are less likely to hold statutory land rights, and, when they do own land, their plots are often relatively small. Foreign investors in land tend to reinforce such inequality by dealing with those who do have formal rights to land—men. They also tend to cut off women's access to common lands for household needs, and to exacerbate the patriarchal land rights that underpin many customary land rights systems.

Second, gender discrimination in credit markets makes it more difficult for women farmers to acquire labour-saving and innovative production inputs. This can impede women's participation in out grower schemes, although some investors facilitate credit access. Women face access barriers to extension services, which creates a knowledge gap that prevents them from benefiting equitably from new innovations.

Third, women's household labour burden can be improved by social development initiatives, but unfortunately their needs are rarely considered by investors, often resulting in unpaid work. Investments that provide access to labour saving technologies can reduce women's labour burden in contract farming, but in agro-processing and plantation agriculture, female waged labourers face longer working hours. Increased incomes under foreign investments can help women to ensure their household is food secure, but the conversion of subsistence to export crops can create new food security risks.

Fourth, investment projects have tended to reproduce gender divisions of labour that relegate women to temporary, insecure employment. Contract farming schemes can raise women's earnings, but women have been largely left out of these opportunities. Plantation type agro-export operations can create new paid employment opportunities, although employment conditions including remuneration are often poor. Moreover, crowding women into field- and packing house-level employment can expose them to physically arduous work and to sexual harassment. Yet, compliance with labour standards and certifications has improved working conditions, including safety and health conditions.

Fifth, where investment projects have raised women's earning power, they have sometimes helped to shift cultural constraints on women's decision-making power within the household. However, investment projects have rarely improved women's under-representation in producer cooperatives or worker groups, including in internal decision making and dispute-resolution bodies, which remain male-dominated. Large-scale investment projects have a poor track record of including women's voices in consultations and negotiations, relying instead on the opinions of male elites.

Strategy

The World Bank has made gender equality in the agriculture and food sector an explicit goal. Each project includes actions based on a thoughtful gender analysis that aim to result in positive gender outcomes. The Bank works to:

- **Expand women's access to land and rural finance**: Providing women with greater access to land, finance, and production inputs is critical to closing the productivity gap between men and women. Microfinance institutions and other financial service providers with presence in rural areas can play a key role in supporting women farmers. The Bank also ensures that women benefit from land titling projects.
- **Link women to agricultural value chains**: When women are linked to agricultural value chains from production all the way to processing and marketing, they help make traditional farming more productive and commercially viable. Inclusive value chains also offer work opportunities for women and men off the farm.
- **Improve rural women's access to training and information**: Knowledge of farming techniques is critical to productivity; however women farmers have inadequate access to agricultural extension and training services. It is also important that training and agricultural technologies are accessible and adapted to rural women's needs and constraints.

- **Produce knowledge, data and tools that promote gender equality in agriculture and food sector projects**: The Bank produces resources that help practitioners integrate gender-sensitive actions in their projects. This includes the Gender in Agriculture Sourcebook and an e-learning course, as well as the World Development Report 2012: Gender Equality and Development.

Family Farming: A Way for Improving Livelihood and Promoting Gender Equity

More than 90% of farms are run by an individual or a family and then produce about 80% of the world's food occupying around 70-80% of farm land. The United Nations declared the year 2014 as International Year of Family Farming aims to raise the profile of family farming and smallholder farming by focusing world attention on its significant role in eradicating hunger and poverty, providing food security and nutrition, improving livelihoods, managing natural resources, protecting the environment, and achieving sustainable development, in particular in rural areas. The goal of the 2014 IYFF is to reposition family farming at the centre of agricultural, environmental and social policies in the national agendas by identifying gaps and opportunities to promote a shift towards a more equal and balanced development. The 2014 IYFF will promote broad discussion and cooperation at the national, regional and global levels to increase awareness and understanding of the challenges faced by smallholders and help identify efficient ways to support family farmers.

Challenges for Gender Sensitive Family Farming

Agricultural Technology

Technologies are seldom wealth and gender neutral, women's participation in the agricultural labour force has decreased due to the mechanization of their tasks because of men's appropriation of machinery. Women were reluctant to adopt mechanized technology due to lack of education, socio-cultural norms, and also because the machinery was not designed for use by women.

Historically, national agricultural research systems have been oriented towards cash crops and commercial farming, and little has been invested in research on other topics that might be more useful to women. This trend, combined with gender blindness in research organizations, leads to the generation of knowledge and technologies that are, in general, focused on the needs of larger-scale, male farmers. Although women can benefit from technologies and information on cash crops, as explained above, they have additional content needs that have been largely ignored by the agricultural research system. In many countries, the majority of agricultural research staff, managers and policy-makers are men, and the perspectives and needs of rural women are not always considered (Beintema, 2014). A study in 64 countries for 2003–2008 found that on average, women made up 23 percent of agricultural research staff (at both public and private institutions), but only 14 percent of managers (Meizen-Dick et al., 2011). The lack of gender balance in leadership positions means that decisions about research agendas and policies are made mainly by men, with little input from women.

Institutional Interventions for Farm Women

In a country with predominant gender bias, the vagaries of rural life is more reflected on the weaker sex, the poor working class women with their increasing dependence on their families for their livelihood and their decreasing bargaining power in the society. Economic empowerment should have backing of sound financial system. The recent report of the 'National Commission on Self-Employed Women' observed that women on being given institutional support, demonstrated high productivity, a better record of payment of loans and the assets are sustained. However, in doing so, it is important to recognize women as a major earner, not as a supplementary worker. The major institutional support is provided to the women by the government, financial institutions and voluntary agencies. However, it was seen that the women focused government programmes suffered from the problems of mis-identification of beneficiaries. Also, use of 'household' approach in allotting the welfare schemes in a male-dominated society like India prevented women quite often from receiving the benefits.

The national data on allocation of credit based poverty alleviation scheme showed that less than 15 per cent of the beneficiaries were women, which was barely half the target of 30 per cent. An in depth study of credit flow by gender in a bank in Andhra Pradesh state suggested that disbursement to women ranged between 6 to 12 per cent over all, but dropped to zero for agricultural loans. It was found that since land has been the major source of collateral, women's lack of ownership barred them from the access to the formal credit system, thus limiting their ability to acquire other productive resources also.

Organizing women into groups has been proved to be a good intervention. It can transform women from the status of "beneficiaries", into "clients", who are in a long-term can have a reciprocal relationship with the institutions meant to serve them. The self-help groups (SHGs) or the thrift and credit groups are mostly informal groups whose members pool their savings and lend within the group on rotational or need basis has been a success story in the country. SHGs take loans from banks/ voluntary agencies/ self-help promoting institutions to meet the needs of the farmwomen. Along with implementing the micro finance programmes, SHGs take up many other important social issues like health care, sanitation, family planning, literacy, management of common resources etc. This in the long run, makes the delivery system more responsive to local priorities and replaces centrally determined prescriptions and top-down approaches with more flexible planning of both contents and mechanism of service provisions.

Besides development organizations there are research institutes and projects under Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs) which are engaged in developing gender sensitive technology, drudgery reducing implements etc. A group of social scientists in the system are specially assigned to promote gender sensitization in agriculture and develop approaches and models for gender mainstreaming.

Development of Gender Sensitive Family Farming Approach through Value Chain

The gender sensitive approach in family farming was designed and tested in Sankilo village of Cuttack district with the involvement of over fifty participating farm women during 2012-17 and is being carried forward in an entrepreneurial mode since then. The village was selected after making due consultations with the households and finding the social climate relatively better in gender sensitiveness. Preliminary meetings, genders sensitization programmes, gender gap analysis and PRA studies were undertaken by involving both male and female key informants separately to identify major gender issues in rice farming.

The major gender issues in rice farming identified include women-friendly technologies, access to resources & information, labour sharing, benefit sharing, capacity building, group mobilization, decision-making pattern, societal gender mindset, constraints in farming, linkage with financial & marketing institutions etc. Accordingly, suitable technological and institutional interventions were provided and evaluated. The male heads of the families/ the legal owners of lands were sensitized and motivated through personal contacts and close interactions to allocate about half an acre rice growing land to all the participating family farm women. A women development group in the name of '*Ánanya Mahila Bikash Samiti*' was formed and registered after mobilizing all fifty farm women for deriving maximum institutional benefits and for group sustainability. Intensive awareness camps were organized and trainings imparted for desirable changes in their skill, knowledge and behaviour with regard to the objective of the programme, rice production technologies, market support and possible outcome of the project.

Demonstrations on rice production and crop management practices on popular and suitable rice varieties based on women's preference and market demand were conducted in the allotted half acre land by each during *kharif* season. Apart from rice, during *rabi* season, technological interventions on cultivation of high value vegetable crops, pulse crops and preparation of value added food products were also given. Seeds and planting materials were provided free of cost as critical inputs during initial years only. Improved rice production technologies like growing of mat type nursery, seed treatment, line transplanting, use of rice transplanters, balanced dose of fertilizer application and need based pesticides application were provided along with technical backstopping in women's perspectives. Similarly, for harvesting and post-harvesting management, training-cum-demonstrations on drudgery-reducing and women-friendly machines and technologies like rice-parboiling unit and rice-husk combustor; and demonstration on paddy-straw mushroom cultivation was also conducted for additional revenue generation and family nutrition from rice by-products.

Looking at their acquisition of enough technical competencies and managerial abilities, the group was made as a signatory to the Rice Value Chain for ensuring greater economic benefits of the participating women members. Reactions of the farm women were recorded at regular intervals to assess the effects of interventions and modify accordingly, if called for. The major impacts of the project in terms of outputs and outcomes as found out through concurrent and end-term evaluations are briefly outlined below.

a) **Change in attitude towards gender mainstreaming:** Significant change in attitude towards gender mainstreaming was established. The male members of the family as well as in the village are now giving more importance and recognition to the farm women in farm, family and community matters. More so, they were happy and motivated to see and watch the success stories of their village in print and electronic media. They are now allowing female members to attend agricultural meetings and programmes outside.

b) **Mindset of male members of family/society:** Findings indicate that there was major change in the mindset of male members of family/society towards women-managed rice farming (90%). All the farm women were feeling recognized by other members of the family as well as village due to their increased capacity in farm and home management activities and leadership in organizing group and social activities.

c) **Competency of farm women:** As opined by the farm women, remarkable changes in behavior of women rice growers were found with regard to agricultural knowledge (100%), technical skill (93.33%), decision-making capacity (86.67%) and undertaking group activities (76.67%). Improvement in skills in nursery raising, handling farm implements, disease and pest management were also observed.

d) **Women friendly production technologies:** Technologies with regards to raising of mat-type seedlings for mechanical transplanting, seed treatment, mechanical line transplanting, use of small farm equipments were found drudgery reducing. Among the women-friendly farm machineries demonstrated, rice husk combustor, finger weeder and 4-row manual drum seeder were perceived as more appropriate by 85.71%, 70.37% and 57.14% farm women respectively. Paddy straw mushroom cultivation as an income generating activity by converting rice byproduct (straw) was also rated as more appropriate by 88.46% farmwomen.

e) **Effect of demonstrated technologies:** All the participating farmers adopted scientific production practices based on their socio-economic feasibilities. The analysis of the data shows that majority of the respondents had positive perceptions with regards to comparative advantage of recommended/demonstrated rice varieties over earlier grown varieties in terms of yield, resistance to pest/diseases, tolerance to weeds/drought, labour saving, profitability and marketability.

f) **Access to productive resources:** Significantly increased access of women to farm inputs was observed through the approach, as evident from the expansion of allotted half an acre land to over one acre in many families by end of 2-3 years. This expansion of area under the control of farmwomen signifies more trust and confidence on women farmers by their male counterparts and a positive impact of the project. Similarly, accessibility to family land (100.0%), seeds (100.0%), fertilizers (100.0%), and money (45.45%) were found.

g) **Entrepreneurial opportunities:** Since, the farm women had their expertise in preparing traditional value added food products (VAP), they were encouraged and supported to convert the traditional value added rice products into demand driven

marketable products through improved food technology process. A book on 'Traditional Rice Foods - The Rich Heritage of India' was also brought out containing the processes of making over hundred traditional rice-based value added products, primarily collected from the women group.

h) **Partnering in RVC:** By working in groups, the women realized their inherent capacity, developed friendly atmosphere and learnt the importance of working in groups in the society. Accordingly the registered group also took up entrepreneurial activities as a signatory to the NRRI rice value chain and in turn potential women entrepreneurs were recognized.

Way Forward

Access to productive resources is critical for enhancing women's economic choices. Since, formal credit institutions rarely lend to this weaker sex, special institutional arrangements has become necessary to extend credit to those who have no collateral to finance their enterprise. In order to have access to credit, social, institutional and government support is required. More than half of the farm labour is contributed by farm women. Moreover, as evident from several literatures, they have also proven their competencies over time and again to manage efficiently and effectively at par with the male members of the society, provided they were supported socially, economically, technologically and institutionally. There is a need to identify their hidden capacities and entrepreneurial abilities and link them to the market. If they can be made technologically competent and socio-economically empowered, they could be the efficient drivers in achieving accelerated agricultural growth and development of the country in general and in boosting family income in particular. Organizing women into groups has been proved to be a good intervention. It can transform women from the status of 'beneficiaries', into 'clients', who are in a long-term can have a reciprocal relationship with the institutions meant to serve them.

Conclusions

- While we talk of empowerment of women in family farming, the discussion invariably focuses around access to and control of women over productive assets and their effective use for sustainable livelihood and income.
- Creating and sustaining competitive and equitably-oriented value chains that help small-scale farmers, especially women, will require explicitly examining gender issues and proactively integrating gender components into value chain analysis and development strategies.
- It is inferred from the findings that, the farmwomen could be the efficient drivers of national agricultural growth and development, if they can be made technologically competent and socio-economically empowered through development of gender sensitive entrepreneurial approaches. This, in turn, would make Indian agriculture more sustainable.

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Horticulture-Based Entrepreneurship through Technology Interventions for High Value Vegetable Crops

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The present population need to be self-sustained both in assuring healthy & nutritious food and economic safety. Being an agrarian country, this can be achieved through horticulture-based approaches, where the advanced technology is a modern venture and a boon for the welfare. In this context the present topic was enlighten upon the entrepreneurship in horticulture industry through interventions of advanced technologies in high value vegetable production. We discussed about seed industry, protected cultivation, vegetable processing approaches, organic production method, bio-pesticides and bio-fertilizers production, role of packaging and hydroponics as an important attribute for achieving the same. Further, the study is focused on the constraints of its adoption and popularization among young generation and women entrepreneur at larger scale. The suitable and need based approaches is required to tackle these issues highlighted precisely. This study could stand as a key for many stakeholders for sustainable entrepreneurship development in high phased vegetable production.

An Entrepreneur (ahn'tra pra nur) is a person who organizes and manages a business undertaking, assuming the risk for the sake of profit. Any person (any age) who starts and operates a business is an entrepreneur. Entrepreneurship is one of the key drivers for economic development. Entrepreneurship has been linked to improved growth, increased wealth and quality of life. In developing countries like India, planning and implementation for development of entrepreneurial programmes are essential for raising the living standard because of their over-dependence on agriculture for employment (Uplaonkar and Biradar 2015). Thus, entrepreneurship development appears to be the best substitute to find employment opportunities, income generation, poverty reduction and improvements in nutrition, health and overall food security in the national economy. It can also be defined as a process in which a representative manages to visualize and implement an idea, belief, service, product or activity (Bernier and Hafsi 2003).

Agri-entrepreneurship

Agriculture sector plays a formidable role in the sustainable growth and development of Indian economy. It provides for the food and nutrition requirements of 1.38 billion Indian people and creates employment opportunities through forward and backward linkages to support 60% of Indian population. While it has achieved substantial progress over the years regarding food security, accessibility and affordability. The agriculture sector is still challenged by low productivity, low profitability, increase in input costs, wastage of crops

due to lack of storage and supply chain management. These challenges present a host of opportunities for Agri-entrepreneurs.

Agri-Entrepreneurship in common language can be defined as sustainable, community-oriented, directly-marketed agriculture. The association of agriculture and business promotes agri-entrepreneurs who innovate, identify markets, and satisfy needs by developing different ways. Growing horticulture crops is now an ideal option to improve livelihood security, enhance employment generation, accomplish income and food security, and increase income through value addition. In horticulture, vegetables play an important role owing to presence of vitamins, minerals, micronutrients, antioxidants and pigments etc. The new generation of educated farmers and unemployed rural youth have an opportunity to become entrepreneur and adopt olericulture as a business enterprise.

Aspect of Entrepreneurship

- The identification/recognition of market opportunity and the generation of a business idea (product or service) to address the opportunity
- The marshalling and commitment of resources in the face of risk to pursue the opportunity
- The creation of an operating business organization to implement the opportunity motivated business idea

Opportunities for entrepreneurship in vegetables

1. **At Farm Level:** Production of vegetable produce by making best use of the technology, resources and demand in the market.
2. **As Service Providers:** These include the input procurement and distribution, hiring of implements and equipment and technical services such as installation of irrigation facilities, weed control, plant protection, harvesting, threshing, transportation, storage, etc
3. **Input Producers:** There are many potential business opportunities like, bio-fertilizers, biopesticides, vermi-compost, soil amendments, agricultural tools, irrigation accessories.
4. **Value Chain / Processing / Marketing:** Small scale agri. processing units, post-harvest etc.

Role of women in entrepreneurship development for high value vegetable crops:

In developing countries like India, women play a significant role in food production and nutrient provision by engaging in agriculture, horticulture, processing and food preparation within the household apart from scheduled work (Hyder et al., 2005). Despite many hurdles, role of women in farming sector particularly horticulture (considered to be evergreen and burning industry) are growing increasingly. It is evident that women farmers are the major stakeholders in vegetable production in kitchen garden and main farm and play a predominant role in on-farm and off-farm activities. Their efforts in vegetable production cannot be ignored when performance of various aspects like time consuming operations, labour intensive and monotonous work that imparting their role as far beyond from the counterpart. Although the perseverance and patience of their role towards vegetable

production is very pertinent, it is the high time to explore their potential in more acutely by acknowledging their strength, focused upon their weakness, providing them with ample opportunities and mitigating their threats. No doubt this can be achieved by emphasizing high value vegetable production and linking with entrepreneurship development. Though both the strategies stand good in their position, these can be strengthened by linking and channelizing with advanced technology interventions. Moreover, with the increasing trend of feminization in agri-horti sector, it is imperative to empower and enrich them with advanced technologies aiming at improving their skill and reducing the drudgery for promoting sustainable livelihood enhancement and nutritional fortification with high remuneration in economic term.

In general concern, entrepreneurship is the ability and readiness to formulate, develop, organize and run a business enterprise along with of its any uncertainties in order to get profit. Many a time, it is seen as a glimmer of hope which may bring about some contribution towards improving economic sustainability and performance, especially in the creation of the employment by youth and women, in general, with further educational training, greater flexibility and who are definitely better prepared for working with new technologies. Instrumental interventions of entrepreneurship through more advance technologies for high value vegetable crops, may play a pivotal role in promoting more gender sensitized concern in a more sustainable way. In this context, it is high and right time to explore the horticulture-based entrepreneurship through technology interventions for high value vegetable crops.

The current developing science paves the way for innovation of useful techniques for better production of vegetable crops. The escalation and exploration of those advanced methodologies is very much important, when the sustainability and profitability is concerned in long term. Additionally, awareness and educational provision to those strategies should be done in systematic manner. Most importantly, adoption of advanced technologies is the key to get success and achieve prosperousness in any sector. Hence, the current topic focused on the well-fit technologies to the high value vegetable crop production that can be linked with entrepreneurship development.

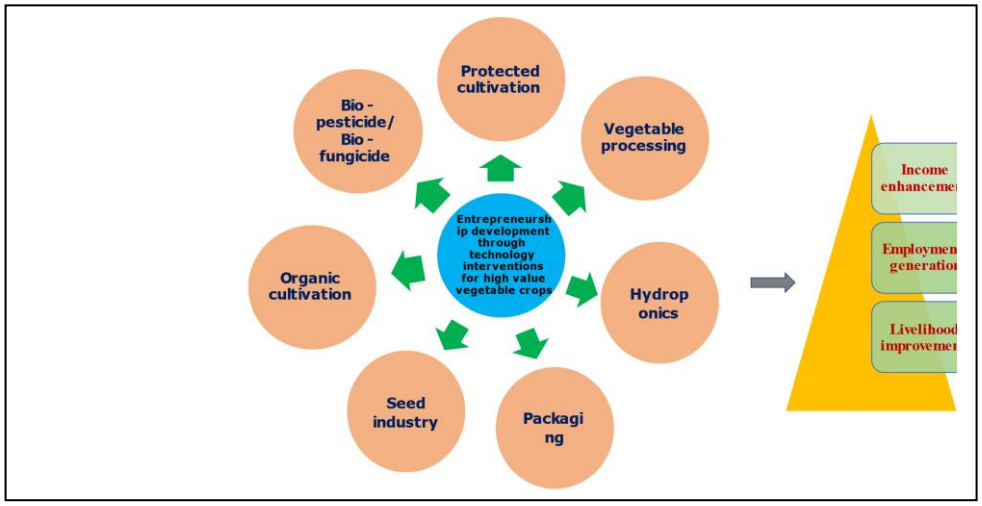

Fig. 1. Schematic view of entrepreneurship development through technology interventions for high value vegetable crops

Seed-Entrepreneurship:

A quality seed/ high quality seedling is the base for a healthy plant and high yield. Within the horticultural sector, seed industry serves as a major catalyst for boosting horticultural production and productivity. Though the seed network in India is comparatively well established and strengthened by reputed institutions that provide scientific support, there has always been a persistent gap in the availability of quality seeds in all major crops. The hybrid seed market is an ever-expanding market in India, especially in the case of horticultural crops. The vegetable seed market is valued at Rs 4000 crore and is reported to grow at the rate of five per cent. Hence, it offers a most viable arena for entrepreneurial ventures. The diverse requirement of varieties in every locality helps in accommodating any level of competition.

Basic requirement for initiating seed entrepreneurship:

- Identification of right crop (high market demand/ introduction of new vegetables/ exotic vegetables)
- Cultivar preference for each crop
- Demand-supply dynamics
- Market information

Entrepreneurship development through protected cultivation of vegetable crops

The plant's environment can be specified by five basic factors, namely, light, temperature, humidity, carbon dioxide and nutrients. The main purpose of protected cultivation is to create a favorable environment for the sustained growth of plant so as to realize its maximum potential even in adverse climatic conditions. Greenhouses, rain shelters, plastic tunnels, mulches, insect-proof net houses, shade nets etc. are used as protective structures. Besides modifying the plant's environment, these protective structures provide protection against biotic and abiotic stresses. Protected cultivation offers several advantages to produce vegetables of high quality and yields, thus using the land and other resources more efficiently. Not only production of high value vegetable crops, but also production of hybrid seed of high value vegetables like sweet pepper, hot pepper, lettuce, broccoli, melon and cucumbers are getting momentum in the protected structure. Protective cultivation generates immense employment with wide boost to horticultural production and helps the betterment of entrepreneurs.

Entrepreneurship development through vegetable processing

Industries dealing with vegetable processing are characterized by seasonality, perishability and variability of raw materials. The food processing sector in India has a quint essential role in linking Indian farmers to consumers in the domestic and international markets. The Ministry of Food Processing Industries (MoFPI) is making all efforts to encourage investments across the value chain. The food processing industry engages approximately1.93 million people in around 39,748 registered units with fixed capital of $32.75 billion and aggregate output of around $158.69 billion. Major sectors constituting the food processing industry in India are grains, sugar, edible oils, beverages, and dairy products. Under Pradhan Mantri Krishi Vikas yojana (PMKSY), 41 mega food parks, 353 cold chain projects, 63 agro-

processing clusters, 292 food processing units, 63 creation of backward & forward linkages projects and 6 operation green projects across the country have been approved. The key sub-segments of the food processing industry in India are fruits & vegetables, poultry & meat processing, fisheries, food retail, dairy industry, etc.

India's exports of processed food were Rs. 36,946.20 Crores/ 4,987.76 USD Millions in 2020-21, which including the share of products like processed vegetables (Rs. 3718.65 Crores/ 501.56 USD Millions), cucumber and gherkins (Prepared. &Preserved) (Rs. 1651.83 Crores/ 223.05 USD Millions). According to FAO (2019), India is the largest producer of ginger and okra amongst vegetables and ranks second in production of potatoes, onions, cauliflowers, brinjal, Cabbages, etc (APEDA, 2021). This symbolizes the mammoth of opportunities for young generations and especially female persons in the processing and value addition enterprise.

Entrepreneurship development through organic cultivation of high value vegetable crops

Organic farming is a production system that sustains the health of soils, ecosystems and people. It combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. Organic perspectives concern about the best utilization of available natural resources that not only provide heathy and environmentally safe food but also phases cost effective approach (Singh et al. 2021). This organic farming is gaining wide attention among entrepreneurs as it improves the quality of produce and subsequent high price in the market, as well, it is labor intensive and provides an opportunity to increase rural employment.

Constraints for Entrepreneurship development through organic cultivation

- Certification for organic farming
- Lack of research and extension support
- Poor marketing
- Lack of awareness

Entrepreneurship development through bio-pesticide/ bio-fungicide etc

Bio-pesticide is one of the promising alternatives to manage environmental pollutions and an integral part of organic production. Though potential application of bio-pesticides in environmental safety is well known, it has gained interest in view of the growing demands for organic food. The importance of organic farming is growing very fast particularly in international market. This sector provides great business opportunities to agro-based entrepreneur. Area under organic farming is increasing but unable to meet the demand of organic produce. The natural plants sustain many pesticidal attributes which can be explored and can be used optimally. It is also evident that combination of crude extracts of many plants having insecticidal quality suppressed pest effectively (Singh et al. 2021). Many such technologies have been developed by ICAR-IIHR which can be commercialized like, Arka Suraksha (*Bacillus licheniformis*, a potential antagonist for the management of purple blotch

disease of onion), Arka Microbial Consortium, Arka Fermented Cocopeat, Neem/ Pongamia soap etc (https://www.iihr.res.in/)

A Success Story: Pave the Way towards Healthy Production

Mr Sebastian is an example of journey of organic agriculture from crisis to creativity with consecutive years of drought and dry spells. At one point of time, he had an opportunity to participate in 2 days training programme organized by Tamil Nadu Agriculture University at Anna Horticulture Farm, Kudumiyanmalai in Pudukkottai District. The training was focused on how farmers can generate alternative income through bio input production and marketing. The inputs and ideas from the training gave him confidence to venture into production of bio-inputs. He perceived it as a solution to his farming crisis. Thus, he shifted his focus and energies from crop cultivation to bio-input production and marketing. Currently, he is involved in preparation of bio inputs like dasagavya, panchagavya, fish amino acid, vermi compost, herbal pest repellent Mixture based on the raw materials available in his farm. After fulfilling his farming needs, presently Sebastian annually markets 100 litres of dasagavya, 100 litres of panchagavya, 20 litres of fish amino acid, 100 litres of herbal pest repellent mixture and 2000 kgs of vermicompost. His income from selling the bio-inputs is around Rs.60000/- annually. His entire family, consisting of wife and two children, is involved in this initiative. Almost, 90% of the bio inputs are sold at his farm gate itself.

Entrepreneurship development through packaging of high value vegetable crops

The fresh-cut packaging revolution is most noticeable in bagged salads, where the moisture-controlled plastic bags created a whole new category. The trend toward fresh-cut packaging is in response to the increase in demand of grab-and-go eating patterns among consumers. A fresh-cut packaging type that is getting more popular is steamtable packaging. “As ready-to-eat foods get more popular, consumers are flocking to vegetables that can be steamed in the packaging, that can include cut vegetables, such as broccoli florets or green beans, or whole foods like microwavable sweet potatoes. ICAR-IIHR has developed shrink wrapping for extending the storage life of capsicum at ambient and low temperatures.

Entrepreneurship development with hydroponics of high value vegetable crops

The hydroponics market is estimated at USD 9.5 billion in 2020; it is projected to grow at a cumulative annual growth rate (CAGR) of 11.3% to reach USD 17.9 billion by 2026. Hydroponics is looked upon as a potential solution for the growing concern about food security in the coming years. The earliest recorded mention of hydroponics grown was in the year 1627 by Francis Bacon in his book, ‘A Natural History’. After the discovery of Hydroponics, research work progressed rapidly on this technique. In recent years, National aeronautics and space administrations (NASA) is experimenting with hydroponics for growing plants on long- term space missions. In 2007, an Arizona based company sold 200 million pounds of tomatoes, which were grown hydroponically. Presently, Canada boasts of hundreds of acres of farms which are using hydroponic techniques including hydroponic greenhouses. They have been successful in growing peppers, tomatoes and cucumbers. Hydroponics is a subset of hydro-culture and is a method of growing plants (mostly high vale crops) using mineral nutrient solutions, in water, without soil. It is estimated that food

production will need to increase by 70 per cent and vertical farming & urban roof-top gardening with hydroponics as the answer to the problem. This method of farming is a niche segment gaining popularity in urban, customized agriculture setup. According to the UN reports on global population, plants grown in hydroponic systems have achieved 20%–25% higher yield than the traditional agriculture system, with its productivity being 2–5 times higher. Water-adaptable fruits such as watermelon, cantaloupe, and tomatoes are among the ideal choice for farmers as they are easier to grow using hydroponic methods. Hydroponic production is getting popular among vegetable producers, since the method is not labor-intensive to manage huge production area, and it is an efficient method for controlling inputs and managing facilitates for pests and disease. Many sectors are highly focusing on building simplified hydroponics systems, to accelerate the exotic vegetables' production, meeting the population's escalating demand. Growing awareness among consumers regarding the advantages of eating fresh vegetables is further contributing to the industry development. India still imports majority of its exotic fruits and vegetables. The push from central government i.e. promoting subsidy for hydroponics indicating we have a long way to go before this technology gains widespread acceptance.

Fig. 2. Vegetable grown in hydroponic method

Best Hydroponic vegetables

Lettuce-one of the most popular choices among hydroponic gardeners and other crops like Kale, spinach, tomatoes, beans, radish, peppers are best suitable for hydroponics

Marketing: Fruit and vegetable vending van designed and developed by ICAR-IIHR consists of an evaporating cooling system for providing higher humidity required to maintain the freshness in fresh fruits and vegetables even under normal conditions. The designed evaporative cooling system helps in retaining the freshness in fruits and vegetables up to 36-48 hours or even more depending on the produce being stored and the weather conditions.

Points to Ponder for Entrepreneurship Development

1. *Financial Aspects;*

    - Lack of Infrastructure facilities- The growth of agri-entrepreneurs is not very healthy in spite of efforts made by government due to lack of proper and adequate infrastructural facilities.

- Shortage of funds- Lack of finance available to Agri entrepreneurs is one of the biggest problems
- Risk element- plays most crucial role in effective management for entrepreneurship

2. *Marketing problems*
    - **Competition-** Major problems faced by marketers are the problem of standardization and competition from large scale units.
    - **Middlemen-** The agri-entrepreneurs are heavily dependent on middlemen for marketing of their products who pocket large amount of profit.
3. *Management Problems*
    - Lack of knowledge in IT
    - Lack of technical knowledge
    - Poor quality of products due to lack of availability of standard tools and equipment and poor quality of raw materials

Need a push from allied resources: for sustainable development of entrepreneurship in high value vegetable sector:

- Introduction of cash awards to entrepreneurs.
- Establishment of Centre of Excellence-for rapid transfer of technology to the farmers
- Development of Agri-incubation centers in different regions for location specific technology
- Banking and credit facilities for startups and Agri- Entrepreneurs/ creation of financial cells
- Formation of FPOs
- Setting up of marketing co-operatives

Conclusion and Future Thrust:

A shift from 'agriculture' to 'Agri-Entrepreneurship' is being viewed as an essential pathway to refresh Indian agriculture. The share of agri/horti-entrepreneurship is bound to go up with the demand for value added products continuously increasing. The overall discussion gave clear insight to the technology interventions for high value vegetable production and further shedding light upon their utilization in entrepreneurship development. The constraints in the present time and need based approached to be followed is narrated precisely. Agri/horti entrepreneurship is also the answer to removal of rural poverty in India. The problem is that most of the rural youth and women especially, do not think of entrepreneurship as the career option. Therefore, it is the high time for them that need to be motivated to take up agri/horti based entrepreneurship as a career, with training and sustaining support systems providing all necessary assistance. Further, the system can be strengthened with focus on efficient regulated market establishment. In this context, the government should also lend its helping hand for more adoption and popularization of the strategies.

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Enhancing Income of Farm Women through Capacity Building in Aquaculture and Value Addition of Fish

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Women play a crucial role throughout the fish value chain. In India a total of around 16 million people are involved in fisheries activities (Both marine and Inland) of which 35% are women. When the sector is taken as a whole, 27% of women are involved in full time fisheries activities and 19% are involved in part time activities. The exact nature of the work in which women are involved differs with culture, region and also between rural and urban areas. Their area of involvement can be divided into fishing and preharvest activities, processing and marketing, labour in processing and aquaculture. Their level of contributions differs because of many social, economic, technological and infrastructural constraints faced by them. Conscious efforts to address the gender issues in fisheries sector is needed for empowering them to be self sufficient. Empowerment of women will have a prominent impact on nutrition of mothers, their children, and other household members. Hence empowerment among women is considered a crucial component in alleviating poverty and has been endorsed through gender mainstreaming to reinstate their position in society in all sectors including fisheries and aquaculture in the past few decades.

Opportunities for women in aquaculture

Women's participation in aquaculture and fisheries is pronounced in many of the Asian countries. In Vietnam, women were found to be very active collaborators in various aquaculture activities including post stocking activities. In Combodian small scale aquaculture women have been found to contribute more than men in all activities like pond digging, preparation of pond, seed procurement, fertilization and feeding. The role of Indian women in aquaculture is relatively low when compared to many other Asian countries. Here, women have to limit their activities to subsistence aquaculture. The low level of participation is due to age old social, cultural and ideological barriers imposed on them. While men are actively engaged in the activities like pond preparation and repairing of hedges, production, maintenance and management of feed are usually done by women. There exists considerable scope for active participation of women. Several factors that weigh positively for women are ready availability of different low cost production technologies of varying production range, compact production area requiring very little mobility on part of women, proximity of these ponds to their houses etc.

The aquaculture technologies like fry production, composite fish culture, culture of small indigenous species of fishes and integrated fish farming can be adopted by women to make use of the watershed ponds. Fry production is found to be a good proposition for farm women as the demand for good quality seed is always high. It has the added advantage that

considerable income could be earned within a short period of 2-3 months of culture. Inability of women to procure fry from long distance, inconvenience in transporting large numbers of fry over long distance, high mortality of fry during transportation, high cost of transportation and packing, unavailability of fry of desired species at the right time are some of the constraints faced by the rural women for venturing into aquaculture.

Across many Asian countries women have proved their efficiency in managing composite carp culture. The major steps in grow out carp culture are fertilisation of pond, stocking of fish seed, supplementary feeding, soil and water quality management and harvesting. With proper skill and knowledge enhancement woen can be equipped to take part in all the management practices.

Integrated Fish Farming (IFF) is a sustainable-agriculture technology practiced widely in Asia and other regions of the world. The farming subsystems, e.g., fish, crop and livestock are linked to each other in such a way that the byproducts/wastes from one sub-system become valuable inputs to another sub-system, thus ensuring total utilization of land and water resources of the farm. Although requiring low levels of inputs, both financial and labour, it has considerable potential to provide food security, nutritional benefits, employment generation and in providing additional income to resource poor small farmers. Simultaneous production of fish in ponds and livestock and poultry production over or beside the ponds constitute a continuous organic fertilization of the pond by the livestock. ICAR-CIWA has also taken steps to popularise the integrated fish farming techniques by giving priority to farmer's choice and resource availability. The continued sale of eggs and meat through integrated fish- duck and fish poultty farming, decreased the economic burden of their family and ensured their nutritional security. Other integration with vegetables and mushroom showed great promise. Small indigenous freshwater fish species (SIF) are defined as fishes which grow to the size of 25-30 cm in mature or adult stage of their life cycle. They inhabit rivers and tributaries, floodplains, ponds and tanks, lakes,beels, streams, lowland areas, wetlands and paddy fields. Integration of SIF in aquaculture has proved to increase the aquaculture production in Bangladesh. The culture of SIF's either singly or as a candidate species in polyculture along with IMC in the backyard ponds will be serve as a source of sustained source income and nutrition to rural women and the pathway to child nutrition is through women empowerment.

Freshwater pearl oyster farming, Ornamental fish farming, Integrated multitrophc aquaculture are some other enterprises in which women can easily venture provided they are given the adequate skill, credit and infrastructural facilities. Water bodies like reservoirs could be leased out to women groups to carry out cage fish farming which holds huge potential in terms of income enhancement. Rural women inhabiting brackish water areas could indulge in aquaculture activities like shrimp farming, crab fattening, milk fish culture, bhekti culure etc. Mariculture technologies that possess potential for women's participation include mussel farming edible oyster farming, pearl oyster farming and pearl production, clam culture, lobster farming and fattening, sea cucumber culture, marine finfish culture, ornamental fish culture, seaweed culture, open sea cage farming etc.

Opportunities for women in post harvest fisheries

Women's most prominent role in small-scale and industrial fisheries is in post-harvest, processing and marketing. 20% of the fish catch processed using traditional methods like salting and drying is done mostly by women in coastal areas of India. The most practical way to increase profitability in fish processing is by value addition. Value addition is any additional activity that in one way or another changes the nature of a product thus adding to its value at the time of sale. With the globalisation and urbanization, the demand for value added fish products is continuously on the rise. Increasing number of working women, reasonably good expendable income, increased emphasis on leisure pursuits, good educational status, overall pressure on time, popularity of microwave oven, health benefits associated with fish are some of the factors which favours the demand for value added products

Some of the value added fish products are:

Chilled fish and Frozen Fish fillets

Nowadays fresh fish and frozen fish outlets are common in cities**.** Chilling is an effective way of reducing spoilage by cooling the fish as quickly as possible without freezing. Immediate chilling of fish ensures high quality products. Chilled fish fetches more price than frozen fish. Modern packaging techniques viz., vacuum packaging, modified atmospheric packaging and active packaging significantly enhances the shelf life of chilled fish products. Freezing and storage of whole fish, gutted fish, fillets etc. are methods for long-term preservation of these species. **Battered and breaded products**

The most prominent among the group of value added products is the battered and breaded products processed out of a variety of fish and shellfish. Battered and breaded items are included in the value added products because the process of coating with batter and bread crumbs increases the bulk of the product thereby reducing the cost element. As a convention 50% fish portion is expected in any coated product. Coated products viz., fish fingers, fish cutlets, fish nuggets, quid rings, cuttlefish balls, fish balls and prawn burgers form one of the major fish and shellfish based items The production of battered and breaded fish products involves several stages. The method varies with the type of products and pickup desired. In most cases it involves seven steps. They are portioning/forming, pre-dusting, battering, breading, prefrying, freezing and, packaging and cold storage.

Ready to serve fish products in retortable pouches

Ready to serve fish products viz. curry products, in retortable pouches are a recent innovation in ready to serve fish products for local market. The most common retortable pouch consists of a 3 ply laminated material. Generally it is polyester/aluminium/cast polypropylene. These products have a shelf life of more than one year at room temperature. As there is increasing demand in National and International market for ready to serve products the retort pouch technology will have a good future.

Extruded product- Fish kure

Fish Kure is a fish based extruded food product and have application as snack food. Usually, extruded products are prepared using cereal flour, which have less protein content and are

limited in some essential amino acid. By incorporating protein-rich fish mince instead of cereal, the product is protein enriched snack food. The production process involves fish meat is mixed with cereal flours, spices and salt and extruded using a twin screw extruder. The dried and coated products are then packed in metalized polyester polyethylene pouches using nitrogen gas filling and the product is acceptable up to 3 months at ambient temperature.

Curing

The traditional methods of processing fish by salting, drying, smoking and pickling are collectively known as curing. Cured fish consumption is more in areas where the availability of fresh fish is comparatively limited, namely interior markets and hilly areas. This is also the cheapest method of preservation, since no expensive technology is used. In India roughly 20 % of the fish caught is preserved by curing. Considerable quantities of cured fish are also exported, mainly to Singapore, Sri Lanka and to the Middle East. Simple sun drying was the widely practiced traditional method of fish preservation. By this, preservation was achieved by lowering of water content in the fish, thereby retarding the activity of bacteria and fungi. The heat was able to destroy the bacteria to a certain extent. Later on, a combination of salting and drying or salting, smoking and then drying were developed. There are basically two methods of drying fish, sundrying and artificial drying. Sun drying depends heavily on the natural weather conditions since the fish is dried by heat from the sun and the air current carries the water away. Here there is no control over the operations and many a time the losses cannot be substantiated. In mechanical driers, removal of water from the fish is achieved by an external input of thermal energy. This is an expensive method since there is need for fuel for heating and maintenance of the temperature.

Salting

This is one of the oldest methods of preservation of fish. Salting is usually done as such or in combination with drying or as a pretreatment to smoking. During salting osmotic transfer of water out of the fish and salt into the fish takes place, which effect fish preservation. Loss of water during salting limits bacterial growth and enzyme activity, thus preserving the fish. The high salt content prevents the growth of normal spoilage microflora in the fish; but halophiles, which can survive 12-15% of salt, will survive.

Fish Pickle

Like vegetable pickles, fish pickle has also gained popularity in the recent past. Fish/Prawn pickle, when carefully prepared under most hygienic conditions with addition of required quantity of salt, preservatives and spices will have generally an average shelf life of one year. Most of the sea fish like Prawn, Tuna, Pomfret, Mackerel, etc are ideally suitable for making fish pickles.

Fish flakes/wafers

Thread fin breams and cat fishes are used in the preparation of flakes or wafers. Fish flesh is boiled, mixed with maida, salt, etc. to prepare flakes or wafers.

By products from fish

Chitin is the second most abundant biopolymer on earth next only to cellulose. It is a white, hard, inelastic nitrogenous polysaccharide extensively used for several purposes. In India, the single largest source of chitin is the shrimp shell and head waste. Chitin is produced

from the shell waste by deproteinisation and demineralization. Chitosan is produced by the deacetylation of chitin. Chitosan has several industrial and medicinal uses.

Shark fin ray is a valuable byproduct from the shark. The shark fins are dried, soaked overnight in 10% acetic acid solution. The skin and the softened muscle are scraped off and the rays are separated individually. They are then washed thoroughly and dried. Shark fin rays are an essential ingredient in some exotic soups.

Squalene is a highly unsaturated hydrocarbon present in the liver oil of certain species of deep sea sharks mainly Centrophorus and Squalidae spp. The liver oil of these species contain high percentage of squalene (90%) which can be isolated and purified and can be used as a dietary supplement.

Isinglass is prepared from fish maws (dried air bladder). Fish maws is soaked in water for 24 hours, washed and extruded, dried at 450 c and then powdered. It is mainly used for the clarification of wines.

Fish protein concentrate (FPC) is a stable protein concentrate prepared from whole fish or other aquatic animals or parts thereof. Protein concentration is increased by removal of water, oil, bones and other materials. It is incorporated as a protein supplement in human diet. 5-10 per cent level FPC in bread and biscuit is considered the acceptable limit. 35 g per person per day is a recommended level of use of FPC.

Fish Gelatin is a protein that lacks in an essential amino acid tryptophan, and hence cannot be considered as a sole source of protein in animal or human nutrition. But it is a relatively high source of lysine and methionine, which are deficient in cereal proteins. However, gelatin finds extensive use in food as also in the formulation of some industrial products. Gelatin can be extracted from the skin and bones of fish.

Fish oil is obtained by extracting from the entire body of the fish or only from the liver. The oil obtained from the entire body is known as body oils and are grouped into drying and semi drying oils. The drying oil comprises oils of sardine, salmon, herring, mackerel, anchovy, and white fish, while the oils of sprat and carp constitute semidrying oil due to the low iodine content. The body oil is edible and used for industrial purposes. Liver oil extracted form the liver, is of medicinal importance and contains vitamin A and D.

Fish meal is a preparation where fresh fish is ground, cooked and dried. It is highly nutrient rich and is an excellent poultry and animal feed, which has proven to increase egg and milk production. As fish meal contains calcium, phosphorus, iodine and rich variety of vitamins and micronutrients it forms an excellent feed in aqua- culture.

Fish silage is a liquid product which can be made from waste of fish or whole fish, which are liquefied by the action of natural enzymes present in the fish. There are two processes by which silage can be made. One is acidification where the natural enzymes in the fish are activated by addition of organic or inorganic acid or a mixture of both. The second process is fermentation, where the enzyme activity is catalysed hy the acids produced by the fermentation of added sugar with or without the presence of lactic acid bacteria. The technology of fish silage production has the following advantages: Simple technology, less capital investment and low skill requirement, hence women friendly, nutrient composition similar to that of raw material (Fish waste), no offensive odour, Fast ensiling under tropical climate (2-3 days), shelf life of more than 6 months for chemical silage and 2 months for

fermented silage and alleviates environmental pollution and Low cost of production. Fish silage finds its major use in the area of animal nutrition, where it is mainly used as a source of protein. Several research studies have been conducted at the Central Institute for Women in Agriculture, Bhubaneswar, to validate the potential use of fish silage as poultry feed ingredient. 10% fish silage in broiler poultry diets reduced the feed cost by Rs 5/kg. Apoultry farmer could increase his profit margin considerably by using the technology. In Japanese quails, the consumption of fish silage resulted in an increase of 8% in egg production. Vanaraja, a most popular dual purpose poultry breed, popular in the rural areas of the India, also showed positive growth performance when fed with fish silage. Thus, the protein to the tune of 35-39% in acid treated silage and 15-19% in fermented silage which could otherwise go as waste can be converted to alternative feed ingredient through this low cost technology. Another probable use of fish silage is as organic fertiliser as it contains the nutrients suitable for plant growth, soil microbes and earthworms and is free from off odour. The production of organic manure from fish silage could be an innovative livelihood option for rural women. Experiments in horticultural crops like Okra (*Abelmoschus esculentum*) and Cowpea (*Vigna unguiculata*) were conducted to study the manurial properties of fish silage. In Okra, treatment with 50% farm yard manure and 50% fish silage gave higher pod weight, pod length, pod number, and average yield which is 12.98%, 0.2%, 10.93% and 31.85% higher than 100% farmyard manure. Application of vermicompost enriched with fish silage had a positive effect on growth and yield of cowpea in terms of better average yield of fruits per plant, plant height, total number of branches per plant, weight per fruit and number of seeds per fruit.

Among these technologies, the production of fish silage, fish/prawn pickle, battered and breaded products, fish wafers etc are suitable to be adopted by rural women as the level of skill and capital involved in the setting up of these enterprises is comparatively less. ICAR-CIWA has initiated promoting entrepreneurship among rural women SHG's in value added fish products. A variety of value added products like prawn pickle, fish pickle, prawn chutney powder, hygienic dry fish, fish papad and prawn sev were developed and the consumer acceptance of these products was studied by conducting a survey of peri urban consumers. Popularization of the products was done through different exhibitions and melas. Several training programmes were conducted on and off campus including capacity building programmes, skill training on hygienic preparation of fish value added products and entrepreneurship management training for developing marketing skill to SHGs. Master trainers were selected depending upon their interest and enthusiasm in taking up the production of these products. Hands on training was imparted to these master trainers. The master trainers eventually trained the remaining members in the village at their household level. Management training of beneficiaries on business enterprise development was also imparted, to educate master trainers about marketing strategy and marketing. Trainings include marketing orientation technique, methods, advertising, promotion (marketing communication) distribution and product management, which will facilitate beneficiaries to set up successful enterprises. The groups were facilitated to obtain the necessary licenses like FSSAI and Trade license. Covid-19 changed the entire world with its onset in Late 2019. By

embracing digital technologies like e-banking, e-commerce and social media, SHG's can tide over the obstacles put before them by the pandemic. The group has been provided with necessary utensils and packaging materials to start the production of value added fish products. They also ventured into online marketing taking into consideration the pandemic situation. Market linkage was strengthened for the rural women SHGs by linking them with retail fish outlets. The sales of prawn pickles has since gained momentum and the women are gaining a profit of Rs 130-150/kg of the pickle.

Conclusion

Technological backstopping is a must to improve the confidence of women in adopting them as livelihood options. There have been tremendous technological advancements in fisheries sector which includes the freshwater aquaculture, brackishwater aquaculture, mariculture and post harvest fisheries. Rural women could easily adopt these technologies to improve their income and livelihood. It can be concluded that with proper technological backstopping and handholding rural women could be equipped to become self sufficient (Atma Nirbhar). Becoming self sufficient is one of the most important steps towards achieving the "Gender Equality" which is the 5th Sustainable Development Goal

Integrating Gender Dimensions for Improvement of Livelihood through Women Friendly Technology Interventions in Crop-Livestock based Farming System

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Livelihood: Livelihood is defined as a means of living. A livelihood is composed of activities essential to everyday life and resources. The activities are related to agriculture, livestock, marketing, wage labour, securing water, food, fodder, medicine, shelter, clothing, etc. to secure their basic needs and to earn income. But these activities depend greatly on access to resources such as: land, water, forest products, technology, etc. Access to resources varies by gender, age, wealth, caste, etc. and therefore so does livelihoods. But livelihood responsibilities and opportunities also vary within households by gender, age and household position (head, husband, wife, sister, etc.). For this reason, in livelihood analysis, we start with the individual and we first learn about the roles and responsibilities of each family member. Livelihood is engagement in activities, self-directing and based on income.

Components of livelihood: The components of the livelihoods primarily cover five types of assests like: human assets (health, nutrition, education, knowledge and skills, capacity to work), social assets (net work, connections, relations, leadership, decision making, socially constructed rules, organizations), physical assets (road, vehicles, shelter, buildings, water supply, sanitation, tools, technology, equipment, seed, fertilizer, pesticides, infrastructure), financial assets (capittal savings, credit/debt, pension, wage) and natural assets (land, water, trees, forest products, wildlife, biodiversity, environmental servises) which are interlinked and no single category is sufficient to capitulate all the required livelihood outcomes.

Sustainable livelihood: Agriculture is the main source of rural livelihood with diversification into non-farm activities to achieve a sustainable livelihood. A livelihood can be sustainable when it survives with taxing situations like: drought, flood, war, etc. It should be environmentally, economically, institutionally, and socially sustainable. The principles of sustainable livelihoods are: people-centred, responsive and participatory, multi-level, conducted in partnership, dynamic, holistic, evidence based and building on strengths and opportunities. Sustainable livelihood framework is essential for success of any project/programme by identifying targeted audience, main livelihood sources of the poor and the associated opportunities and constraints. Livelihood strategies focuses on increased assets, long term livelihood security and quality life.

Gender and livelihoods: Women are more vulnerable than men. They usually have less access to assets, face more issues in living and adopt dissimilar strategies from men. The wants, needs, and, preferences of women are different than men. Their livelihood strategies

mostly focuses on meeting the basic needs of family specially the children. SHGs should be made sustainable as a strong unit of social safety net and should be given intensive capacity building, marketing linkage facilities etc. Women should be able to access the benefits of friendly schemes. There should be provision for equal wage and credit for women as men. Awareness should be created through campaigns among women about legal rights for women, safety, exploitation, violence, legal aid service, labour laws, PDS facilities, ration cards and complaint redressal mechanisms.

Gender dimensions: In spite of immense contribution by women in Indian agriculture, they are neither being recognized as farmers nor involved in decision making process and also bypassed and ignored in sharing benefits coming out of agriculture. In this context, the empowerment of farm women is felt essential. However, attaining empowerment of farm women is not possible without integrating important gender dimensions like: employment, drudgery reduction, health and nutrition, leadership, mobility, access, benefit sharing, etc. Integrating family approaches can also activate the women empowerment process.

Livelihood analysis: Livelihood analysis is utmost vital to get the answers to the questions like: Who does what? Who uses what? Who controls what? It gives learning about different gender roles, their issues and opportunities for enhancement of income, nutrition, access to resources, social leadership, decision making and reduction in vulnerability. Logical Framework Approach may be used for a planned analysis of the existing situation with four main analytical elements like: (i) Problem Analysis**,** (ii) Stakeholder Analysis, (iii) Analysis of Objectives and (iv) Analysis of Strategies.

Women friendly technologies: Most of the tedious and back-breaking tasks in agriculture, animal husbandry and households are done by women. Both men and women perform the farm operations but still the women workers do not use machines as mostly theses have been developed with male anthropometry in mind. These equipment are not suitable for women as the ergonomical characteristics (aerobic capacity, strength, anthropometry, physiological workload, work preference, wearing of loose clothes/dupatta and safety issues) of farm women differ from that of men. Therefore, women have been using traditional methods/ tools. As a result, the farm women face drudgery in various agricultural operations including household. But, it could be suitably addressed with the women friendly technologies. Now, it has been realized that the needs of men and women with respect to technologies differ because of the differences in preference, priorities and working environment and accordingly the researchers have designed the technologies/tools with to suit women. Some of the examples of women friendly technologies are:

Sl. No.	Name of the technology	Source	Cost (Rs.)
1.	Saral Kurpi	College of Rural Home Science UAS, Dharwad, Karnataka	120
2.	Serrated Sickle	ICAR-CIAE, Bhopal, Madhya Pradesh	105
3.	Sitting type Ground nut decorticator	ICAR- CIAE, Bhopal, Madhya Pradesh	2500

4.	Standing type Ground Nut Decorticator	Agriculture Engineering College, Raichur, Karnataka	4500
5.	Ground Nut Strippers	➢ Maharashtra University of Agriculture, Parbhani ➢ MPUAT, Udayapur, Rajasthan ➢ UAS, Dharwad, Karnataka	1600
6.	Cycle weeder	UAS, Dharwad, Karnataka	1850
7.	Twin Wheel Hoe Weeder	ICAR-CIAE, Bhopal, Madhya Pradesh	1600
8.	Eared Cutter for Jowar Harvesting	College of Home Science, VNMKV, Parbhani, Maharastra	10000
9.	Trishul weeder	College of Home Science, VNMKV, Parbhani, Maharastra	300
10.	Mittens for Harvesting Okra and Brinjal	College of Home Science, VNMKV, Parbhani, Maharastra	140
11.	Weeders	College of Home Science, CSKHPKV, Palampur, H.P.	150
12.	Clod Breaker	College of Home Science, CSKHPKV, Palampur, H.P.	175
13.	Potato Picker	College of Home Science, CSKHPKV, Palampur, H.P.	400
14.	Vadi Maker	College of Home Science, MPUAT, Udaipur, Rajasthan	200
15.	Cotton Picking Machine	College of Home Science, MPUAT, Udaipur, Rajasthan	8000 - 9000
16.	Cotton Stalk Puller	College of Home Science, MPUAT, Udaipur, Rajasthan	800 - 900
17.	Ground Nut Stripper	College of Home Science, MPUAT, Udaipur, Rajasthan	1600 - 2000
18.	Comb Stripper for Groundnuts	College of Home Science, MPUAT, Udaipur, Rajasthan	200
19.	Harvest Apron & Vegetable Plucker	College of Home Science, MPUAT, Udaipur	300 - 350
20.	Motorized Paddy Thresher	College of Home Science, GBPUA&T, Pantnagar	4000
21.	Grain Picker	College of Home Science, GBPUA&T, Pantnagar	600
22.	Fetching Trolley	College of Home Science CCS HAU, Hisar	3000
23.	Wheel Hand Hoe	Dept of Farm Power & Machinery CCS HAU, Hisar	1200
24.	Head Load Carrier	College of Home Science CCS HAU, Hisar	3000

Some identified parameters of a checklist to assess technology:

1. Is it generated by considering the preferences of both the genders?
2. Does it fulfil the location specific needs of both the genders?
3. Is it compatible with the existing socio-cultural climate of the society?
4. Is it easily accessible and affordable to both the genders?
5. Is it simple to understand by both farm men and women?
6. Is it easy to handle and operate by both farm men and women?
7. Is it efficient to reduce drudgery of both farm men and women?
8. Does it reduce workload of women?
9. Does it boost efficiency and productivity of both the genders?
10. Is it flexible to get modified according to the needs of both gender?

However, need based technologies can be introduced to farmwomen after evaluating its women friendliness. Hence, women friendly technologies can be identified from the pool of technologies by considering few parameters while evaluating. Also a technology can be made women friendly by necessary refinement in its base model keeping the need of women in mind. For examining the women friendliness of a technology a checklist with few identified parameters can be very useful.

Livelihood Improvement and Nutritional Security of Farmwomen through Technology Interventions in Poultry Farming

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Poultry for commercial production of egg and meat is one of the most innovative industries and fastest growing sector in India. Having evolved from the backyard, Poultry sector in India has witnessed a phenomenal growth and transformed itself to a vertically integrated and organized dynamic agri-based industry. Poultry egg and meat is important animal protein sources and essential in providing balanced diets for nutrition and health. An egg provides 6 to 7 gm wholesome protein with balanced amino acid to the human diet. Poultry farming in rural areas could be a viable option for addressing malnutrition among children and women in India. As per the recommendations of the Nutritional Advisory Committee, the per capita requirement of egg is 180/year. But the present availability is 79 only (DAHD, 2019). Thus, the poultry sector has to grow 3 to 4 folds to meet the nutritional requirement. India has nearly 70% of its population living in rural areas. Most of the commercial poultry production in India is concentrated in urban and peri - urban areas. Just 30% population living in urban and peri-urban areas consumes about 75-80 % of eggs and poultry meat. Non-availability of poultry products and low purchasing power of the rural people devoid them of access to the highly nutritious products like egg and meat, thereby, resulting in malnutrition.

India is one of the fastest growing countries in terms of population with 1.37 billion people and with an annual growth rate of 1.2%. The Global Hunger Index 2020 report has placed India 94th position among 107 countries, much behind Bangladesh, Pakistan and Nepal. As per the World Bank estimates, India is one of the highest ranking countries in the world for the number of children suffering from malnutrition. Malnutrition caused 69 per cent of deaths of children below the age of five in India, according to a UNICEF report. Extreme poverty, low dietary diversity and mother's lack of education are among the key risk factors that contribute to malnutrition of children in India. Poultry farming in rural areas could be a viable option for addressing malnutrition among children and women. The lack of basic infrastructure and poor socioeconomic condition of people in the rural area are major bottlenecks for adopting commercial poultry production. Popularization of backyard poultry farming is the need of the hour to ensure increasing access to protein and nutritious food at an affordable price in rural India (Panda et al., 2010).

Why Backyard Poultry Farming?

The lack of basic infrastructure and limited resources of the poor people in rural areas creates a major huddle to undertake commercial poultry farming using high yielding varieties of poultry. Adapting poultry farming in rural/tribal areas utilizing chicken varieties which

demand low inputs in terms of nutrition and management and perform better is a potential tool to increase the availability of poultry products and economic status of the rural people. Free range and small scale poultry production can be promoted in rural areas to improve livelihood and nutritional status of farm families. Backyard poultry farming introgressing scientific practices can be used as a powerful tool for poverty alleviation, eradication of malnutrition and creation of gainful employment, and gender equity in vast rural areas (Sharma and Chatterjee, 2009; Rajkumar et al., 2010, Panda et al., 2020).

Advantages

- It needs minimal use of land, labour and capital.
- It is easy to manage and handle.
- It needs little intervention in rearing,
- It can easily integrate with other agriculture, aquaculture and livestock farming.
- It can contribute to the village economy.
- There is higher demand and better price for eggs and birds of native fowl.
- Women in rural areas can operate family poultry with maximum involvement.
- Has a potential to fight poverty and malnutrition and provide scope for high employment generation and solving gender issues in employment

Gender and Poultry

Gender is defined by FAO as 'the relations between men and women, both perceptual and material. Gender is not determined biologically, as a result of sexual characteristics of either women or men, but is constructed socially. Gender relations affect household security, family well-being, planning, production and many other aspects of life (Bravo-Baumann, 2000). The role of backyard poultry in poverty alleviation, food security and the promotion of gender equality in developing countries are well documented. Backyard poultry production represents an appropriate system to contribute to feeding the fast growing human populations and to provide income to poor small farmers, especially women.

Livestock and Poultry production in the rural areas is generally considered a key asset for rural livelihoods. It offers advantages over other agricultural sectors and is an entry point for promoting gender balance in rural areas. Rural women traditionally play an important role in poultry sector and are often in control of the whole process from feeding to marketing, which is not the case in production systems for other livestock species. Poultry is easy to manage, requires few external inputs, and enjoys good market demand and prices. Rural poultry keeping can be used to reduce poverty among women and children in rural areas. By increasing women's income, poultry farming also enhances women's social status and decision making power in the household. Understanding and considering the gender roles in

family poultry production is crucial to identifying the most appropriate approach when designing and implementing development activities.

Technological Intervention

While going for rural poultry production, it is essential to understand the local production system, their limitations and opportunity, the circumstances under which such traditional system came into existence and how they can be improved further. The important points to be considered are adoption of appropriate technology, utilization of locally available resources, proper health management, training of farmers and proper marketing system.

Development of appropriate variety

The indigenous/native breeds of fowl is the choice for rural poultry production as they are hardy, resistance to common diseases, heat tolerant and do not need special attention as compared to exotic breeds. These native breeds have also acquired considerable adaptability to the local climatic environments due to several years of natural selection. Some indigenous breeds possess few unique genes like necked neck and frizzle gene which help in better heat dissipation under tropical conditions. Dark meat chicken (Kadaknath) is a highly valued chicken at some regions for its nutritive properties is assumed to alleviate bone and kidney disease and also human lactation. Because of coloured pulmage, long shank bone and alertness, these birds can camouflage characters to protect themselves from predators.

Due to low productivity of native breeds of chicken, a need to develop suitable germplasm for rural / backyard production with improvements in the economic traits in the existing native breeds or the development of new stock with infusion of native blood was felt. The productivity of these stocks should be 120-150 eggs per annum and around1kg meat in 10-12 weeks of age. Several chicken varieties such as Giriraja, Vanaraja, Gramapriya, Swarnadhara, Narmadanisdhi, Srinidhi have been developed for rural poultry farming. However, they are unable to cater the need of the country. There is a need to develop more such varieties giving emphasis on agro-ecology (Location specific) to meet the growing demand.

Table 1. Chicken varieties developed for rural poultry production

Variety	**Type**	**Developing Agency**
Giriraja	Dual	KVAFSU, Bangalore
Girirani	Egg	KVAFSU, Bangalore
Vanaraja	Dual	ICAR-DPR, Hyderabad
Gramapriya	Egg	ICAR-DPR, Hyderabad
Krishibro	Meat	ICAR-DPR, Hyderabad
Srinidhi	Dual	ICAR-DPR, Hyderabad
CARl Debendra	Dual	ICAR-CARI, Izatnagar

CARIBRO Dhanraja	Meat	ICAR-CARI, Izatnagar
CARI Nirbheek	Egg	ICAR-CARI, Izatnagar
CARI Shyama	Egg	ICAR-CARI, Izatnagar
Narmadanidhi	Dual	JNKVV, Jabalpur
Kalinga Brown	Egg	CPDO, Bhubaneswar
Rajasree	Egg	SVVU, Hyderabad
Kamrupa	Dual	AAU, Guwahati
Pratapdhan	Dual	MPUAT, Udaipur
Jharshim	Dual	BAU, Ranchi

Low cost feed formulation utilizing of locally available resources

In poultry, feed accounts for 65-70% of total cost of production. Therefore, feeding of adequate amount of balanced and wholesome feed is important for optimum production. Feed should be formulated to contain optimum nutrient concentration obtainable at reasonable cost for maximum growth, production and efficiency of feed utilization. In the backyard poultry keeping, it is difficult to know the activity of the birds for their picking up habits and availability of feed ingredients. It is therefore suggested to provide some diets to satisfy their nutrient requirements for optimum production for egg and meat. The availability of common feed ingredients for poultry is becoming a scarce as sizable human population depends on grains like maize, sorghum and other coarse millets for their sustenance. It has become necessary to identify the alternative feed resources available locally and evaluate their nutritional value for poultry. This will not only help in reducing the cost of production but also proper utilization of the local produce.

Research conducted at ICAR-CIWA revealed Azolla leaf meal can be incorporated up to 10% in the diet of Vanaraja laying hens without affecting the growth and egg production. Azolla feeding in laying hens give dark yellow colour to the egg yolk. The cost of feed can be reduced by Rs. 2/ kg by including 10 % dried Azolla meal in poultry feed. Cassava root meal can be totally substituted with maize without affecting the production performance of Vanaraja laying hens.

Table 2. Effect of dietary incorporation of Azolla meal on production performance and egg quality of laying hens

Parameters	Azolla meal (%)			SEM	P value
	0	5	10		
Egg production (%)	50.09	52.76	51.13	1.81	0.845
Egg weight (g)	61.62	61.62	60.50	0.60	0.692

Feed efficiency (g feed/g egg)	4.41	4.36	4.59	0.22	0.914
Haugh unit	75.38	75.39	74.41	1.04	0.161
Albumen (%)	58.35	56.86	57.29	0.37	0.249
Yolk (%)	32.70	34.27	34.07	0.34	0.121
Eggshell (%)	8.95	8.85	8.63	0.12	0.572
Eggshell thickness (mm)	0.372	0.381	0.378	0.005	0.452

Proper health care

A healthy flock is necessary for successful poultry production. For effective poultry health management, three components are very important such as bio-security, vaccination and medication. Prevention should be the approach as the cost of medication is relatively high and once disease occurs, the productivity is affected and profit margins are reduced despite effective treatment.

Constant outbreak of poultry diseases in the recent past is one of the havocs for rural poultry production. The single most important disease concerning rural poultry production has been reported to be Ranikhet Disease (RD) which is accountable for 60-80 per cent mortality. Hence vaccination against most common poultry disease (Marek's disease and Infectious bursal disease) in general and Ranikhet disease in particular is very essential for success of rural poultry. There is also a need for reliable diagnostic tests and facilities to differentiate various poultry diseases and also efficient vaccines must be made available at reasonable cost. More women should receive training in husbandry practices and gain access to poultry health services for successful poultry activities.

Table 3. Vaccination schedule for Rural Poultry

Age	**Vaccine**	**Dose**	**Route**
1st day	Marek's disease	0.2 ml	Subcutaneous (S/C)
7th day	Newcastle disease	1 drop	Ocular or nasal
14th day	Infectious bursal disease	1 drop	Ocular or oral
24th day	Infectious Bursal disease	1 drop	Ocular or oral
28th day	Newcastle disease	1 drop	Ocular or nasal
6th week	Fowl pox	0.2 ml	Intramuscular (I/M)
8th week	Newcastle disease	0.5ml	I/M
18-20 weeks	ND+IBD killed	0.5ml	I/M or S/C
40th week	ND+IBD killed	0.5ml	I/M or S/C

Training and Extension service

The lack of knowledge, experience and sufficient exposure to poultry rearing are the major bottle necks for successful poultry production by farm women. Training for the backyard poultry keeping will help the farmers to know some of the important tips related to the poultry management and disease control in the flocks. Training programs at village level targeting the stakeholders, women and youth should be organized for effective implementation of the rural poultry farming. Providing extension services including management, vaccination, disease diagnosis, market information and other inputs like supply of chicks, quality feed etc. is the need of the hour. "Learning-by-doing" training, exchange visits for backyard poultry producers, and follow-up sessions have all demonstrated to be successful ways for building capacity. KVK's should organize more programs to show the efficacy of new technologies and create awareness among small and marginal farmers.

Proper marketing system

Several problems such as lack of proper transportation facilities, fluctuation in market prices, market distance, lack of storage facilities and lack of grading and packaging are major bottleneck for efficient marketing. The birds in the rural areas are sold live or slaughtered at the place of sale. Similarly eggs are sold in open without consideration for preservation of their quality. Development of reliable and stable market chain round the year is a must for effectively absorbing the rural surplus production. Also facilities for hygienic slaughter and preservation of eggs should be made available at market places in rural areas. Formation of women producer co-operatives/ Associations and Rural market yards will help in proper marketing.

Conclusions

Successful rural poultry production will not only ensure nutritional security but also corroborate livelihood improvement. It can also be used as a tool for rural development. If properly adopted and implemented, rural poultry production will be a boon for the resource poor rural farmers. Promotion and implementation of long term policies for sustainable back-yard poultry farming involving farm women are thus most important and if implemented properly the authors feel that rural poultry will definitely overcome the poverty and malnutrition in rural areas of this country.

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Gender Mainstreaming through Improved Dairy Farming for Livelihood Security and Entrepreneurship Development

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Livelihood security refers to the ability to continuously maintain or enhance a healthy and secure life. Livelihood is made up of a range of on-farm and off-farm activities which together provide a variety of procurement strategies for food and cash. Population growth, urbanization and income growth are fuelling a substantial global increase in the demand for food while aggravating the competition between crops and livestock and influence livelihood security. Livestock based production system is an integral component of agriculture in rural economy. Dairying in India is a female dominated enterprise. Women always participated in dairy and animal husbandry activities in addition to their daily household chores. Women spent more time than men in dairy production activities. Dairy farming is considered as an extension of domestic activities like feeding and watering of animals, bringing fodder from the field, cleaning of animals and sheds, preparation of cow-dung cakes, protection of animal from diseases, milking, milk products making and marketing of milk. Women play crucial and significant role in livestock rearing, but their contribution in livestock rearing has not been given the due place they deserve and they always remain invisible workers. About 75 million women as against 15 million men engage in dairying in India (Thakur and Chander, 2006). In fact dairy farming is becoming feminized. Most of the farm activities such as fodder collection, feeding, watering, health care, management, milking and household-level processing, value addition and marketing are performed by women.

India is the world's largest milk producing country with a share of about 16 per cent in world's total milk production and rank 1st in milk production with a production level of 132.4 million tonnes of milk growing steadily at a compound annual growth rate of about 6.5 per cent (Anonymous, 2012-17). The major share of the credit for India's position has to go to the largely illiterate rural women dairy farmers. Dairy farming does not demand heavy labour and provides good opportunity for women to develop this activity as an enterprise and ensures steady cash returns throughout the year by selling milk, milk products, farmyard manure and biogas using agricultural by-products. Such mixed farming ensures an excellent nutrient recycling which is an eco-friendly practice. Within this framework, an integrated crop-livestock farming system represents a key solution for enhancing dairy production and safeguarding the environment through efficient utilisation of resource.

Rural women play a significant role in conducting small-scale dairy farming. They have full potential for achieving sustainable development and improvement of quality of life through their proactive participation in farming activities. Rural women have become effective role players in both income-generation and household management. They work hard to improve their life style and trying to overcome poverty through their participation in small-scale dairy

farming. However, lack of awareness and adoption of scientific managemental practices in animal husbandry, gender assymetries like access to market, income generated from sale of livestock/produce, processing technologies and interventions, veterinary services, participation in dairy developmental programmes and policies are the major constraints for upliftment of farm women engaged in dairy farming. Special attention needs to be oriented towards the role of women and their empowerment in dairy production system.

Role of Women in Dairy farming

Women play crucial and significant role in dairy farming, but their contribution is not yet recognised and they always remain invisible workers (Chayal *et al*., 2009). In India, majority of dairy farm women participated in the care of newborn calf, milking, cleaning of animal shed, cleaning of utensils, weaning and management of calf, preparation of cow dung cakes and construction of animal sheds but their participation was least in maintenance of farm records. Involvement of farm women in the care of newborn calf and cleaning of utensils and shed (100%), compost making (73%), milking of animals (70%) and weaning and management of calf (67%) is more (Lahoti *et al.,* 2012). Most of the activities of dairy farm were carried out by women and about 295 minute/day is utilized in different dairy farm activities like feeding, watering, milking, housing, breeding, animal health care and marketing (John Christy and Thirunavukkarasu, 2002).

Fodder management, sale of milk and health care of animals were important areas where farm women played a major role in decision-making. The participation of farm women was least in the economic activities like taking loans, purchase and sale of animals and choosing animals for dairy. They have less contact with progressive farmers, officials and banks resulting low level of involvement in decision-making (Upadhyay and Desai, 2011). Patriarchal type of society, illiteracy of women and low knowledge and skill also led to low participation in decision making. Despite their considerable involvement and contribution, significant gender inequalities also exist in access to technologies, credit, information, inputs and services probably because of inequities in ownership of productive assets including land and livestock. The rapidly increasing demand for livestock products creates opportunities for empowerment of women**.** Women face greater constraints than men in accessing natural resources, extension services, marketing opportunities and financial services as well as in exercising their decision-making powers. The nature of the work of women and men performed within the livestock sector may expose them to various health and safety related concerns, such as heightened exposure to zoonotic diseases (WHO, 2009). Therefore, there is a need to correct gender bias in livestock sector, veterinary education, research and service delivery systems as to enhance the effectiveness of women-oriented livestock development programs (Anonymous, 2012-17).

Why Gender mainstreaming in Dairy sector?

Mainstreaming gender can benefit both beneficiaries and project implementers and other stakeholders. Some of the key benefits that can be gained from mainstreaming gender in dairy farming are as follows:

- **Improve individual and household well-being:** Understanding men's and women's different decision-making powers and negotiating strategies can inform initiatives of the dynamics within and between households that need to be addressed in developing more viable livestock options and, in turn, improving the livelihoods and overall wellbeing of all household members. Addressing gender in dairy projects means identifying, understanding the relevance of, and addressing the different livelihood needs, priorities, interests, and constraints of men and women along lines of age, ethnicity, socioeconomic status, and ability (among others). It means maximizing the available social capital through engaging all household members as agents of poverty reduction. Women and men are far more likely to participate in efforts to improve their livestock initiatives if they can see that the benefits (for example, improved productivity, food security, income generation, less disease) outweigh the costs (for example, time, labor, social commitment).
- **Address women's and men's needs and interests:** Mainstreaming gender in dairy initiatives means addressing the perceived needs and interests of women, men, boys, and girls involved in livestock production. Women may have very different interests and criteria for selecting livestock. Addressing gender issues in livestock production can contribute to women's and men's economic and social empowerment, particularly for those who are vulnerable or living in marginalized areas.
- **Improve social protection:** Addressing gender in livestock programs is important as a social protection measure. Doing so builds assets at the individual, household, and community levels through reducing vulnerability and increasing the opportunities of men, women, boys, and girls. Women in many areas around the world use income generated from poultry and dairy production – for instance, to pay for social goods such as children's school fees, medical fees and other assets to provide for their families. This is particularly relevant to protect those in vulnerable situations from being forced to take risks to secure food, income, shelter, clothing, and other necessities.
- **Promote better livestock technology development and adoption:** Involving adult men and women where appropriate, boys and girls or elder women and men in livestock technology development is more likely to lead to more relevant technologies and greater adoption rates. Women benefit most when they have decision-making authority over the animals they manage, even if they do not hold the legal ownership Understanding the significance of mainstreaming gender is an important step in redressing the lack of attention to women's and men's different roles, responsibilities, needs, interests, and constraints in the planning of livestock initiatives. However, translating this understanding into action poses the greatest challenge to livestock officers, planners, and implementers at all levels and across regions. As the livestock sector restructures, women as well as men increasingly find themselves working in situations in which they have less control over production and processing (such as industrial factory operations). Moreover, poor livestock producers, particularly women, typically face disproportionate barriers in meeting a growing number of

regulations (for example, phytosanitary standards) required by more structured markets. They also find it more difficult to compete when barriers such as tariffs are in place. Women, more than men, may also face an increased risk of harassment and abuse as they move into working situations in which they do not control their own labor, as is found in industrial livestock systems.

Empowering women through Improved Dairy farming: Scope and Challenges

Education on dairy farming enhances knowledge and skills in animal rearing practices, disease management and feed management, which eventually improve income to the household (Nirmala *et al.,* 2012). Training on balanced feeding ranked highest in information need as compared to breeding, marketing, management of cattle shed, etc. Training has made tremendous change and interest among the trainees to gain more knowledge probably due to usage of method demonstration, audio visual aids and also their own different livestock species they could easily understand and remember the technologies taught in the training. Further, training if conducted frequently would increase the level of knowledge, which in turn reflects into better dairy farming and management and ultimately increases production performance of dairy animals and empowerment of farm women. Selection of breed, compounding balanced feed using locally available ingredients, feeding during pregnancy, health care and banking and insurance were the most preferred area in dairy farming. Dairying is most likely to be effective as 'a pathway out of poverty for rural women and enable them to compete with commercial producers provided the organisations planning and implementing livestock development programmes are sensitive towards the needs, resources, production systems and perceptions of the families and extension service is strengthened and targeted to the underprivileged families particularly the women. Action plans should be agreed and implemented based on the outcomes of the iterative interactions amongst the social groups and the technical teams regarding the ways to increase productivity and profitability and to improve the non-market functions of dairy farming at household, community and village levels. Success in dairy farming improved the socio-economic status and the position of the farm women in their home and village which ultimately leads to women empowerment through creating awareness and capacity building, leading to greater participation, greater decision making power, control and transformation action.

Dairy farming in cooperative mode: A need of the hour

Dairying in particular play a vital role in the Indian economy. Millions of people are employed in the livestock sector and women constitute about 70 percent of the labour force. India is the world's largest producer of milk due to the policy initiatives of Government of India and contributions by various institutions of animal husbandry and allied sectors. Producing milk in rural areas through producer cooperatives and moving processed milk to urban demand centres became the cornerstone of government dairy development policy. This policy initiative i.e. Operation flood, gave a boost to dairy development and initiated the process of establishing the much-needed linkages between rural producers and urban consumers. The performance of the Indian dairy sector during the past

three decades has been very impressive. Despite, it's being the largest milk producer in the world, India's per capita availability of milk is still lower than the recommendation (280 gm per day) of ICMR. The socioeconomic and demographic changes, rising income levels, urbanization and changing food habits and lifestyle, have also reinforced growth in demand for dairy products. Further, on the supply side, technological progress in the production and processing sectors, institutional factors, and infrastructure played an important role to the increased milk production in the country. In late 1980s, National Dairy Development Board placed a major emphasis on women's education as part of our co-operative development programme, an activity designed to strengthen the role of women members in the control and governance of the dairy co-operatives through *ANAND* pattern. Men were educated about the role of women in dairying and about 6,000 out of the 70,000 dairy co-operative societies in India are women's societies (Sheela and Ramegowda, 2013). Because of their direct involvement in animal husbandry, women also know much more about the care and feeding of dairy animals, identifying first signs of oestrous in cattle and buffaloes, disease and pest problems. Women's dairy co-operatives perform better than men's because women are less political, more loyal to the cooperative concept, more inclined to co-operate with each other and to place their common interests and concerns above the superficial differences of religion, caste and political affiliation.

Support to Training and Employment Programme (STEP) for women was launched by the Ministry of Women and Child Development, Government of India, as one of the measures to ensure well being of women in the traditional informal sector in the year 1986 and advocates the objective of extending training for upgradation of skills and sustainable employment for women through a variety of action oriented projects which employed women in large numbers on a self sustaining basis in the market place with the minimal governmental support and intervention. However, dairy cooperatives and their members face several challenges i.e irregular/ unreliable market, low milk prices, diseases, water shortage, poor performance of the cooperatives, lack of access to input services and lack of qualified staff. Women's poor access to markets, services, technologies, information, and credit decrease their ability to improve productivity and benefit from a growing livestock sector which needs to be taken care by government interventions (FAO 2013). The white revolution of India is now discussed all over the world for the wide span of development it has engineered. However, need based scientific ways of animal based production systems need to be intensified at farm women level to improve productivity and livelihood support of farm women leading to their empowerment?

Strategy to improve livelihood security and empowerment of farm women

Selection of breed and breeding strategy

India has best indigenous milch breed of cattle and buffalo, but majority of them are maintained by small and marginal farmers. Low productivity and poor breeding efficiency, small herd size, lack of coordinated and organized efforts for breed improvement along with inadequate infrastructural facilities are major limitations. Selective breeding, grading up of

local non descript cattle and buffaloes, cross breeding programme along with long term breeding strategies is required to sustain improved productivity of animals.

Health care of animals

The health of dairy animals should be monitored through p**r**eventing the entry of diseases into the farm. Construction of boundaries/fencing, avoid direct contact of visitors with animals, taking bio security measures in place to minimise the risk of spread of disease, isolation of sick animals suffering contagious and zoonotic diseases should be emphasized for maintaining health of the herd. Dairy animals should be vaccinated with right dose at right time against various infectious diseases i.e F.M.D, H.S, B.Q, Anthrax, Brucellocis, Theileriosis, Rabies etc.

Preparation of milk as functional dairy food

In order to produce quality milk and milk products, hygienic milk production and processing is the prime need. Milk as a functional food may improve bone, heart or gastro intestinal health and thus will be contributing in the reduction of life style associated diseases of consumers in India. The acceptance of indigenous cow milk as A2 milk is gaining popularity due to health reasons. In order to harvest good quality milk, appropriate udder preparation for milking, consistent milking techniques, separation of milk from sick or treated animals and hygiene of milking equipments, milkers and clean environment of milking premises must be ensured. Cooling of milk to the specified temperature and/or delivery to a processing plant in a specified time should be undertaken in time.

Feed and fodder resource management

Feeding of balanced ration to dairy animals

Farm women usually feed homemade concentrate devoid of mineral mixture imbalanced with energy, protein, mineral and vitamins which adversely affect the health and productivity of the animals and hence the economic return. Preparation of balanced ration by incorporating locally available mixed food grains ensuring optimum proportion of macro and micronutrients certainly ameliorate the malnutrition problems of animals. The concentrate and roughage ratio is usually recommended at 40: 60 for milch animals and 1kg concentrate for every 2.5 kg milk production along with 1.5-2 kg of concentrate as maintenance ration should be followed for dairy animals. Besides concentrate mixture, provision of 20-30 kg of good quality green fodder along with 2-3 kg of dry roughage (straw/hay) is normally recommended for a cow yielding 5kg milk per day.

Fodder resource management

Fodder contributes an important part in daily feed required for animals in integrated farming system. Legumes enriching the soil can be grown in mixtures with grasses in grasslands. Indigenous legumes i.e., white and red clovers have proved successful apart from Lucerne and Berseem. The grass rangelands exhibited enormous gain in forage production through

multi-tier silvipasture and hortipastoral techniques amalgamated with planting of multipurpose trees in wastelands followed by planting grasses in inter-spaces of trees.

In order to provide green forage, year-round alternate land use (Agroforestry) systems need to be developed on private or community lands in the vicinity of villages. The community lands serve as potent source for grazing. Legume and fodder tree/ shrub species and access to fodder minikits programmes need to be prioritised for production of good biomass. Management of natural forest by the community could be improved substantially, ensuring ecological stability and reducing biotic pressure on existing resources.

Conservation of fodder resource

Green fodders of conventional source in excess during rainy season can be conserved as silage and hay making. Silage (Pashu achar) is the preserved green fodder in succulent form made from maize, sorghum, bajra and barely at flowering to milk stage of cereal crops. Stemmed crops like berseem, lucerne, cowpea, soybean, oat and natural grasses at early flowering stage are suitable for hay making. Effective preservation of green fodder will meet out the fodder deficiency in India to a certain level. Tree leaves like *bhimal, oaks, biul, bamboo, khirk, tooni* and *kachnar* which form the major fodder in hilly areas can be fed to dairy animals with straw based diet (50: 50) increased animal productivity.

Improvement of quality of crop residues and agro industrial by-products

Crop residues especially Jowar, Bajra, maize stovers, wheat and paddy straw are used as staple diet for dairy animals in our country are highly fibrous in nature with low crude protein and high energy content. But, their lingo-cellulose complex is more resistant for rumen microbial enzymes and reduce the bioavailability of energy source to animals. Various processing methods like physical (chaffing, chopping, soaking, grinding, pelleting etc.), chemical treatment (urea, sodium hydroxide, calcium hydroxide etc.) and biological treatment (white rot, brown rot fungi) improve the nutritive value of crop residues.

Urea-molasses liquid feed and Urea molasses mineral block (Pashu Chocolate)

It is an uniform mixture of 2.5% urea dissolved in 2.5 litre water,1% common salt in 94.6% sugarcane molasses which can be supplemented with an intact protein in the form of oil seed cake (250-300 g/head/d) and green fodder (2-3 kg/head/d) and can be used as a life saving food during floods.

It supplements the deficiencies of crop residues, straws and stovers being used as the staple feed of animals in India. Blocks are suitable during droughts and floods, and are cheaper than the conventional source of intact proteins (oil cakes) having a long shelf life on storage at a dry place. It contains urea, molasses, mineral mixture, binder, salt, cake and bran which provide nitrogen and energy requirement of the microbes in the rumen, improves protein synthesis, and maintains the animal without any other supplement. Animal can consume up to 0.5to 0.6 kg of the brick in a day.

Compressed complete feed block

It ensures the availability of all nutrients uniformly in balanced and adequate amount reducing wastage of feeds during handling at the time of feeding, transportation and storage, besides saving the labour and transportation expenditure. Suitable amount of complete feed mixture consisting of wheat straw, molasses, crushed maize, deoiled groundnut meal, mineral mixture, salt and vitablend are mixed in a machine and compressed at 250 kg/cm^2 pressure to form block. The common formulation of standard compact feed block is wheat straw / cellulosic waste/ tree leaves: 55-60 %, concentrate mixture:30-35 %, molasses: 10%, mineral mixture :1% and salt : 0.5%.

Area specific mineral mixture

Area specific mineral mixture was developed based on mineral deficiency in different regions especially on the micro-nutrient content in water, soil, feed and fodder and biological materials of animals by various leading institutes. The mixture is advocated to be incorporated in the concentrate mixture @ 2kg per 100 kg (without salt) and @ 3 kg/100 kg (with salt) or can be supplemented @ 50 g per day per adult animal mixed in feed. It is cost effective formulation, fortified with vitamins and probiotics which improves production and reproduction performance in dairy animals.

By-pass fat and by-pass protein

The supplementation of by-pass fat (Calcium soap of fatty acid) usually prepared from palm oil is fed to high yielding crossbred cows and buffaloes (more than 15-20 lt. milk/day) at the rate of 2.5% of dry matter (maximum 6-7%) improved reproductive and productive performance. Similarly, to ensure that the protein is adequately protected against ruminal degradation, highly degradable feeds were converted into by-pass proteins through formaldehyde treatment (1.5% of CP). It was also ensured that there is no over protection of protein and the treatment has no adverse effect. These technologies have improved feed conversion efficiency of nutrients and have been adopted by feed manufacturers.

Government - NGOs working together for feminization of dairy sector

It is hightime for the feminization of dairy. The solution lays in the formation of village level women self help groups. Concerted efforts of these SHGs, FPOs, Govt. and NGOs are required to fight against the constraints in each aspect of dairy farming practices. Government and milk federation must take corrective action for formation of village level cooperative societies, so that farmers get proper market for their milk with reasonable cost. In addition to this dairy development department must conduct skill-oriented long term training programs for production of value added milk products, so that they get more prices, from milk. Local banks should encourage the rural women for dairy business by easily availability of loans with reasonable interest or providing subsidies to dairy farmers. Government as well as NGOs must take initiative for proper functioning of artificial insemination centres, conducting vaccination/deworming/health care programme. If all suggestive measures taken up by government then only the study area will get momentum in feminization of dairy sector.

Dairy Entrepreneurship is generally sustainable, community-oriented, directly-marketed agriculture focused on the interrelationships of social, economic, and environmental processes which is a major agenda of government for better balancing in the society and women empowerment. Government is also emphasizing ICT projects like e-NAM, e-Pashuhaat, e-Choupal etc. to reach each and every farme rapidly with less cost and easy access which promotes agripreneurship. Policy implications like DEDS (Dairy Entrepreneurship Development Scheme, Agri Udaan etc.) emphasize entrepreneurship in agriculture. Animal-Agriculture sector provides various employment opportunities like Organic farming, Agro based industries, synthesis of bio fertilizers like vermi composting, milk processing and chilling, meat processing, feed preparation, Vaccine and drug preparations, fish production, oyster farming etc. Opportunities are not lacking, concern is proper utilization of the existing resources. Women farmers need to be aware, motivated and trained about these diverse animal- agripreneurial opportunities and skilled to manage those, from the bottom level by organizations like Krishi Vigyan Kendras (KVKs), NGOs and agricultural universities on agri-preneurship development which will not only solve the purpose of women empowerment in terms economic and socio-cultural aspect but also will make agriculture more attractive and lucrative.

Conclusion

Dairying in India is a female dominated enterprise. Selection of breed, compounding balanced feed using locally available ingredients, feeding during pregnancy, health care and banking and insurance were the most preferred area in dairy farming. Dairying is most likely to be effective as ‘a pathway out of poverty for rural women and enable them to compete with commercial producers provided the organisations planning and implementing livestock development programmes are sensitive towards the needs, resources, production systems and perceptions of the families and extension service is strengthened and targeted to the underprivileged families particularly the women. Action plans should be agreed and implemented based on the outcomes of the iterative interactions amongst the social groups and the technical teams regarding the ways to increase productivity and profitability and to improve the non-market functions of dairy farming at household, community and village levels. Success in dairy farming improved the socio-economic status and the position of the farm women in their home and village which ultimately leads to women empowerment through creating awareness and capacity building, leading to greater participation, greater decision making power, control and transformation action.

Effort should be intensified in capacity building of rural farm women through education which can enhance their productivity through better adoption of technology that will invariably enhance output and increase revenue. Governments should intervene to encourage women in cooperative activities by providing the initial take-off capital needed and fostering an enabling environment for cooperative activities to thrive. Government efforts should also be intensified at making more extension agents available and accessible to these women through employing more hands to complement available personnel and giving them all necessary incentives. Village based institutions should be enabled to handle the term loans for livestock production, as this is the simplest solution for accessing loans and repaying them. In

addition, women self help groups as institutions for cash/micro credit for goat production should be promoted as a part of livestock schemes under rural development programmes.

Extension approach should be need-based with problem-solving dimensions and participatory in nature. The exposure visits and training were essentially aimed at strengthening the human capital of the individuals i.e ethno-veterinary training provided to traditional healers to upgrade their skill and capacity, groups with specific needs for training on fodder production be imparted fodder technology. A massive campaign required to launch capacity building and empowerment of village communities that will act as the harbinger of change and technology adoption and to establish the foundation for a farmer-to-farmer livestock extension mechanism and need for the Government to continue to protect the interests of livestock producers. The need for appropriate policy about animal breeding and delivery services (credit, health, market and extension) and steps to improve feed and fodder situation are strongly recommended for sustainable development.

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Integrated Farming System Model for Livelihood Improvement and Sustainable Development of Farm Families

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The Indian economy is predominantly rural and agricultural based. But the declining trend in average size of landholding poses a serious challenge to the sustainability and profitability of farming. The average size of the landholding has declined to 1.1 ha during 2010-11 from 2.28 ha in 1970-71. If this trend continues, the average size of holding in India would be mere 0.68 ha would be further reduced to 0.32 ha in 2030. As per estimates, more than 95% of the holdings will be under the category of small and marginal holders in 2050. The smallholders are major (78%) contributors to the total production but weak in terms of generating adequate income and sustaining their own livelihood. The livelihoods of the smallholder farm families are the major concern. In fact, our past experience has clearly evinced that the income from cropping alone is hardly sufficient to sustain the smallholder's livelihood. Hence, it is imperative to promote integration of different farm enterprises in the existing socio-economic condition of smallholders for additional employment and income generation round the year. Under the gradual shrinking of land holding, it is necessary to integrate land based complementary enterprises on small farms which require less space, less external inputs, optimum resource utilisation and give maximum returns. This kind of synergies and complementarities between different farm enterprises form the basis of the concept of Integrated Farming System (IFS).

"A judicious combination of two or more components using cardinal principles of minimum competition and maximum complementarity with advanced agronomic management tools aiming for sustainable and environment friendly improvement of farm income, family nutrition and ecosystem services" is called as Integrated Farming System (IFS). Crop and livestock cannot be separated for small holder agriculture in India as crop +livestock is the pre-dominant farming system existing in the country and livelihood of 117 million marginal and small farm holdings revolves around this system. Vertical expansion in small farms is possible by integrating appropriate farming system components requiring less space and time and ensuring periodic income to the farmers. Integrated Farming System (IFS) is considered to be powerful tool and holds the key for ensuring income, employment, livelihood and nutritional security in a sustainable mode for small and marginal farmers who constitute 84.97% of total operational holdings and has 44.31% operational area. Integrated system meets the above goals through multiple uses of natural resources such as land, water, nutrients and energy in a complimentary way thus giving scope for round the year income from various enterprises of the system.

Farming Systems

A farming system is defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods, constraints, and for which similar development strategies and interventions would be appropriate. A farming system is a collection of distinct function units such as crop, livestock, processing, investment and marketing activities which interact because of the joint use of inputs they receive from the environment which have the common objective of satisfying the farmers' decision (decision makers) aims. There is synergism in IFS since the working together of the subsystem has greater total effect than the sum of their individual effects. The other related advantages are that it improves their diet, balances the risks among the various farming subsystems, provides fuller employment and generates surplus produce for sale. In this system, an inter-related set of enterprises are used so that the "waste" from one component becomes an input for another part of the system, which reduces cost and improves production and/or income. In other words, we can say that IFS works as a system of systems. Integrated Farming combines the best of modern tools and technologies with traditional practices according to a given site and situation. In simple words, it means using many ways of cultivation in a small space or land. Traditional agriculture as an indigenous form of farming is a result of the co-evolution of local social and environmental systems that exhibits lot of ecological rationale expressed through use of local knowledge and locally available natural resources. So using it is not just cost-effective but also does not disturb the ecological balance.

Primary Objectives of the Farming System Research

1. To identify the constraints in increasing farm productivity
2. To provide technological intervention options for improving farming system at a given resource base through farmer participatory research.
3. To conduct farmer's participatory research in refining technologies of farming systems and provide feedback on farm problems to On-station researcher.
4. To monitor the impact of component or system related technology on sustainability of farming systems to meet the growing needs of population with emphasis on equity and gender issue

The Four Primary Goals of IFS are

1. Maximization of yield of all components, enterprises to provide steady and stable income at higher levels.
2. Rejuvenation/ amelioration of system's productivity and achieve agro ecological equilibrium.
3. Control the build-up of insect pest, diseases and weed population through natural cropping system management and keep them at low level of intensity.
4. Reducing the use of chemical fertilizers and other harmful agro chemicals and pesticides to provide pollution free, healthy produce and environment to the society at large.

Classification of Integrated Farming System

1. Crops subsystem- multiple cropping comprising a mix of cereal, vegetables, cash crops, legumes and fodder crops – any permutation combination
2. Crops + Livestock subsystems
3. Crop + Fish subsystems
4. Crop + Fish+ Livestock subsystems

Women in Agriculture

Today women are central to both farming and household activities. Women represent more than 40% of the global labour force and 43% of the global agricultural labour force. Agriculture employs $4/5^{th}$ of all economically active women in India. 48% of India's self-employed farmers are women. In India 79% of women continue to be engaged in agriculture and allied activities as against only 63% of men. But still women in agriculture remain untapped resource which is contributing significantly to socio-economic development of the country. Women's subordinate position is a cause of concern especially when increasing men declining interest in farming and migration to nonfarm activities are forcing women's to shoulder household as well as farm responsibility. Agricultural research is mostly focused on the generation and refinement of production technologies for men farmers rather than women farmers. Hence, strengthening women perspectives in agricultural technology generation is need of the hour. Therefore, time has come for us to make concerted efforts to address gender issues and provide support for social, technological and economic empowerment of farm women.

Female farmers are the invisible farmers whose contribution is immense but not visible because their contribution is primarily seen as part of their household works which is not considered as a formal sector of work. Also the agriculture policies in India till recently were male-centric. Men only were seen as the beneficiaries of agriculture sector- so all programs, policies and schemes were addressed from their perspective alone. Now our governmental and non-governmental policies and programs are awakening to female farmers as a commendable contributor to the sector. Due to land competition and low productivity and profitability many of the households are becoming female headed owing to men migrating to the urban centres for other means to earn a living. Also there is need for knowledge and understanding of our traditional agricultural practices which were basically eco-friendly in nature. This knowledge is mainly resting with the women.

Role of Women in Integrated Farming System

The term 'gender' was derived from the french word 'gendre' means kind, type or sort. Gender refers to socially constructed roles, behaviours and expectations. It refers to a set of qualities and behaviours expected from males and females by society. Some important gender issues need to be addressed for sustaining livelihood of smallholder women farmers. Integrated farming system can address these gender issues as it involves both the male and female farmers, and both the counterparts are equal contributors in various activities of the different enterprises. IFS can integrate gender perspectives and different farm enterprises in

the existing farming system. The fact that environmental degradation has affected women's lives in ways different from men is well established by now. Women have been identified as the key casualties of overall global ecological degradation by many environmentalists. This is mainly attributed to the fact that there exists a clear gender demarcation with regard to tasks both at farm level and at household level. It is women primarily who are responsible for producing, processing and gathering food, fetching water and carrying fuel wood. But owing to this women's perspective of task completion is very much holistic and integrated. Traditionally, they look at farm and household as one unit and not as disparate units. In India too, women play a very important role in household management including agricultural operations. This is especially true for hilly and tribal areas. As such, one can see further on, a gradual feminization of agriculture owing to men especially the small and marginal level farmers migrating to rural non-farm sectors as well as urban centres too.

Research shows that on average, women are better at multi-tasking as compared to men. They are able to organize their time better and switch from one work to another faster with relative ease as compared to their male counterparts. This makes it easier for women to adopt IFS. It is definitely easier for them to further hone their multi-tasking skills at home and at the farm taken together. Thus women especially need to be given training on the new permutation combinations in IFS. Another rationale for enhancing the skill of women with regard to IFS is due to the fact that they are the key custodians of traditional knowledge. When we talk of managing and preserving traditional knowledge, the pivotal role played by women cannot be ignored. It is true that women have much more pragmatic knowledge of the practices in which they are engaged, leading to a kind of specialization. The close association between women and natural resources exists because of their social and economic roles which have for generations required them to provide food, fuel and fodder from the surroundings. Farm women are closer now than ever before towards increased food production with the increased concern of environment and overuse of pesticides. Recognition of Women work participation will shift agriculture from increased production to increased prosperity through development of various gender friendly IFS required for the sustainability of small and marginal farm families, which are the back bone of agriculture globally.

The issues pertaining to gender are;

a) Women's triple role: Women play reproductive, productive and community management roles in the society. Hence, time constraint is important issue of women in agriculture. Women spend less time on farm activities but work longer on reproductive activities which are not valued. The child care, household responsibilities and socio-cultural norms limit mobility of women in and outside the society.

b) Invisible face: Agriculture is the major activity in which 83.30% of workforce is comprised of women but this increased participation has not translated into equal employment opportunities or equal earnings for women. The census enumeration has consistently ignored the contribution of women in the unorganized sector.

c) Access to and control over productive resources: According to the Food and Agriculture Organization (FAO), even though women are major producers of food, they lag well behind

men in ownership of agricultural land and access to income from land. It is mainly caused by cultural and traditional behaviours and norms, and can be mitigated through gender sensitive interventions.

d) Access to extension services: There is huge gap in number of men and women extension workers in India. About 85% of extension workers are men in India (NSSO survey, 2005). Women farmers have less contact with men extension workers than men farmers. In fact, agricultural knowledge is transferred inefficiently from men to women and vice-versa.

e) Access to financial services: Women have less access to credit services because of less control over economic assets, illiteracy, socio-cultural barriers, the nature of their economic activities, and inability to provide collateral requirements.

f) Access to markets: Despite their major role in the crop and livestock production, women frequently have poor access to markets than men, and play a limited role in the commercialization of farm products. This tendency often arises from poor marketing skills, low levels of literacy and customary practices that prevent women from freely leaving the house premises.

g) Participation and decision-making power: Both men and women have differences in access to productive resources, information, literacy and attitude towards suitable work for them which limit their active participation in agricultural activities. In many rural areas, cultural and social norms tend to prevent women from actively engaging in the decision-making process. Women's lower status and input into household decisions gives them restricted control and decision-making power over productive resources and income generated from farming activities.

h) Occupational health and safety: Women and men's close proximity to crop and animals expose them to various health risks and hazards. Women are traditionally the household members responsible for handling food for both family consumption and sale. As a result they tend to have greater exposure than men to occupational hazards and diseases.

Women friendly IFS model: Involvement of women in crop and livestock production varies according to the type of crop grown and livestock reared, and socio-economic conditions. There is need to develop scientifically designed, economically profitable and socially acceptable integrated farming systems models especially for women farmers having integration of women friendly farm enterprises. Some women friendly farm enterprises
a) Apiculture, b) pond fishery, c) Vegetable cultivation, d) Vermicomposting, e) Backyard Poultry, f) Goatary, g) Kitchen garden, h) Piggery, i) Duckery, j) Marigold cultivation, k) Mushroom cultivation, l) Nursery, m) Value added agro-products, n) Biogas

The smallholder farmers having sufficient farm resources can integrate horticultural crops *viz.*, fruits, vegetables and flowers as an additional enterprise along with prevailing ones. Marginal farmers living nearby fruit orchards can integrate apiary and mushroom. Farmers having sufficient irrigation water or living in low lying riverbed areas can choose fishery as an additional enterprise. Farming systems under small land holdings can only be made

profitable if farmers adopt a conservative approach at all stages of farming. For this they have to utilize each and every piece of land for raising suitable crops, select viable enterprises for diversification, recycle all farm wastes and crop residues within the system itself and make productive use of farm boundaries and waste lands. They can make use of renewable sources of energy such as solar and biogas.

Constraints encountered in practicing different Integrated Farming Systems

The integrated farming systems with different enterprise combinations practiced by farmers have some inherent constraints and can reduce some constraints of farm family. These are constraints in practising IFS:

a) High initial capital investment

b) Difficult to manage various enterprises simultaneously

c) Difficulty in intercultural operations

d) Competition for resources

e) Effect of shade and defoliation on yield

f) Long transition period in tree component

g) Difficulty in animal care during peak agricultural season

h) High skill requirement

i) Difficult to market of diverse farm products

Conclusion

As one of the most populous nations with a high percentage working in agriculture, this is time to focus on women's skill improvement, women friendly technology development, organisation of women groups, providing equal access to and control over productive resources, collecting gender-disaggregated data for designing women friendly policies and bottom-up gender sensitisation will help in creating space for women farmers in Indian agriculture. Generating educated, trained, self-reliant, self-motivated, innovative, responsible and visionary women farmers who can lead our agriculture out of their multiple roles is the great challenge ahead especially when India is on the verge of a second green revolution. The choice of enterprise and crops in any combination should take into account the available resources, crop geometry and environmental conditions. The marketing channels for inputs and outputs for a particular enterprise combination should not be excessively risk-prone. The particular enterprise combination can be successful once credit, information about know-how, market and other farm inputs are well established. Potential improvements and increased productivity from the various enterprises can only come from a better understanding of the nature and extent of the interactions various enterprises and natural resources, economic benefits, as well as the impact on the livelihoods of small farmers and the environment. Research on these aspects provides major challenges for sustainable agricultural development through integrated farming systems in the future.

Doubling Farm Women's Income in Crop-Livestock-Fisheries System through Entrepreneurship

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Aiming to boost Indian agriculture, the Government has set a goal to double the farmers' income level by the year 2022. It is possible by formulating suitable action plan for development of location specific technologies, and timely transfer of such technologies to the farmers' fields. To fulfil the aim, a range of approaches and strategies need to be adopted starting from transformation of production-driven as well as market-driven factors and an enabling environment, which support farmers in all their endeavours. Current level of average income of an Indian farmer is about Rs. 6,430 per month (NSSO, 2012-13) with huge disparity among different regions, like farmers of Punjab earned highest income (Rs. 18,060) followed by those in Haryana (Rs. 14,440), Jammu & Kashmir (Rs. 12,685) and Kerala (Rs. 11,890), whereas farmers of Bihar earn the least (Rs. 3,560) per month. Hence, instead of 'one solution fit for all', a mix of strategies will need to be embraced which not only enhance the income to double or nearly double but discourage the level of disparity among different regions of India.

Options for Improving Farmers' Income

Farmers' income can be improved when productivity goes up, cost of production comes down, risk is reduced, post-harvest loss is minimized and commodities produced get a remunerative price. It should also improve income from allied activities to agriculture. The strategy should integrate these all. The following options are available for increasing farmers' income in rice-based systems (Pasupalak et al, 2018).

A. Improving productivity and quality

1. Providing quality seed and enhancing seed replacement ratio
2. Promoting high-yielding varieties and hybrids
3. Growing nutrient rich (CR Dhan 310 and 311) and aromatic rice (Basmati)
4. Increasing cropping intensity in rice-fallow areas

B. Increasing input use efficiency

1. Crop planning to identify areas where the crop can be grown with least input
2. Promoting water harvesting and micro-irrigation to achieve per drop-more crop
3. Using soil health card and site-specific crop management
4. Promoting farm mechanization and solar energy

C. Reducing crop loss

1. Adopting plant protection measures
2. Promoting resistant varieties and e-surveillance
3. Crop insurance to mitigate risks at affordable cost
4. Weather services and forecasting system

D. Diversification

1. Dairy husbandry for small farmers
2. Promotion of intensive vegetable production
3. Promotion of ancillary activities like poultry, beekeeping and fisheries
4. Strengthening Organic Food Program

E. Market price realization and value addition

1. Community/co-operative farming with crop-value chain
2. Use of the crop biomass to make products through small industry
3. Creation of a national farm market with information system for export and online selling
4. Agribusiness Incubation Centres to promote agripreneurship

Women in Agriculture in India

Women's involvement in agriculture is complex and diverse. Unlike their male counterpart, women are involved in a wide range of activities in agriculture as well as at home. However, the spectrum of women's participation in agriculture is changing with the changing profile of agriculture and development of non-farm sector. World over, about 42% of women workers were engaged in agriculture in 2010, down from 53.5% in 1980. In the developing countries, agriculture supported about 52.7% of women workers in 2010. There is considerable difference in the extent of women's participation across regions of the world. In South Asia, over 60% of women workers are in agriculture. In India, as per Census India data (2011), 16.6 percent female population work in agriculture against 26.6% male population. Sixty five percent of female workers are involved in agriculture (24% cultivators + 41% agricultural labourers) as against 50% of male workers (25% cultivators + 25% agricultural labourers). Thirty seven percent of agricultural workers are female (13.7% Cultivators + 23.4% Agricultural labourers). Thirty percent of cultivators (36M) and 43% agricultural labourers (62M) are females.

Gender Issues in Agriculture

Despite the contributions of women in agriculture, there are many concerns that bother farmers, researchers and policy makers. One such concern is gender issues that have serious socio-economic implications. The results of gender researches reveal that despite the important role women play in agricultural production, they remain disadvantaged in numerous respects. On one hand, women have limited access to a wide range of agricultural inputs including seeds and fertilizers, technological resources, equipments, land and so forth. In addition, women often lack the capacity needed to deploy these resources. For example, women may have access to land but lack the capacity needed to deploy the resources as

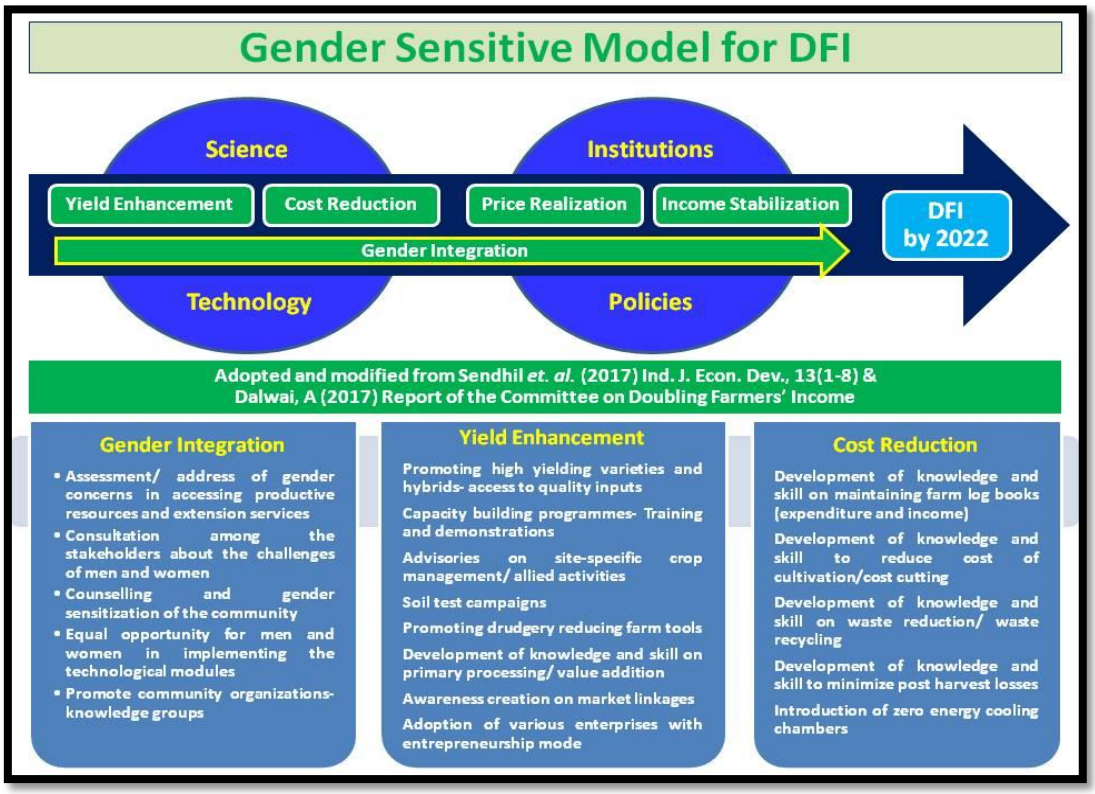
mentioned above. Illiteracy, neo-literacy and lack of scientific knowledge are the major impediments in their growth. Furthermore, many non-tangible assets, such as social capital, human capital, rights and decision-making power, are more difficult for women to access and exercise due to cultural barriers and gender discrimination.

In a nutshell, the gender issues in agriculture can be summarized as;

- Gender stereotypes
- Lack of access to assets, resources & services including extension advisory services
- Male migration & increasing women headed households
- Women's triple role – time constraint
- Poor participation and decision-making power
- Unable to exercise non-tangible assets
- Drudgery, occupational health and safety
- Women agricultural labourers- wage disparity
- Lack of gender sensitive extension models/ approaches

Gender Sensitive Model for Doubling Farmers' Income by Addressing Gender Concerns and Technological Gaps

Keeping those gender issues in mind, a 'Gender Sensitive Model for Doubling Farmers' Income by Addressing Gender Concerns and Technological Gaps' was evolved and implemented by ICAR-CIWA during the period 2017-2020 (Fig. 1).



(Fig. 1. Gender-sensitive model for doubling farmers' income)

Under this model, the technological interventions for doubling farm income include; promoting high yielding varieties and hybrids, capacity building programmes- training and demonstrations, advisories and information bulletins on site-specific crop management/ allied activities, promoting drudgery reducing farm tools, animal health camps, development of knowledge and skill on maintaining farm log books (expenditure and income), development of knowledge and skill to reduce cost of cultivation/cost cutting, development of knowledge and skill on waste reduction/ waste recycling, development of knowledge and skill to minimize post harvest losses, development of knowledge and skill on primary processing/ value addition, awareness creation on market linkages, regular interfaces and monitoring and convergence of developmental agencies.

Integrating Gender

- Assessment of gender concerns in accessing productive resources and extension services among the farm families
- Consultation among the stakeholders about the challenges of men and women
- Equal opportunity for men and women in implementing the technological modules
- To promote community organizations- knowledge groups of men and women
- Motivation of rural youth to involve in agriculture sector/ adoption of various vocations with entrepreneurship mode
- Mode of technology transfer – through implementation of gender sensitive extension models
- Counselling and gender sensitization of the community
- Gender sensitization of developmental agencies

Gender-specific Strategies for Doubling Farm Income: Opportunities and Constraints

Most common agricultural practices including AH, Dairy, Hort & Fisheries	Available improved practices	Expected additional income (Rs.) per ha or per farm household
Nutrition Garden: ➢ Availability of homestead land ➢ Knowledge in horticulture	➢ Seed multiplication by farmwomen in homestead garden ➢ Organic production	➢ Rs.20,000/- per year
Mushroom: Major crop: Paddy; Abundant availability of paddy straw	➢ Backyard mushroom cultivation	➢ Rs. 20,000/- per year from 360 beds (30 beds per month)
Poultry • Rearing of non descript poultry birds (5-6: less than Rs. 500/-) • Feeding of readymade concentrate mixture procured from market - Un economic & Imbalanced ration • Lack of awareness on scientific managemental practices • Improper vaccination	✓ Introduction of improved variety ✓ Utilization of local feed resources as supplementary feeding ✓ Capacity building of farm women in improved rearing and management practices of birds ✓ Availability of quality vaccines	Rs 2,000/- per household per month by rearing of 15 and 10 chickens through 2 cycles
Goatry • Feeding of balanced ration with mineral mixture is rarely practised • Lack of awareness on scientific managemental practices • Incidence of infectious diseases	✓ Preparation of low cost balanced ration using locally available feed resources and area-specific mineral mixture ✓ Capacity building of farm women and community goat keepers on scientific rearing and management of goats ✓ Monitoring of health of animals through timely vaccination	Rs. 5,000/- per month by keeping 20 goats and a buck
Dairy • Rearing of low producing indigenous cows following conventional method	✓ High yielding cross bred cows ✓ Introduction of high yielding fodder varieties	Rs 10,000/- per household per month through rearing of 2 cows yielding 15 litres of milk/day

Most common agricultural practices including AH, Dairy, Hort & Fisheries	Available improved practices	Expected additional income (Rs.) per ha or per farm household
• Feeding of poor quality roughages (paddy straw, dry grasses) • Feeding of imbalanced ration • Improper vaccination • Lack of awareness on scientific practices	(Maize- African Tall, Oat- Kent) (Perennial fodder- Hybrid Napier) ✓ Introduction of chaff cutter ✓ Feeding balanced ration along with supplementation of area specific mineral mixture ✓ Monitoring of health of animals through timely vaccination ✓ Gender sensitization for capacity building of farmwomen on scientific management of dairy animals ✓ Establishing linkage of farmwomen with dairy co-operatives for marketing milk and byproducts	
Drudgery Reduction Farm women follow conventional methods which induce drudgery and occupational health	• Improved tools and equipment for increasing working efficiency • Value addition of vegetables and fruits	• Increased working efficiency upto 30% • Minimal post harvest losses
Vermicompost Dumping of cowdung/ household waste on daily basis is the sole responsibility of the farmwomen at open space available near house. This is further utilized as farm yard manure after one year.	Vermicompost making is viable option, which not only provides better decomposed input for farm but also can recycle the cow dung and farm waste 4 times/year. This will increase the availability of manure four times in a year for utilization in farm/field.	An additional income of Rs. 770/-@ 10/ kg. for vermicompost and Rs.4375/- from earthworm sale @ 250/kg from an area of 63 ft3. in 3 months.

Opportunities for Women Entrepreneurship, Household Income & Nutrition

- Crop production and natural resource management- Resource efficient/ diversified cropping models, IVFS, Nutri-farm models
- Fisheries and livestock- IFCAS, Family Poultry, homestead aquaculture
- Secondary agriculture- Engendering value chains
- Policies and institutions- Gender budgeting and programs
- Market linkage- Vegetable supply chains…

Women Entrepreneurship in Fisheries

Despite the potential the fisheries sector offers, fisherwomen have not been able to have sustained incomes throughout the year. The active participation of women in fisheries needs to be recognized, as they help to ensure distributive justice among rural poor ensuring economic stability. Hence empowerment of fisherwomen should be treated as an agenda of top priority in all fisheries development programmes. Suitable sustainable micro-level ventures can be implemented through self help groups, with the back-up of technical and developmental agencies. Expansion of non-formal education, empowerment of women through promotion of rural women entrepreneurship, increased involvement of NGOs, market promotion through co-operatives and NGOs, selection of technology transfer programmes by taking into consideration the availability of local inputs/ resources, integrated approach and formation of women demand groups are some of the immediate concerns. Policy development to support small-scale fisheries requires appropriate institutional arrangements and effective organizations and structures.

Empowerment of women through value chain

Projects that strengthen women's engagement in value chains are making important contributions, not just to improve household income and local economies, but to gender relations at the individual and societal level. Building women's individual and collective power to influence policies and decision making, is a critical element in making value chains work for women. Increased income is a means for change as well as an end in itself. It is a tool for women to change power relations in their households and communities.

Chain Empowerment

Chain empowerment occurs when participants add value to their products, and also increase their control over income and the processes involved in value creation. Chain empowerment looks at who participates in a given value chain (chain actors), and identifies new opportunities to involve those who may be excluded. Chain empowerment, in general, occurs when producers gain capacities to add value to the activities they are involved in, and are engaged in managing or controlling the chain. Findings of researchers on women empowerment through value chain shows women have increased knowledge and skills, confidence, assertiveness and access to information and resources. From the perspective of chain empowerment, women report now having the skills to take on new activities that reduce transaction costs and add value to their products, or to work more efficiently and to a higher standard.

Policy Needs for DFI and Farmwomen Entrepreneurship Development

- ✓ The cost of cultivation has increased manifolds for many crops. In order to optimise the net income, the input delivery mechanism needs to be strengthened, especially with regard to critical inputs and access to extension services for women in agriculture.

- ✓ Huge data gaps exist in assessment of the changes in farmers' income, savings and investments over time, and also lack of gender disaggregated data. There is a need to measure these components on a regular basis to formulate evidence-based appropriate policy interventions.

- ✓ The Central and State machineries need to reform the agricultural marketing systems for enabling better price realisation by the farming communities, especially farmwomen. Online marketing may be facilitated for the produces of farmwomen and SHGs by providing suitable platforms and handholding support.

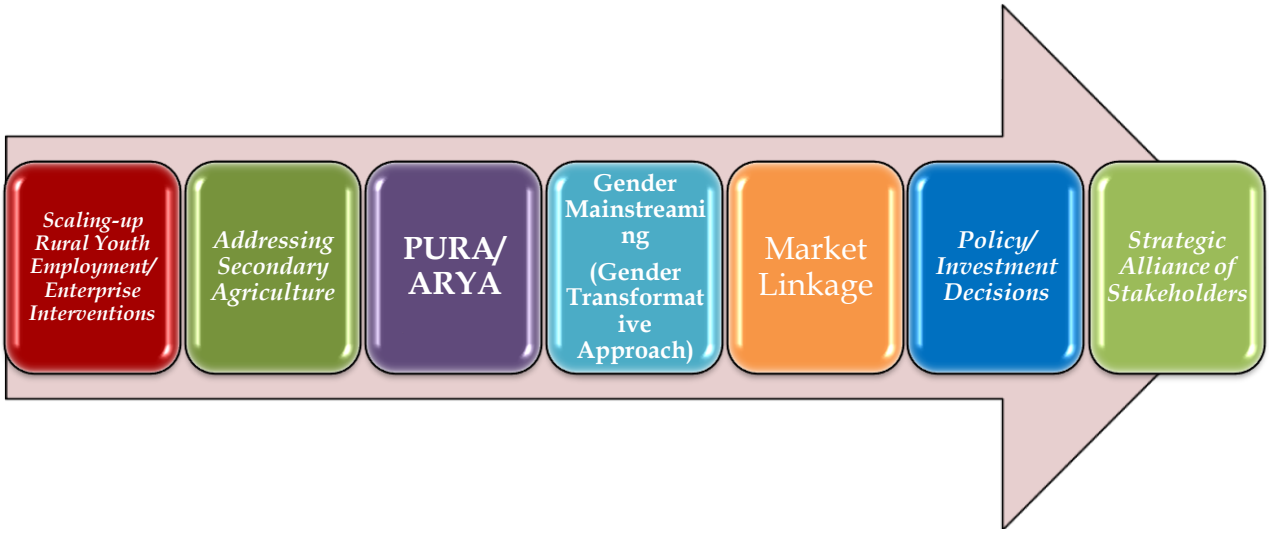
- ✓ Policy interventions are also needed to simplify the procedural formalities of establishing Farmer Producer Organisations (FPOs), in which farmwomen are partners is crucial for scaling up post-harvest operations and directly linking them with markets beyond the local *mandi*/market. This would enable aggregation and pooling of the output from farms and in organising the market linkages, reducing post-harvest losses as well as help farmers realise higher prices for their produce.

- ✓ Policy instruments and interventions in infrastructure such as financial institutions, markets instruments, physical infrastructure, access to information and customized capacity building measures to create awareness and disseminate desired knowledge would be effective.

The acceptance of entrepreneurship as a vital force for development by itself will not lead to rural development, and advancement of rural enterprises. What is needed in addition is an environment enabling entrepreneurship in rural areas. The existence of such environment largely depends on policies promoting rural entrepreneurship.

Way Forward

To increase income of farmers, a range of strategies (Economic, Technological, Infrastructural/Information, Political/Policy and Social) need to be adopted to transform the current production-driven to income-driven farming system and reduce the disparity among farmers of different regions of India. A region and state-specific action plan is required to address the constraints of increasing farmers' income.



Farmwomen continue to bear the double burden of household activities as well as a bread winner, which leads to more drudgery prone life as compared to working in the agricultural fields in their own villages. Women empowerment and livelihood security through agricultural investment, targeted in key areas is needed. Effective and efficient measures must be adopted to establish agro-processing units and village cottage and handicraft units in the rural and urban areas so that rural youth and women can get employment. Rural youth and women need to be sensitized about the livelihood opportunities that secondary agriculture can offer along with micro level efforts to make agriculture sustainable. By making agripreneurship more attractive, and equipping women with the education and skills they need to engage in economic opportunities, they can be helped to become active contributors and financially independent members of their communities. Agriculture may very well offer the best opportunities for the entrepreneurship development among women, but only if the right policy and investment decisions are made.

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Eco and Women Friendly Pest Management Practices in Crops for Sustainable Agriculture Production

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In India, women play significant role in household management including agricultural operations. This is especially true for hilly and tribal areas. Research shows that on average, women are better at multi-tasking as compared to men. They are able to organize their time better and switch from one workto another faster with relative ease as compared to their male counterparts. Farm women are the invisible farmers whose contribution is immense but not visible because their contribution is primarily seen as part of their household works which is not considered as a formal sector of work. In India when technologies were introduced, men were the key recipients of it. This was because of the lack of recognition given to women's contribution.

The Indian Prime Minister, Shri Narendra Modi Ji, had announced the introduction of agricultural education at middle school level in the National Education Policy (NEP) 2020 . The Cabinet Committee of the Central Government recently approved the New Education Policy (NEP) 2020-2021. Professional Education is an integral part of the higher education system. Vocational education will begin from the sixth class with training in the new NEP. A separate Gender Inclusion fund and Special Education Zones for disadvantaged regions and groups has been recommended for the empowerment of Women. The Indian Council of Agricultural Research has also formulated Gender Budgeting Cell during November 2020 in order to facilitate Gender Responsiveness in the Department's policies/ programmes. Cell will function as per the guidelines contained in the Charter for Gender Budget developed by the Ministry of Finance. The first ever National Agriculture Policy was announced on 28th July, 2000. National Agriculture Policy seeks to actualise vast untapped growth potential of Indian Agriculture, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro-business create employment in rural areas, secure affair standard of living for the farmers and agricultural workers and their families, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization over the next two decades with one of the aim to attain Growth that is sustainable technologically, environmentally and economically. In the above backdrop Eco and women friendly pest management practices in crops for sustainable agriculture production is the need of the hour in order to address Growth with equality, i.e. growth which iswidespread across regions and farmers.

Despite having achieved national food security the well being of the farming community continues to be a matter of grave concern. With the initiation of green revolution in mid sixties the insect pest scenario became more complex due to altered microclimate. Indiscriminate application of insecticides is one of the reason for the development of resistance and resurgence of pests, and also

threatened health. The eco-friendly practices including ancient wisdom has sustained food production for several millennia been ignored in our approach. In the context of global change, people's low cost traditional wisdom in pest management has assumed greater significance. Women's key role in the production of major grains and minor millets illustrates their invaluable contribution to the food security. In addition, women play a crucial role in ensuring supply of food as food vendors. As major buyers of family food and meal-makers, women ensure adequate food security. As primary providers of nutrition to the young children, women are the major decision-makers in ensuring nutrition to the next generation. Marginal farmers are often engaged in professional pesticide spraying and therefore subject to continuous exposure. Women and children are specially at risk because they are frequently employed in mixing pesticides and refilling pesticide tanks. Women and children also perform secondary activities that have been neglected in studies dealing with direct exposure. Extremely time consuming operations such as weeding are often performed by women and children during the peak spraying season, when residue levels in fields are high and can cause secondary poisoning. Women are also exposed to pesticides in the home, by washing pesticide soaked clothing and disposing of /or using empty chemical containers. Women are particularly vulnerable to pesticides when they are pregnant. Health problems passed on to offspring add to the concern over pesticide poisoning in women. Compared to men, women are usually less informed about safe pesticide practices and the dangerous side effects of pesticide use. High levels of pesticide poisoning among resource poor farmers, especially women, are often reported to be linked tolow levels of literacy and education.

The people who are involved in growing our food are probably the people whose health is most affected by the pesticides used in agriculture. Women play a crucial role in agriculture throughout the world, producing and providing the food we eat. Despite of their contribution to global food security they are frequently bypassed various development strategies. Due to injudicious use of pesticides farm families are at risk due to pesticide hazards. For an example Atrazine, an herbicide used in corn production, causes breast cancer in laboratory animals and it is also a contaminant of streams and rivers. We need to produce about 320 metric tonnes of food grains by 2025. It implies more pressure on our existing land, soil, and water resources. Main target to meet Agri-Food Demand by 2050 (Base 2010) a fourfold increase in land productivity is required. Therefore, we have to increase the production in continuously decreasing area thus improving productivity with women empowerment in Eco and women friendly pest management practices in crops for sustainable agriculture production.

Pesticides and toxic waste alter DNA

In the Andean regions of Bolivia, Colombia and Peru, women develop and maintain the seed banks on which food production depends. In Philippines women are affected by the misuse and mishandling of pesticide containers. This, of course, also affects their children's health. A two year study commissioned by the Punjab pollution control board (PPCB) in November, 2007 and conducted by Chandigarh, s postgraduate institute of medical education and research (PGIMER) in 25 Punjab villages located near 5 open drains in Jalandhar, Ludhiana and Amritsar districts, reported Significantly high rate of miscarriages among women and slow growth in children.

Pesticides were also detected in vegetables, blood as well as human and cattle milk samples. Evidence of genotoxicity and DNA mutations in 65 percent of the blood samples were noticed.

How have humans affected the food chain?

When we spray pesticides, we put the food chain in danger. By breaking one link on the chain means all of the organisms above that link are in threat of extinction (like the domino effect). By hunting animals nearly to extinction, everything above the animal in the food chain is put in danger. A 'chain reaction' in the food chain can be perilous. Since the food chain provides energy that all living things must have in order to survive, it is imperative that we protect it. After WTO establishment, many developed countries began applying phyto-sanitary and other environmentally, socially acceptable cultivation practices due to barriers in international trade. At present a big questions how to achieve the best security of safe food without environment disturbance. The ways to do are:

- Judicious use of pesticide.
- Development of safer, effective, target oriented molecules.
- Use of IPM (Integrated Pest management) and IRM (Insecticide Resistance Management)
- Stricter control on spurious pesticide use
- Precision pesticide application, Enhanced use of seed treatment and newer pesticide applicationtechniques.
- Pesticides monitoring mechanisms for Phyto Sanitary issues.
- Enhanced use of ICT and forecasting and forewarning.

Majority of the pesticides are sprayed and broadcasted which is an inefficient process. Around 10-20 percent of the pesticides applied as dust and 20-25 percent applied as spray are deposited and rest goes waste. Hence proper timing and method for each situation need to be devised. Seed treatment is a very efficient method for many diseases. Unfortunately, its use has not been largely adopted. In case of pesticide monitoring for residues, the classic example is of grapes. The zero-residue quality grapes have entered EU member countries and Middle East markets mainly because of total system devised to monitorthe use of pesticides from farm to ship.

Pesticides are used in grocery stores and food storage facilities to manage rodents and insects, may be harmful to farmwomen. Rodenticides are chemicals used to control rats, mice, bats and other rodents by most of the farmwomen at household level. Chemicals, which control other mammals, birds, and fish, are also grouped in the category of rodenticides by regulatory agencies. Most of the times suicide cases of farmwomen have been reported with the use of rodenticides and insecticides used for stored grain pests. Due to large surface application of pesticides, hazard to human beings, domestic animals and wildlife has been reported. Each use of a pesticide carries some associated risk on human health and women are worst affected by these risks. Some of the vegetables like ladies finger, cauliflower, pointed gourd and brinjal are dipped directly in the pesticide solution to improve their appearance before putting in the market for sale. In most developing countries, rural women are the victims of the increasing costs of pesticides and fertilizers, and increasing hazards to human health. High pesticide residues in food chain cause health hazards *viz*; pesticides poisoning cases and deaths

through organ dysfunctions, immune supression, neurotoxicity, impairment of reproductive functions, carcinogenicity, tumorogenecity, paralysis *etc*., and harm to non target beneficial fauna and flora.

In India, women bear most of the responsibility for selecting and storing seeds for the next season. In Nepal, women have almost full responsibility for seed selection, sowing, weeding, fertilizer and pesticide application, harvesting and threshing of rice in the mountain area. While performing different plant protection operations at household level specially for storage of food items, storage of pesticides brought for field crops, pest management of kitchen garden in homestead lands, reuse of pesticide containers, preparation of spray solution for spraying without personnel protective equipments (PPE) and weeding in field crops sprayed with pesticides; farm women get exposed to a variety of chemical pesticides and suffer with various adverse health effects due to lack of information and technological empowerment.

Eco-friendly technologies with the use of multiple approaches to control pests, is becoming widespread and has been used with success in countries such as Indonesia, China, Bangladesh, United States, Australia, India and Mexico. Rural women are slowly coming forward to manage independently their farm enterprise as well as family headship. Therefore, it is expected that farming and allied enterprises may go to the hands of rural women and they require technological knowledge to face the future responsibilities. The important components for Eco and women friendly pest management practicesin crops for sustainable agriculture production are described below:

1. Ecology based Pest Management

Various eco-friendly tactics of pest management have to be integrated to avoid the use of chemical pesticides. The knowledge of interaction among plant, pest, natural enemies and environment is essential for effective pest management. When man disturbs balance of nature, nature strikes back in the form of pest outbreaks. Some examples of pest outbreaks are as follows:

- White flies in cotton
- *Helicoverpa armigera* in cotton
- Slug caterpillar in coconut
- Eriophyid mite on coconut

Moreover, the pest status changes over the years due to interaction of various biotic and abiotic factors. One has to thoroughly understand the reasons for outbreak of pests and their changing status and plan the management practices accordingly so as to prevent further outbreaks.

2. Habitat Diversification

Habitat diversification makes the agricultural environment unfavourable for insect pest population growth multiplication and establishment. The following are some approaches by which the pest population can be brought down.

2.1 Ploughing, hoeing and basin preparation

Cultural practices like ploughing, hoeing and basin preparation influence directly, the survival of soil inhabiting pests. These routine agricultural operations expose soil inhabiting insect, pests and other arthropods and nematodes to harsh weather and to natural predators. Insects are most vulnerable when in the pupal stage and most insect-pests pupate in the soil, which furnishes a protective habitat. Birds like the king crow, the myna, the starling, *etc.* pick up the exposed pupae following these cultural operations. Some insects *e.g.* grasshoppers, crickets, mole crickets and borers lay their eggs in the upper layers of the soil. These eggs exposed during soil preparation and desiccated subsequently. Many insects like cutworms, grubs of the root borer and white grubs which feed on the root system of plants, are also exposed to the vagaries of the elements during basin preparation and hoeing. Ploughing the field after summer showers, removing the crop debris from the field, exposing the different stages of insects *viz.*, egg, larvae and pupae to sunlight greatly reduce the pest abundance and prevent the pest population buildup. Deep ploughing carried out during winter helps in reducing the over wintering populations of several pests. However, the degree of success of these operations is related directly to the presence of natural predators in adequate numbers and the synchronization of these operations with the vulnerable stages of the pest's life cycle.

2.2 Intercropping System

Intercropping system has been found favourable in reducing the population and damage caused by many insect pests due to one or more of the following reasons:

- Pest outbreak less in mixed stands due to crop diversity than in sole stands.
- Availability of alternate host.
- Decreased colonization and reproduction in pests
- Chemical repellency, masking, feeding inhibition by odours from non-host plants.
- Act as physical barrier to plants.

Few examples like Interplanting maize in cotton fields increased the population of *Araneae, coccinellidae* and *chrysopidae* compared with control fields. Maize also acted as a trap crop for *H.armigera* reducing the second generation damage to cotton (Wu *et.al*., 1991). Intercropping pulses in cotton reduced the population of leafhopper (Robindra, 1985) and Lablab bean in sorghum reduced the sorghum stem borer incidence. Hence, appropriate intercropping systems have to be evolved where reduction in pest level occurs.

Intercropping sorghum with other crops has been shown to reduce *C.partellus* damage on sorghum, urdbean, pigeon pea, cowpea and lablab bean (Mahadevan and Chelliah, 1986). The incidence of groundnut leaf miner, *Aproaerema modicella* was highly reduced when groundnut was intercropped with cowpea of blackgram at the ratio of 3:1 (Logiswaran and Mohanasundara, 1985) and with pearl millet at a 4:1 ratio (Baskaran and Thangavelu, 1990: Sathiyanandam *et.al.,* 1992). The latter case increased natural enemy activity and reduced the requirement for one round of insecticide spraying and increased yield. Sowing cowpea (1:4) as intercrop with groundnut minimizes leaf miner

infestation. Growing cowpea as intercrop also helped in attracting the female moths to lay more eggs on it and for early detection of occurrence. Intercropping system of groundnut and Bajra at 6:1 ratio had lowest leaflet damage by leaf miner (41.23%) and larval numbers (2.57) per plant followed by groundnut + cowpea, which had 49.26 percent and 3.10 larval number as compared to 64.56 and 4.13, respectively in groundnut pure crop. (Sathiayanandam and Janarthanan, 1995). Greengram (Co2) intercropped with sugarcane recorded 77 percent decrease in sugarcane early shoot borer incidence over control (Kirshnamurthi and Palanisamy, 1995). Intercrop of soya bean, green gram, black gram *etc*. has been reported to reduce weeds as well. Sunhemp has been interplanted with potatoes to deter the potato blight fungus, *Phytophthora infestans* (Israel 1981). Intercropping with onion and garlic is recommended for nematode control. The damage of cotton ash weevil was more pronounced when eggplant was grown as intercrop cotton or as preceding crop, since both are preferred hosts for it.

2.3 Trap Cropping

Plantings of the susceptible or preferred crop of a pest grown near the main crop to attract insects or other organisms like nematodes to protect target crops from pest attack. Beneficial effect of trap cropping is achieved by

- Either preventing the pests from reaching the crop or
- Concentrating them in a certain part of the field where they can be economically destroyed.
- Growing trap crops like marigold which attract pests like American bollworm by lay eggs, barrier crops like maize/jowar to prevent migration of sucking pests like aphids and guard crops like castor which attracts *Spodoptera litura* in cotton fields was reported by Murthy and Venkateshwarulu (1998). Growing mustard as trap crop, 2 rows per 25 cabbage rows for the management of diamond back moth. First mustard crop is sown 15 days prior to cabbage planting or 20 days old mustard seedlings are planted. Growing castor along the border of cotton field and irrigation channels act as indicator or trap crop for *Spodoptera litura*. Planting of 40-day-old yellow African tall marigold and 25 day old tomato seedlings (1:16 rows) or *Bidil rustica* tobacco around tomato (1:5) simultaneously reduces *Helicoverpa* damage. All the eggs of *Heliothis armigera* deposited on yellow *Tagetes* flowerbuds could be destroyed by the inundation of *Helicoverpa* adapted strain of egg parasitoid (*Trichogramma chilonis*). The main crop of tomatoes is also sprayed with either HaNPV or Bt, both of which are compatible with *Trichogramma.*

2.4 Companion Plants

Companion plants constitute a form of biological control - the use of living organisms to manage unwanted pests and disease organisms. *Cannabis* plants have been grown as companion plants alongside crops, which require this protection. Riley (1885) noted that *Cannabis sativa* growing near cotton exerted a "protective influence" against cotton worms *(Alabama argillacea,* then called *Aletia xylin*a). Similarly,sunhemp grown around vegetable fields safeguarded the fields from attack

by a cabbage caterpillar, *Pieris brassicae* (Beling 1932); potato fields were protected against the potato beetle, *Leptinotarsa decemlineata* (Stratii 1976); wheat suffered less damage by the root maggot, *Delia coarctata* (Pakhomov and Potushanskii 1977); and root exudates of *Cannabis* repelled underground larvae of the European chafer *Melolontha melolontha* (Mateeva 1995). *Cannabis* suppresses the growth of neighboring plants, whether they are noxious chickweed, *Stellaria media* (Stupnicka-Rodzynkiewicz 1970) or valuable crops such as lupine, beets, brassicas (Good 1953) and maize (Pandey and Mishra 1982). For the control of nematode *Chamanthi* (*Chrysanthemum coronarium*) , a flowering plant is raisedon the borders of tomato fields.

2.5 Crop Rotation

Crop rotation breaks pest life cycles, often improves tilth and fertility. Sustainable systems of agricultural production are seen in areas where proper mixtures of crops and varieties are adopted in a given agro-ecosystem. Monocultures and overlapping crop seasons are more prone to sever outbreak of pests and diseases. For example, growing rice after groundnut in garden land in puddle condition eliminates white grub. Crop rotation with non-host crop e.g. Sorghum, sesamum, wheat and barley reduced the incidence of root knot nematode. Crop rotation with French beans reduces the bacterial wilt disease. *Sorghum bicolor* (Johnson grass) is grown as fodder crop in April –May. After harvesting the crop, brinjal is planted by keeping roots of Johnson grass in the field. This results in zero incidence of wiltdisease in moderately infested plots.

3. Host plant resistance

Use varieties that are resistant to common pest species. Host plant resistance forms an important component of Eco-friendly pest management. Several resistant varieties of crops have been evolved against major pests, through intensive breeding programmes. Uses of resistant varieties reduce the cotton ash weevil damage. In rice, resistant varieties viz., MDU 3 (Gall midge), PY 3, CO42 (Brown plant hopper) should be used. To resist sorghum shoot fly incidence CSH 15 R can be used. Groundnut resistant varieties like Robut 33-1, Kadiri 3, ICGS 806031 should be grown in endemic areas to reduce the risk of thrips damage and bud necrosis disease in case of cotton, whitefly tolerant varieties like JGJ 14545, LK 861, Supriya and Kanchana should be grown in endemic areas (Regupathy *et.al*., 1997). Use less susceptible varieties of brinjal like SB 17-4, PBR-129-5, Punjab Barsati, Arka Kasumkar, Pusa purple round, Punjab Meetam, Pusa Purple Long and Surti Gota against shoot and fruit borer.

4. Physical method of pest control

Physical, (devices and procedures used to change physical environment of pest populations), methods of pest control are the oldest insect control methods. These are rooted in simple practices that man, as a farmer, has leant from his long and close association with pests. These aid him in reducing pest populations to low levels. These include both direct and/or indirect measures which

may be preventive or corrective in nature but are essentially slow acting, often eco-friendly, cost effective and compatible with other methods of pest control.

5. Mechanical methods of pest management

Mechanical methods of pest control are essentially slow acting, often ecofriendly, cost effective and compatible with other methods of pest control. These characteristics make them amenable to blend better with other methods of pest control even though they do not bring about an immediate or drastic reduction in pest populations. Modern concept of pest control does not emphasize the outright eradication of pests but focuses on maintaining their populations at levels, which do not cause economic losses. Some of the mechanical methods of pest management include:

5.1. Light trap

Nocturnal insects responding positively to light, e.g. defoliating beetles, moths of Bihar, hairy caterpillar, tomato fruit borer, tobacco caterpillar, and *cerambycid* beetles *etc.* are collected, using light source or by trapping them in a light-trap and are subsequently destroyed. The light traps could be used both for monitoring and as a means of control. Mohan and Janarthanan (1985) observed that the rice stem borer and the brown plant hopper responded more towards yellow light source, while the rice leaf folder and green leaf hoppers *Nephotettix virescens* and *N.nigropictus* responded to green light source.

5.2. Coloured Sticky trap

White coloured traps are most effective in attracting the pigeon pea fly and *Melanagromyza obtusa*; Yellow colour attract cotton whitefly, Bemesia tabaci, cotton aphids, Aphis gossypi G. and green house white fly (Bhatnagar and Davies, 1979 and Gillespie and Quiring, 1987). Models combining the sticky trap with water pan have also been developed in increase the insect catch. Sticky traps are generally used with pheromones (Mohan *et.al.,* 1994).

6. Use of Hormone

The basic studies of insect physiology have evolved the successful use of insect hormones in minimizing the pest population. The prime candidate for developing hormonal pesticides is the Juvenile hormone that all insects secrete at certain stages in their lives. It is one of the three internal secretions used by insects to regulate growth and metamorphosis from larva to pupa and pupa to adult. The Juvenile hormone is secreted by *corpora allata*, which is in the form of two tiny glands in the head. Besides, Ecdysone is secreted from thoracic gland, which causes pupation and maturation in insects. These hormones have been shown to alter the course of development in insects abruptly when applied at appropriate time and in turn it may be used as pesticides. Carroll M. Williams was first to synthesize *cecropia crude* juvenile hormone.

7. Use of insect pheromones

Pheromones are chemical substances released by insects, which attract other individuals of the same species. Pheromone trap catches are highest when wind is from the East. Sex pheromones have beenused in pest management in the following ways:

a. Monitoring
b. Mating disruption
c. Mass trapping

Pheromones are naturally produced chemicals used by animals to communicate to each other. There are three basic types of pheromones. *Aggregation pheromones* attract many individuals together, for example, a site where food may be plentiful. *Sex pheromones* are used by one sex of a species to attract a male. *Trail pheromones* are deposited by walking insects, such as ants, so that others can follow. Synthetic pheromones produced in laboratories mimic these natural chemicals. They are used to attract pest insects into traps, disrupt mating, and monitor populations of insects. Because they do not leave any residual effect they are considered gender friendly pest management tools for farmwomen. In some cases women have had to walk long distances to fetch water to prepare pesticides for cotton production, and switching to pheromone trap based pest control lightened women's labour.

8. Using farmers' wisdom ITKs

The knowledge that indigenous people have regarding ecology, biodiversity and land use management is embedded in their belief system, their culture and religion. They have evolved ecologically sound technologies to deal with issues related to eco-friendly pest management. Traditional knowledge was perceived as a social responsibility albeit a paid one. Growing commercialization and industrialization over the last two decade has eroded this commitment adversely affecting the quality of care. In the context of global change, scientific validation of traditional knowledge has assumed greater significance. Around the world, there is growing interest in finding alternatives to the industrial farming methods that have emerged during the 20^{th} century. One approach is to build upon traditional methods, which evolved over the first 10,000 years of agriculture. Hence, the need for an array of technological solutions to provide sustainable intensification of agriculture globally, each customized for a specific agro-climatic zone. The much anticipated solution lies in a set of advances in the improved agricultural practices. There is a large space for short term strategies referred to as sustainable and climate friendly systems and techniques. Also there is need for knowledge and understanding of our traditional agricultural practices which were basically eco-friendly in nature. This knowledge is mainly resting with the women.

9. Use of plant products/botanicals

Recent studies have indicated the presence of photo-activated Secondary Phyto Chemicals (SPCs) they become toxic to insects in the presence of light (Arnason *et al*., 1992). These SPCs are involved in the plant defense mechanisms against insects. Such naturally occurring solar powered toxins are an attractive alternative to chemical pesticides because they are biodegradable (Saxena, 1998).

10. Biological control

Suppression of harmful pest organisms by introduction, augmentation and conservation of their natural enemies is known as biological control. Natural enemies include parasitoids, predators, and microorganisms of pests. Recent efforts to reduce broad spectrum toxins added to the environment have brought biological insecticides into vogue. Biological insecticides include products based on Bacteria, entomopathogenic fungi (*Metarrhizium anisopliae*), nematodes (*Steinernema feltiae*) and viruses (*Cydia pomonella* granulovirus).Since the biological insecticides are safer, therefore as the market for biological pesticides increases, we will see more and more farmwomen use these biopesticides, which are better for the environment and beneficial to reduce pesticidal hazards.

11. Ecological Engineering

Ecological Engineering (EE) for pest management is a new paradigm to enhance the natural enemies of pests in an agro ecosystem and is being considered an important strategy for eco friendly pest management. Ecological Engineering considers pest management approaches that are based on cultural practices and informed by ecological knowledge rather than on high technology approaches such as synthetic pesticides and genetically engineered crops. (Gurr,*et.al.*2004). The primary objective in Ecological engineering is to make environment of the Agro-ecosystem suitable for the better survival of natural enemies of pests. Habitat manipulation aims to provide natural enemies of pests with nectar, pollen, physical refuge, alternate prey, alternate hosts and living sites. This can be through plantation of appropriate companion plants like floral trap crops and repellent crops, through which the population of pollinators, predators and parasitoids can be enhanced to manage the herbivorous insect pests. Ecological Engineering (EE) strategies focus on pest management both below ground and above ground. The main emphasis is to improve the soil health below ground by developing soils rich in organic matter and microbial activity and above ground plant health by habitat manipulation to increase the biodiversity of beneficial natural enemies.

Ecological Engineering for Pest Management – Above Ground:

Focus is on making the habitat less suitable for pests and more attractive to natural enemies. These includes (1) Raising flowering plants along the border by arranging shorter plants towards main crop and taller plants towards the border to attract natural enemies as well as to avoid immigrating pest population. (2) Inter-cropping, border-cropping and mix cropping of the flowering plants provide nectar/ pollen as food for various bio-control agents. (3) Trap crops and repelling crops for pests are also grownas intercrop along with the main crop. (4) Not uprooting weed plants which are growing naturally like *Tridax procumbens*, *Ageratum* sp, *Alternanthera* sp *etc*. as they act as a nectar source for natural enemies, (5)Not applying chemical pesticides, when the P: D ratio (Pest : Defender ratio) is favorable. The

compensation ability of the plant should also be considered before applying chemical pesticides.

The plants used in Ecological Engineering can be classified into four categories *viz*;

1. **Attractant Plants** - Attract the Natural Enemies of pests are Mustard, sunflower, buckwheat, carrot, marigold, French bean, maize/corn, cowpea, spearmint.

2. **Trap plants** - Trap the crop pests .Successful examples are:
    - Basil and marigold as a border crop (main crop- Garlic) controls Thrips
    - Castor plant as a border crop in Cotton and chilli field, controls Tobacco caterpillar
    - Legume as inter / alternate crops in sugarcane enhances the population of fungal andbacterial BCA for the management of nematodes & other soil borne diseases.
    - Inter crop rows of *Tridax procumbens* in paddy crop enhances the natural parasite andpredator populations.

3. **Repellent plants** - Grown either as border crop or main crop, these repel the pests away from the crop mainly due to the release of volatile repellent plant chemicals. Successful examples are:
    - Basil repels flies, mosquito and tomato borer.
    - Garlic repels beetles, aphids, weevils, spider mites and carrot fly.
    - Radish deter cucumber beetle.
    - Mint repel cabbage moth.
    - Marigold repels beetles, cucumber beetles and nematodes.

4. **Barrier/Border plants -** Prevent the entry of pests. These protect the main crop against small soft bodied flying insects which migrate from one field to other field such as whiteflies, hoppers, aphids, mealybugs, thrips *etc.* e.g. Maize, Sorghum, Bajra, Redgram *etc*. can be grown as barrier crops.

Ecological Engineering for Pest Management – Below Ground:

This focuses on improvement of soil health • Keeping soils covered round the year with living vegetation and/or crop residue. • Adding organic matter in the form of farm yard manure (FYM), Vermicompost, crop residue which enhance below ground biodiversity. • Reducing tillage intensity sothat hibernating natural enemies can be saved. • Applying balanced dose of nutrients using biofertilizers. • Applying mycorrhiza and plant growth promoting

rhizobacteria (PGPR) • Applying Trichoderma spp. and Pseudomonas fluorescens as seed/seedling/planting material, nursery treatment and soil application. These practices strengthen the ability of crops to withstand pests and also help improve soil fertility and crop productivity.

Conclusion

There is no harm to follow the Israel model. The Israelis do not make islands in the shape of palmtrees, nor towering skyscrapers, nor expensive hotels, nor do their leaders use cars with massive silver bodies (clear allusion to Dubai and the United Arab Emirates).The pride of the State of Israel is that soon its technologies will be able to be used by all humanity. In order to attain Growth that is sustainable technologically, environmentally and economically as well as to avoid the dangers to environment, ecology and human being, the adoption of Eco and women friendly pest management practices by blending with new technologies with the incorporation of traditional and ecological farming is the best alternative and needs to be promoted at community level in India. It will not only reduce the exposure of farmwomen and their families to pesticides but also would make agriculture more qualitative and sustainable for future. There is an urgent need to disseminate such type of technologies at micro level, to bring rural women in mainstream and to promote ***Local with the Global***. We/our farm women should not shy to become Vocal for the Local technologies/tools/products/ knowledge/ideas for contributing ***Atmanirbhar Bharat*** or self-reliant India for transforming India from being just a passive market to an active manufacturing hub at the heart of global value chains through Women Agripreneurship. In order to awaken women the needed orientation of literacy and skill development is the need of hour for sustainable agriculture .Women's participation through Panchayati Raj Institutions, Voluntary groups, social activists and community leaders should be adequately encouraged.

Efficient Management of Family Resources for Sustainable Agripreneurship among Women Farmers

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Management is a purposeful activity, undertaken to achieve set targets. Everyone of our life is full of goals and when there is a goal; management is the right action to ensure its accomplishment. Management is an activity –oriented process in which results are reached systematically by combining the efforts of people. Thus management is an art of getting things done by self or by others. A manager or a person, who undertakes the management activity, integrates the activities and unifies efforts, resulting in the implementation of the planned activities for the achievement of goals. To get success in the efficient management, it is important not only to look for the techniques, but also to understand its depth and challenges.

As a human being, every one of us is a member of an organization or an enterprise, be it a home, sports club, college, religious association or a business. The various organization or groups differ in one or more respect. However, in all these organizations, among the various areas of human activities, the act of managing certainly finds an important place. Thus we can say that the membership of this organization is characterized by mutual cooperation and pursuit of some common objectives. Thus Management, which is nut shell, is a process of achievement of goals is universal to all originations. Family is the basic unit of a society. The family is a socially recognized unit of people united together by marriage, kinship or legal ties. Provide the basic needs such as food, shelter and care. It helps to satisfy economic and emotional needs; contributes in child bearing and rearing; develop physical and mental security; helps to inculcate skills necessary for personality development of an individual and helps to establish inter-personal contact, socialization and recreation. Management is required not only in business but also in various family activities. To be an effective manager, the homemaker must possess special qualities for being effective and efficient.

Women Farmers in Management

Rural women's economic and social development is necessary for overall economic development of society and nation. Rural women are now increasingly run their own business yet their entrepreneurial potential, managerial skill and socio-economic contribution remain largely neglected. Women entrepreneurship development is the instrument of women empowerment. Empowerment through entrepreneurship leads to self-fulfillment and makes women aware about their status, existence, right and their position is in the society. In modern era, women are becoming socially empowered, and economically empowered through business ownership. Women entrepreneurship is gaining importance in India in the

wake of globalization and economic liberalization. The institutional and policy framework for developing entrepreneurial skills, providing vocational education and training has widened the horizon for economic development of women. Women entrepreneurs tend to be highly motivated, self disciplined & self directed. On the other hand, empowerment of rural women is also very significant. Economic empowerment of rural women will lead to the development of our country and it is very necessary to give keen attention over the empowerment of women in the rural areas for the real development of our country in all spheres. Women's entrepreneurship is important for women's position in society, and economic development of women will lead to development of family, community and country. It opens up new avenues for creating employment opportunities for women and men. Efficient management of family resources is very much required among women farmers for sustainable agirpereneurship. For reaching to achieve the goal the women farmers must aware about some important aspects related to available resources. This will be discussed.

Purpose of Family Resource Management

- To use available resources efficiently in order to achieve goals
- To improve the quality of family life
- To enable family members to achieve their full potential

Meaning of Resources

Resources are the Means for Satisfying our Needs and Reaching our Goals

CLASSIFICATION OF FAMILY RESOURCES

Family Resources are classified into three groups, human resources, non-human resources and shared resources.

Human Resources are Time, Energy**,** Ability, Skill**,** Knowledge, Interest**,** Attitude**,** and Health

Non-human are, Material, Money, Wealth, Fringe benefit, Elastic income (Credit), Space, Fuels (Conventional, Non-Conventional)

Shared (Community) are, Manmade (Educational service, Consultancy services, Community facilities), Natural (Land, Water, Air, Forests etc.)

Characteristics of Resources

- Resources are useful
- Resources are limited in supply
- Resources are inter-related
- Resources have alternate uses
- Resources can be substituted
- Resources can be developed or generated
- Resources can be conserved or saved for future use

Efficient management of resources for Maximizing Satisfaction

- ❖ Identify all the available resources.
- ❖ Make use of only the right amount of resources.
- ❖ Substitute the less expensive resources for the more expensive ones.
- ❖ Develop the habits that can enhance the use of resources.
- ❖ Cultivate practices to increase the availability of resources.
- ❖ Learn to share resources so that you do not deprive others of their use.

  Adopt the 3-R - Reduce, Reuse, and Re-cycle the resources to maximize satisfaction from their use.

Factors Affecting the use of Resources

- Size of Income
- Socio- Economic status
- Occupation
- Gainful Employment of Homemaker
- Size and Composition of the Family
- Motivation / Attitude
- Education
- Family Heritage and Cultural Background
- Location of the Family
- Health

By knowing the above facts related to resources, now it is important to know the management process for sustainable agirpereneurship among women farmers.

What is Management?

Process of using what you have (in the best way) to achieve what you want.

Management helps you to:

- ➢ Reach your goals
- ➢ Achieve what you want
- ➢ Utilize your resources properly
- ➢ Make your life more systematic
- ➢ Avoid wastage of resources
- ➢ Increase efficiency in work situations
- ➢ Achieve a better standard of life

Steps in Management Process

Planning - Organizing – Controlling- Evaluating

Planning

- Listing activities
- Sequencing activities, and
- Providing flexibility for any adjustments

During planning think about the following;

- What is to be done?
- Who will do the work?
- How will it be done?
- When will it be done?
- What resources will to carry out a plan?
- But, while assigning tasks to other people, we must make sure that they have the time and ability to do that work and are willing to do the same.

Organizing

- Organizing means assembling resources and fixing responsibilities But, while assigning tasks to other people, we must make sure that they have the time and ability to do that work and are willing to do the same.
- Organizing ensures that: all the planned work gets done, there is proper distribution of work, work gets finished on time, time, energy, and other important resources are saved, and your planning is successful.

Controlling

Controlling is also known as putting a plan into action. Controlling means carrying out the activities as planned and organized earlier.

- As the plan is being carried out, you also have to check the progress of your plan. When you do this, you may sometimes find a changed situation which calls for a fresh decision.
- You make adjustments as the plan is being carried out or implemented. You change or control your activities so that your plan is not a failure. This is also called **flexibility.**

Evaluating

- Evaluating means checking the progress of your plan and taking corrective measures if needed.
- Thus evaluation helps you to understand your weaknesses and mistakes so that it is checked and will not be repeated in future. This is also called looking back or "feedback''
- Evaluation is done at each stage of management i.e. planning, organizing, and controlling. You have to evaluate at every stage so that you do not regret in the end
- Evaluation at each stage help you to bring a change in you're planning and/or organizing and controlling so as to improve end results and complete the process smoothly and successfully or learn to do a better job in future.

Attributes Affecting Management

- **Composition of family :** Number of people in the family, presence of persons with special needs, one parent or two parent family
- **Stages in life cycle:** Priorities are different for a family with or without children. As children get older, they become part of the decision making process
- **Employment patterns :** Number of family members working, whether employment is inside or outside the home, type of employment, hours of employment
- **Socio-Economic status:** People from different socio economic backgrounds have different needs. Lower socio economic backgrounds place emphasis on needs while people from higher socio economic backgrounds place emphasis on luxuries **Culture :** The culture of a country can affect management of family e.g. dress code, food eaten, religious practices
- **Management of Dual Roles:** This refers to where both parties work outside the home and extra planning is required. Single parent families, extra demand being earner and parent
- **Gender Roles:** Roles or behaviour expected by men and women. More equal partnership and shared roles nowadays
- **Values and Standards:** Affect management as they determine decision taken. When circumstances change in a family so too can values e.g. illness of a family member

Conclusion

The advent of the industrial revolution and consequent technological developments coupled with advanced education and changing socio-economic needs brought about enormous changes in women's lives and their roles. While job opportunities in both public and private sectors have increased, more and more women are using their managerial skills at work, which were earlier confined to the management of their home alone.

For sustainable agripereneurship, the individual must set a goal; the goal should be SMART, i.e., specific, measurable, available, relevant and time-bound. The science and art of management is being extensively used by women in every field of life, including that of a home. Traditionally the managerial skills of women were restricted to home and its activities. Though it is treated as an informal sector, managing the home had always been a big challenge for every woman, as she had to toil the whole day to be successful in her role. The present day home based managerial activities pose bigger challenges, as her role is now extended beyond the four walls of the home. However, management of home for centuries have given women managerial skills, which enabled them to become successful managers of bigger and more formal organizations as well, although, home management is still their prime responsibility of management at home as home as well as in the organization in which they work.

Incubation Process for Agripreneurs

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Indian Agriculture is the main source of livelihood for about 58 percent of the population. In spite of the high importance of agriculture in Indian economy, the returns from agriculture does not commensurate with the efforts the tillers invests on it owing to several issues confronting it. The major challenges in Indian agriculture are Small and fragmented land-holdings, Seeds, Manures, Fertilizers and Biocides, Irrigation, Lack of mechanisation, Soil erosion, Agricultural Marketing, Inadequate storage facilities, Inadequate transport, Scarcity of capital and huge post harvest losses. The problems are addressed from both technological and political fronts. However, innovations help in converting the problems into opportunities. Many startups have entered in the space of agriculture owing to prevalent obsolete technology and lack of market connect in Indian agriculture.

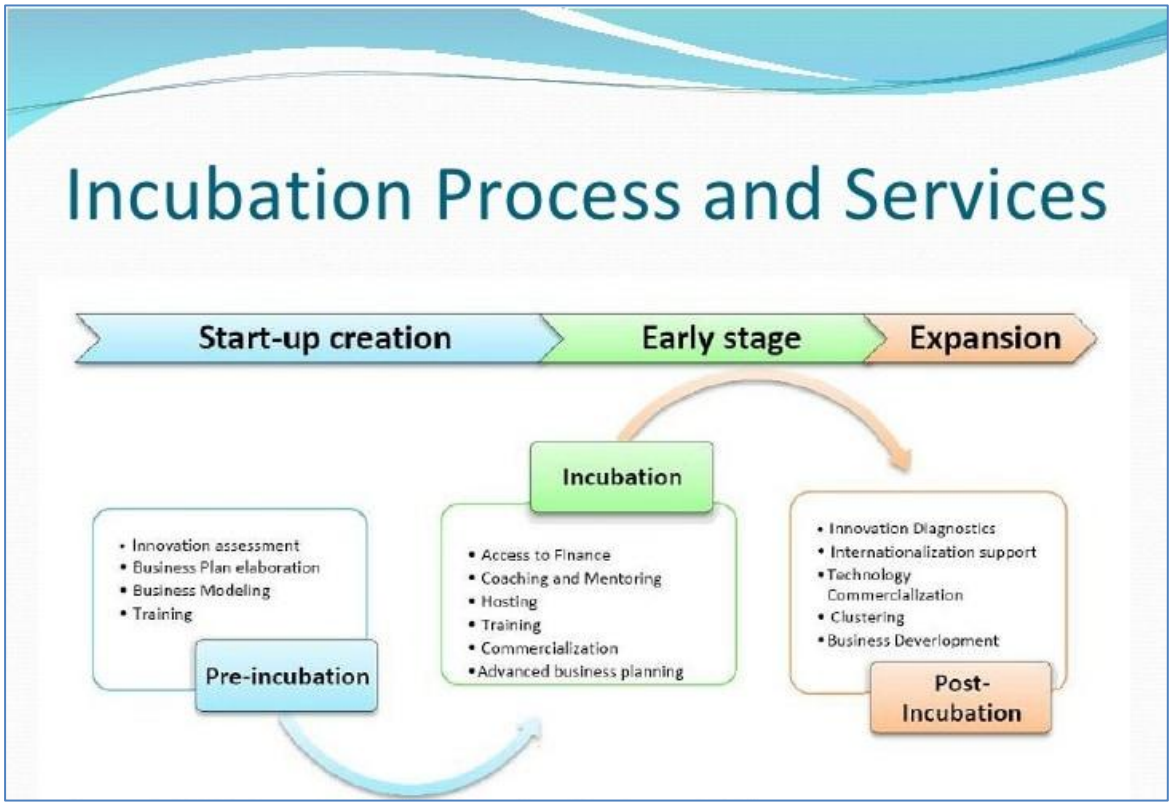
Entrepreneurship acts as a fuel for rapid and sustained economic development. The last century has seen a flurry of innovations in various spheres of the economy. Individuals who are associated with innovation has shot to fame building a large business entity from nowhere in a short span of time. In spite of these achievements, innovators often struggle on critical stages and thus, 90 per cent of Startups fail in the initial stages itself. Handholding Startups in the initial stages by providing support in terms of technology and finance will help many to succeed in their efforts. Incubators have taken up the role of supporting by offering professional services like mentoring, capacity building and establishing networks with players in the supply chain and investors.

Incubation process & stages

Business incubation is a unique and highly flexible combination of business development processes, infrastructure and people designed to nurture new and small businesses by helping them to survive and grow through the difficult and vulnerable early stages of development.

Business incubators have allowed the development, maturation, linking of entrepreneurs that, otherwise, would be impossible and in the worst case would lead to failure; According to figures from Small Business Trends , 90% of new startups fail or die, and those with the highest mortality rate are information technology, construction and manufacturing industries.

Stages in incubation process



1. GENERATION OF IDEA

This stage is also called ideation or stage of startup creation. All entrepreneurs need to have ideas to initiate their entrepreneurial ventures. The process of generating ideas is itself an innovative process. The question is from where an Entrepreneur can get the idea. Different researchers have tried to find out the source of an entrepreneur's ideas.

How to generate ideas

A. Environmental scanning: Entrepreneurs should make use of available information to catch the current developing trend in business and for that he should keep reading local, national, international; news papers, magazines, journals, commercial articles, and should keep watching commercial news on TV. Moreover, it may look like a difficult task but the potential entrepreneurs should do it passionately to get in touch with current scenario.

B. Use of Creativity to problem solving: Entrepreneurs should use their creativity to have solution of unusual problem. Creative thinking means to link new concepts in extraordinary manner.

For example,

i) **The checklist method,** in which an entrepreneur makes use of different questions or statements and thereby develops new ideas.

ii) **Free association,** in which an entrepreneur develops a new idea through a series of word associations;

iii) **Attribute listing,** in which an entrepreneur develops a new idea by looking at the constructive and unconstructive attributes of a product or service.

C. Brainstorming: One of the most popular approaches to generating ideas is brainstorming. It is an idea-generating process for getting dynamic solutions that gives a large number of alternatives. Brainstorming is a simple technique that can be done with friends or colleagues. In a brainstorming session, a group of people get together, mostly in a relaxed atmosphere, where everyone feels free to broaden their minds and imagine beyond the ordinary. A group leader presents the issue or problem to be solved and ensures that all participants identify with it. Then members put up as many ideas as they can in a specified time by explaining them orally. Participants are motivated to come up with as many ideas possible and to build on one another's ideas. In brainstorming sessions, discussion is nonstop as participants propose a good number of ideas. No participant is allowed to criticize the ideas of other participants during the brainstorming session. Moreover, all ideas delivered by the participants get recorded and are further put for discussion. The purpose of brainstorming is to open up as many alternatives as possible. It can lead to strong arguments and counterarguments but it is certainly a fruitful way to generate abundant ideas.

D. Focus groups: These groups of people's present information about projected products or services in a prearranged setting. In a focus group, a moderator focuses the group discussion on number of issues. For example, a focus group might look at a proposed product and answer specific questions asked by the moderator. Secondly, the focus group might be given a moral general issue to discuss and the moderator simply leads the discussion based on interpretations made by the group. Thus, a focus group can provide an outstanding technique to generate innovative ideas.

E. The Role of Intuition: Intuition is a cognitive process through which we knowingly or unknowingly make decisions on the basis of our knowledge and experience. It is perhaps a sudden outcome of the mind. Even though structured or systematic approaches to generating ideas are important, intuition also plays an important role. Intuition is certainly a powerful source of new ideas if you learn how to use it effectively. However, the best approach of all could be to combine the structured with the intuitive as both of them complement each other. We should listen to that intuition and use more structured approaches to modify our ideas.

2. IDEA INCUBATION

Idea incubation means to exercise the ideas in reality. Idea incubation stage is also called early stage startup stage. It begins with basic elements by the one who considers the particular idea as the best to be used. He/she involves others in the process and proves the idea to be perfect. Finally, the idea results into a new product believing that it is capable enough to avail fund successfully and is also commercially useful. Numerous companies promote idea incubation by grouping workforce collectively in cooperative environments. Cooperative groups work best for idea incubation so as to identify strengths and weaknesses of the idea, and thereby product which is more refined and strong can be gained. Several companies offer their services as professional idea incubators. These companies use a trained staff that can think innovatively. There are lots of Idea incubation firms which provide support to product development throughout the process from the initial vague concept to viable manufacture. Successful idea incubation can result into all types of products. Finally, what requires is strong leadership and administrative skills along with entrepreneurial guts. Once an idea is incubated, it needs to be further developed and commercially presented. This depends a lot on the team leader who can motivate the employees to use the idea in productive way.

Business incubators are programmes intended to speed up the successful improvement of entrepreneurial companies. Incubators differ in the way of their services, in their organizational constitution, and more or less in the types of consumers they serve. Successful completion of a business incubation programme increases the probability that a new company will continue in business for the long period.

Entrepreneurs who wish to enter a business incubation program must apply for admission. Acceptance criteria vary from program to program, but in general only those with feasible business ideas and a workable business plan are admitted. It is this factor that makes it difficult to compare the success rates of incubated companies against general business survival statistics. Although most incubators offer their clients office space and shared administrative services, the heart of a true business incubation program is the services it provides to start-up companies. The amount of time a company spends in an incubation program can vary widely depending on a number of factors, including the type of business and the entrepreneur's level of business expertise. Life science and other firms with long research and development cycles require more time in an incubation program than manufacturing or service companies that can immediately produce and bring a product or service to market.

The objective of incubation process is to provide focused support to entrepreneurs through a supportive environment that helps them to

- Establish their business ideas and develop their concepts into market ready products,
- Supports the acquisition of business knowledge,
- Facilitates the raising of necessary fiancé,
- Introduces the entrepreneurs to business networks

The major outcome anticipated is to reduce their probability of failure.

3. COMMERCIALIZATION

This stage is also called as scale-up or expansion stage. Commercialization is the process of introducing a new product into the market. It’s the most important aspect of business as the success of any product depends a lot on the way it’s being commercialized.

Commercialization of a product is possible with only the following three facts:

i. **The launching period:**

The time to launch any product in the market should be decided after observing the market condition and consumers’ interests.

ii **Place to launch its product:.**

A product can be launched at a single place or at many places at a time. This depends a lot on the company’s resources, in terms of capital, administrative intelligence and operational capacities. Smaller companies usually launch in attractive cities or regions, while larger companies launch their products at national r international level at a time. Multinational

companies do launch their products at international level as they have that capacity as far as finance and skilled staff is concerned.

iii. **To decide primary target consumer group:**

This primary consumer group should consist of innovators, early adopters, heavy users and/or opinion leaders. This will guarantee the success so as to be used in nearer future by other buyers in the market place.

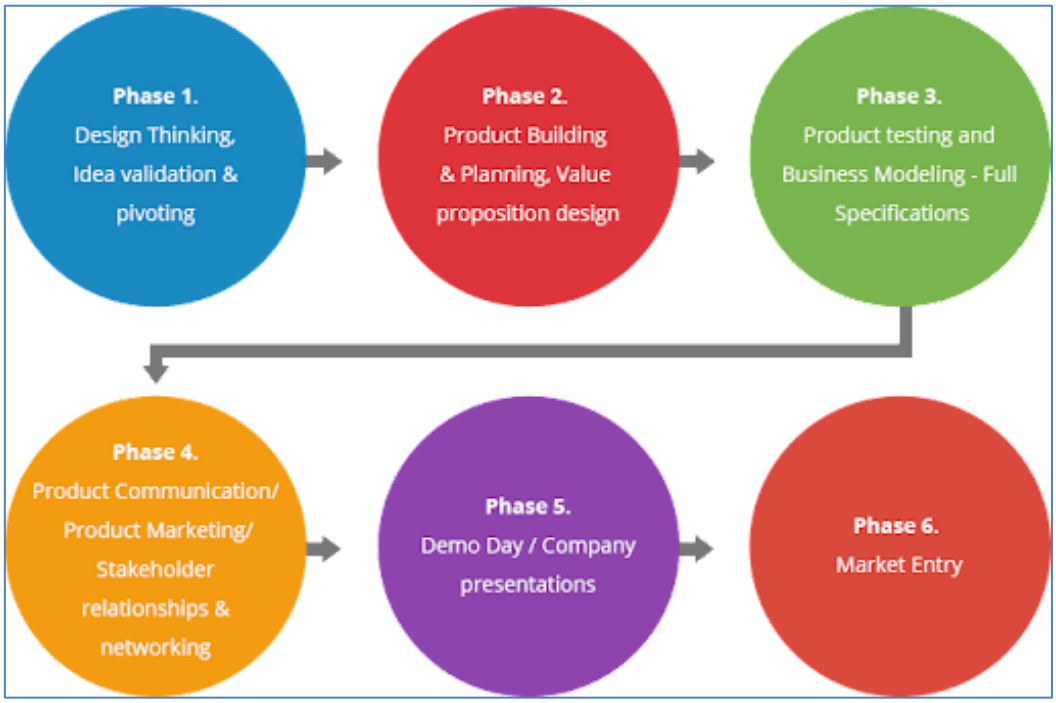
Thus, commercialization of new product is perhaps the most important aspect that needs to be taken care for the success of new product.

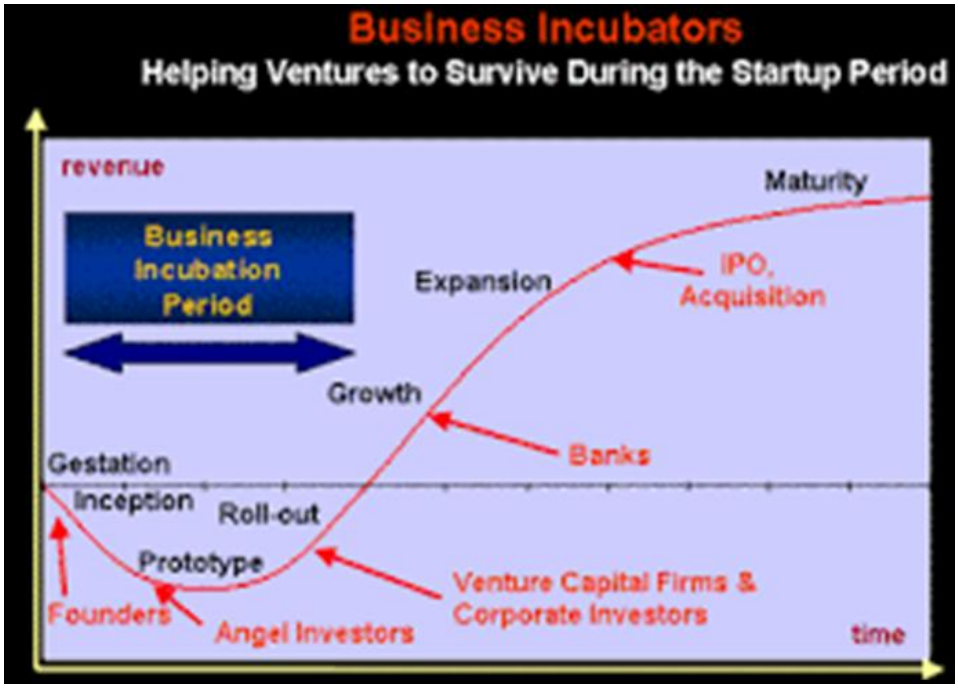
Value chain of incubation process

Various stakeholders are involved in the value chain of incubation process which includes Government, investors, mentors, advisors, service provider which helps in sustainability of incubators and thus the incubatees as well.

Incubation Activities

Each incubator follow similar type of activities albeit, differentiate based on their core competency. In the first phase, design thinking helps in selecting most important idea which has commercial value/ big market. Once a single idea is selected, product building activities are initiated. In the third stage, product testing and business modelling activities are initiated. The fourth and fifth stages include testing the idea and connecting them to investors. The last stage is Market entry when the company started to sell their produces/products. Each startup stage required different way of mentoring, networking and type of investment, etc. to entail the company successful.





Association of Innovation Development entrepreneurship in agriculture (a-IDEA)

The current challenges faced by Indian agriculture include not only enhancing productivity and production of agriculture produce but also building opportunities for agricultural goods in the production-consumption continuum. These challenges call for the skill of management of research output towards technologies and up-scaling these to processes and produce products of commercial value. Therefore, the creation of a one-stop Centre for Agri-Innovation was set up wherein tech management, entrepreneurship, and Ideation, Incubation, Acceleration and Investment with strong foresight study are promoted. The initial handholding attempts made by this centre included the ICAR-funded Agri-Business Unit which led towards creating an institutional culture for creating value chains through technology transfer from ICAR institute onwards entrepreneurship channels. The Centre provides handholding support to the Agri-Business incubators by inter-alia developing modules, guidelines and other forms as of learning material for capacity building for the startups; and also provides need-based support for analysis/valuation of the commercial potential of technologies; negotiation skills; monitoring of IP- rights and license agreements, marketing instruments. The main objectives of the Centre are: to organize training & capacity building programs on technology transfer, IP management, business incubation, entrepreneurship development, and investment; to develop foresight and policy framework for governance and coordination of technology development and commercialization in the NARES and incubation development for agribusiness entrepreneurs, and to provide a platform for up-streaming and down-streaming of technologies through advisory services for IP and technology management leading to entrepreneurship development.

The major programmes of a-IDEA are

Agri Udaan

Agri Udaan, Food, and Agribusiness Accelerator is the flagship accelerator program of a-IDEA, NAARM. It brings on board a range of diverse partners to create an inclusive and collaborative ecosystem focusing on catalyzing scale-up stage Food and Agribusiness startups through rigorous mentoring, industry networking and investor pitching. It is a unique platform for scale-up stage innovators, entrepreneurs and startups in Food and Agribusiness sectors to showcase their products/services and to receive valuable inputs from Mentors, Incubators, R&D Institutions, Agribusiness Industry, and Investors.

Krishi Boot

It is an incubation programme. Presently, the call for application is in pipeline.

Seed Support

a-IDEA has Nidhi SSS and Bioseed programmes where investment is made on various companies both in equity as well as debt.

Capacity Building

Various capacity building programmes conducted for students, startups and for faculty/researchers.

Aggnite

It is a business plan competition to sensitize students about entrepreneurship.

Krishikalp

It is a sensitization programme for faculty and students of agricultural colleges to become aware of entrepreneurship.

Ideation at a-IDEA

Ideation event is a more organized and structured event to identify creative ideas on agriculture from the students. We have launched ideation event in agriculture with the name of the event as "Krishi Kalp". This Krishikalp acts as a platform to attract the innovative technology and business based ideas from the students representing agriculture colleges and management institutions. Krishikalp has paved the way for creative ideas in agriculture and the students who have been judged as innovative ideas were provided with a token cash prize. Further, we are encouraging these students to see if in the later part of their career they would like to take up their innovative idea to an enterprise. The prime objective of this program is to inspire students to take up entrepreneurship as a career avenue with support from our institution.

Incubation at a-IDEA

The incubation program at a-IDEA is an ongoing program to support early-stage agriculture startups. The startups who are keen to get incubation support from a-IDEA need to fill up the incubation template available on our website and submit it to us for further evaluation of the incubation proposal with our experts. Post review of the incubation proposal, the prospective incubatees arrive at an MOU with the incubator and they are provided with the incubation support facilities and services based on the requirement of the startup. The incubation program nurtures and provides a supportive environment for entrepreneurs during the initial and critical stages of starting up a new business. Incubation program helps entrepreneurs grow their businesses, streamline their operations and become independent.

The objective of incubation is to support Startup Entrepreneurs on various aspects including infrastructure, office & on-farm testing facilities, linkages for technologies & upscaling, mentoring & guidance and access to networking and pitching events. The incubation period is usually for one and a half years and subjects to extension in special cases, post which the startups are graduated and they set up their business out of the incubator premises suiting its market requirements. The objective of the incubator is to support the consecutive batch of the

startups in the facilities to keep and ongoing support to the agricultural startups after every batch of the startups supported.

Acceleration at a-IDEA

The Accelerator program is a PAN India competition which is held yearly once, and the startups applications once received are reviewed and evaluated by the experts in the screening committee and then shortlist a cohort of the startups which are trained virtually for a period of 4 months, during this intense training period the startups are provided access to training, handholding support through access to mentors, technology support, technology validation, business model development, product launch, networking, capacity building, pitching, access to industry expert linkages & funding through a Demo day.

The acceleration program at a-IDEA helps start-ups in scaling up. The acceleration program boosts the entrepreneurs to accelerate the process of defining a proven business model based on a set of methodologies and best practices for growing into Agri-based players.

Business Plan Development for Agripreneurs

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Any business venture should have a goal and a strategic work plan to achieve this goal. Comprehensive work plan which serves as a roadmap for business is termed as business plan. It is a written document describing the nature and targets of the business and emphasizes on the financial projections and the background information of an organization. It embodies the strategies required to achieve the framed targets. Well framed business plan will help you steer your business as you start and grow. It has the strategies for fund raising and controlling the expenses. It helps in identifying the risks and plan to mitigate them. It serves in evaluation of product, market, sales promotion and expansion. The content and format of the business plan are determined by the goals and audience. Wide knowledge is required from various disciplines to make the business plan more effective. Success of business plan depends on proper planning (Pinson, 2008). A successful business plan will help in accelerating the business. Critical points to be considered in designing an effective business plan are dealt in this section.

A business plan is a written statement of your business and it guides you to understand the following aspects.

1. How will you do the business?
2. The product or service you are going to deliver to the customer.
3. The growth potential and the financials of the business.

A business plan is necessary to effectively communicate how business will embrace and capitalize on the current and future opportunities.

Why do we need a Business plan?

1. It will help you steer your business as you start and grow.
2. Fund raising & control costs: Investors will often require a written plan.
3. Uncover omissions: Identify risks & plan to mitigate them.
4. Evaluate product, market, sales, promotion and expansion.
5. Orienting teams.
6. Securing alliance relationships.
7. Raising capital.
8. Enhancing business' valuation.
9. Expediting business success.

It is important to find your competitive position in the market with a **SWOT** Analysis (Humphrey, 2005) before working on a Business Plan

Strengths

- What advantages does your company have?
- What best you can offer compared to others?
- How your selling points are distinctive than others?

Weaknesses

- What are the sectors you can improve on?
- What are the lacunae of your company?
- What advantage your competitors have over you?

Opportunities

- How the advances in upcoming technologies, government policies and societal norms influence the growth opportunities of your company?

Threats

- What are the hindrances on the growth of your company?
- Identify your competitors?
- What changing factors can threaten your company's position?

Essential components of a Business Plan

I. Executive Summary

The Executive Summary should briefly explain each of the following:

1. An overview of your business idea (one or two sentences).
2. Short information about your product and/or service.
3. Future plan about your company in the next consecutive years.
4. Your potential customers?
5. Your uniqueness in comparison with your competitors.
6. About your efficient management team.
7. Financial overview of your business.

An executive summary it is needed to grab the attention of your possible investor and banker. Goal of this section:

- A basic understanding of your business,
- Should be excited about its potential,
- Should be interested enough to read further.

II. Company Description

This section explains the basic elements of your business including:

1. Company mission statement
2. Company vision
3. Company goals
4. Target market
5. Industry
6. Legal structure

Company's Mission, Vision,

- Clearly defines your company's mission, vision and values.
- It is a powerful way to align your team and reach your goals.

- **Vision** is about the insight into company's future.
- **Mission** is the approach of a company to reach the set objectives.
- **Values** are the guiding principles or standards of behavior to accomplish mission and vision.

Visibility of a company in the market depends on appropriate business plan (Aderemi et al, 2008).

III. Products & Services

Here are some items to consider:

- Your company's products and/or services.
- The problem the product or service solves.
- Any proprietary features that give you a competitive advantage.
- How you will price your product or service
- What your business does?
- What problem of the customers does it address?
- Distinctive features of the product which makes it competitive in the market.

IV. Marketing Plan

Market research

- The total size of your industry
- Trends in the industry – is it growing or shrinking?
- Proportionate share you plan to obtain from the target market
- Understanding dynamic changes in customers' needs and preferences

Barriers to entry

- Elevated startup costs
- Elevated production costs
- Elevated marketing costs
- Challenge of brand recognition
- Finding qualified employees
- Need for specialized technology or patents
- Tariffs and quotas
- Unionization in your industry

Threats and opportunities

- Changes in government regulations
- Changes in technology
- Changes in the economy
- Changes in your industry

Product/service features and benefits

- Describe the salient features and uniqueness of the product
- Describe the most prominent benefits the product offers for the customer

After-sale services:

- Product delivery
- Warranty/guarantee
- Service contracts
- Ongoing support
- Training
- Refund policy

Key competitors

- Mention the important companies that compete with you with regards to products and services and whether the competition exists only in particular location or uniform across the locations. It is important to list out the competitions as per their product and service.

Positioning/Niche

Have a clear understanding of your business's niche (your unique segment of the market) as well as your positioning (how you want to present your company to customers)

How you will market your product/service

Advertising may include:

- Online
- Print, Radio,
- Cable television, Out-of-home

Marketing may include:

- Business website
- Social media marketing
- Mobile marketing
- Search engine optimization
- Content marketing
- Print marketing materials
- Public relations, Trade shows
- Networking, Word-of-mouth
- Referrals

Promotional budget

- Before startup (These numbers will go into your startup budget)
- On an ongoing basis (These numbers will go into your operating plan budget)

Pricing

- Does your pricing strategy reflect your positioning?
- Prices should be comparative among the competitors
- Pricing should be reasonable and it should not be a deciding factor for the customers to purchase your product.

Location

- It should be convenient location for customers
- Parking facility should be available for employees and customers
- It should be well connected with transport and roads
- Types of businesses nearby

Distribution channels

- Retail
- Direct sales
- E-commerce
- Wholesale
- Inside sales force
- Outside sales representatives

V. Operational Plan

1. Production: Describe your production methods, the equipment you will use and how much it will cost to produce what you sell.

2. Quality control: Describe the quality control procedures you will use and how will you maintain stability?

3. Location:
    a. The size of your location.
    b. The type of building (retail, industrial, commercial, etc.)
    c. Accessibility to customers with proper transportation.
    d. Costs including rent, maintenance, utilities, insurance and any buildout or remodeling costs.

4. Legal environment
    a. Any licenses and/or permits that are needed and whether you have obtained them.
    b. Trademarks, copyrights or patents granted to you or in the process of application.
    b. The insurance coverage of your company.
    c. Any environmental, health or workplace regulations affecting your business.
    d. Any special regulations affecting your industry.
    e. Bonding requirements, if applicable.

5. Personnel
    a. Number of employees required.
    b. Will you hire them as freelancers or on contract basis?
    c. Include job descriptions.
    d. What is the structure of payment (freelancing, salaried, contractual, etc.)?
    e. How will find qualified work force?
    f. What type of training is needed and how will you train employees?

6. Inventory
    a. What kind of inventory will you keep on hand (raw materials, supplies, finished products)?
    b. Amount you invest on an inventory.
    c. Rate of inventory turnover?
    d. Does your inventory requirement vary with season?

7. Suppliers
    a. Names, addresses, websites.
    b. Type and amount of inventory furnished.
    c. Their credit and delivery policies.
    d. History and consistency of supplier.
    e. How do you manage shortage in supply?
    f. Availability of suppliers for critical products.
    g. Your strategy to deal with fluctuating cost prices in the market.
    h. Payment terms and conditions for your suppliers.

8. Credit policies
    a. Whether this is typical in your industry (do customers expect it)?
    b. Extent of credit you can extend and the terms and conditions for credit policies.
    c. How will you check new customers' credit worthiness?
    d. Detail how much it will cost you to offer credit, and show that you have built these costs into your pricing structure.

VI. Organization& Management

This section deals with experiences of the work force you will employ to organize and manage your company. Active participation of management in preparation of business plan will fetch you good results (Duft, 2010). It includes,

1. Biographies:
    a. Summarize your experience & of key employees.
    b. Focus on the prior experience and skills.
    c. In case someone has previous experience starting and growing a business, explain this in detail.

2. Gaps:
   Plan to fill in any gaps in management and/or experience.

3. Advisors:
   List the members of your professional/advisory support team, including:
    a. Attorney
    b. Accountant
    c. Board of directors
    d. Advisory board
    e. Insurance agent
    f. Consultants
    g. Banker
    h. Mentors and other advisors

4. Organization Chart
   An organizational chart shows the internal structure of an organization or company.

VII. Establishment Expenses & Capitalization

This section deals with the ready capital available with you to start the business.

1. Start-Up Expenses.
2. Opening Day Balance Sheet.
3. Personal Financial Statement.
   Objective of the session is to understand the availability of capital and readiness to do business.

VIII. Financial Plan

Financial plan helps in organizing financial needs and goals. Finance can be obtained from lenders and investors with proper strategic financial plan.
Include the following:

1. 12-month profit & loss projection
2. 3-year profit & loss projection
3. Cash flow projection
4. 3-year cash flow statement
5. Projected balance sheet
6. Break-even calculation
7. Use of capital

Conclusion

Business plans are decision-making tools. Banks and various financial institutions sanction loan based on the merit of the business plan. A comprehensive business plan will make the business credible, clear, and attractive to someone who is not familiar with the business. Hence one should focus on preparation of a lucid business plan by considering all the above aspects to start a hassle free business. Some terms associated with business plan are given in Annexure-I and the model format of business plan given in Annexure-II will become handy to the candidates in formulation of business plan for any agribusiness.

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Annexure- I

Some Terms associated with Business Plan

IRR- Internal Rate of Return is a method of calculating an investment's rate of return.

$$IRR = \frac{\text{Cash flow-initial investment}}{(1+r)^i}$$

Here cash flow=cash flow in the time period
r=discount rate
i=time period

NPV-It is the difference between the values of cash inflow and cash outflow over a period of time.

$$NPV = \frac{R_t}{(1+i)^t}$$

here NPV= Net present value
R_t=net cash flow at time t
i=discount rate
t=time of the cash flow

Fixed cost- It is the cost which does not change. ex-interest, rent etc.

Variable cost- It is the expense that vary in proportion to the volume of goods or service that a business produce. Ex. labour cost, material cost etc.

POP expenses- Preliminary expenses are the expenses relating to the formation of an enterprise and preoperative expenses are the expenses incurred before the commencement of actual production.

Miscellaneous fixed assets- Misc. fixed assets are the small fixtures and equipment required for an enterprise.

Working capital -Working capital is an amount borrowed from a bank or other lender and used by a new business to keep operations going and pay business bills during the initial phase, when income is usually less than expenses.

Total cost of the project -The sum total of all funds required to complete the establishment of an enterprise is called total project cost. It includes expenses required for land and building, machineries/ equipment, misc. fixed assets, POP expenses, working capital and contingencies.

Means of Finance: How much and from where you got finance in which rate of interest. It includes own investment + term loan from financial institution.

Sales Revenue: The sales revenue or turnover is income that an enterprise receives from its normal business activities, usually from the sale of goods and services to customers.
Profitability Projections - A profit and loss or P&L forecast is a projection of how much money you will bring in by selling products or services and how much profit you will make from the enterprise.

Break-even Point - The breakeven point is the point where the project fixed cost is recovered and the unit starts making profit from sales realization. BEP analysis is a standard part of every business plan before the business is launched.
BEP: There is no loss or gain. It is the point at which total cost and total revenue or equal

Revenue –Expenses= profit
If it is positive number, then it is profit
If it is negative number, then it is loss.

$$\boldsymbol{Break\ Even\ Point(Units) = \frac{Fixed\ costs}{(Revenue\ per\ unit - Variable\ cost\ per\ unit)}}$$

$$\boldsymbol{Break\ Even\ Point(Revenue) = \frac{Fixed\ costs}{\left[\frac{Revenue\ per\ unit - Variable\ cost\ per\ unit}{Revenue\ per\ unit}\right]}}$$

It is the point at which total cost and total revenue are equal.

BEP Analysis is used to examine the relation between the fixed cost, variable cost and revenue.

Annexure-II

Business Plan Format

Executive Summary

1. General

Name of the Firm:
Project:
Location:
Type of the organization: Proprietary /Partnership/Other (Pl specify):
Address:

Name of the chief of promoter (s):
Birth date:

1.1 Educational Qualification

SSC or below	Degree/Diploma	Institute	Major Subject	Year of passing

1.2 Special Training

Training	Institute	Duration	Achievement/ Remarks

1.3 Work Experience (Past and Present)

Organization	Position	Nature of work	Duration

1.4 (I) Promoter's annual income Rs. (Last year)
(ii) Assets owned by the promoter(s) Movable Rs.

Immovable Rs.

2.0 Details of the proposed project: Manufacturing /servicing

2.1 Infrastructure

Sr. No	Particulars	Area required	Total value	Remarks
	Land			
	Building			

2.2 Equipment

Sr. No.	Description	Nos Required	Rate (Rs.)	Total value (Rs.)

2.3 Misc. fixed Assets

Sr. No.	Description	Nos Required	Rate (Rs.)	Total value (Rs.)

2.4 Preparatory and pre-operative expenses

Sr. No.	Particulars	Amount (Rs.)	Remarks
1	Interest during implementation		
2	Establishment expenses		
3	Startup expenses		
4	Misc. expenses		
	TOTAL		

2.5 Working capital

Sr. No.	Item	Duration	Total value (Rs)		
			I-year	II year	III year
1	Raw material stock				
2	Semi-finished goods stock				
3	Finished goods stock				
4	Sales on credit				
5	Production expenses				
		Total			
		Working capital loan			
		Margin			

2.6 Total cost of the Project

Sr. No.	Particulars	Value (Rs)
1	Land and building	
2	Machineries/equipment	

3	Misc. Fixed assets	
4	Contingencies	
5	POP Expenses	
6	Margin for working capital	
		TOTAL

2.7 Means of Finance

Sr. No.	Particulars	Amount (Rs)	Remarks
1	Own investment		
2	Term loan		
3	Any other source		
	TOTAL		

3.0 Market Potential

3.1 Current supply and demand of the product

3.2 Competition

3.3 Target clients/selected market area

3.4 Marketing strategy (USP)

4.0 Manufacturing process

a) Availability of technical experts. Step by step description of the manufacturing process

b) Attach process flow chart (if required)

5.1 Production program

i) No. of working days per year -

ii) No. of working shifts (8 hrs) per day -

iii) Installed capacity (annual) -

iv) Utilized capacity (%) -

I Year-

II Year-

III Year-

Sr. No.	Item (s)	Quantity produced per year	Capacity utilization (%)

5.2 Sales Revenue

Year	Item (s)	Quantity sold per year	Rate per unit (Rs)	Sales realization (Rs)
			TOTAL	

5.3 Raw Materials (Annual requirement)

Sr.No.	Item (s)	Quantity	Rate (Rs)	Total value (Rs)
			TOTAL	

5.4 Utilities

Sr. No.	Particulars	Annual Expenditure (Rs)	Remarks
1	Power/Electricity		
2	Water		
3	Coal/Oil/Steam		
4	Any other item		
	TOTAL		

5.5 Man Power (Salaries/wages)

Sr. No.	Particulars	No.	wages per month (Rs.)	Annual Expenses (Rs)
1	Skilled			
2	Semi-skilled			
3	Unskilled			
4	Office staff			
5	Any other			
			TOTAL	

5.6 Repairs and Maintenance

Sr. No.	Particulars	Amount(Rs)
	TOTAL	

5.7 Selling and Distribution Expenses

Sr. No.	Particulars	Amount (Rs)	Remarks
1	Publicity Expenses		
2	Travelling		
3	Freight		
4	Commission		
5	Misc.		
	TOTAL		

5.8 Administrative Expenses

Sr. No.	Particulars	Amount (Rs)	Remarks
1	Stationery and Printing		
2	Post/Telephone/Telegrams		
3	Entertainment expenses		
4	Misc.		
	TOTAL		

5.9 Interest

Year	Outstanding loan Amount (Rs)	Interest (Rs)	Installment (Rs)	Balance (Rs)

5.10 Depreciation

Sr. No.	Type of asset	Cost of asset	Expected life	Depreciation

6.0 Profitability Projections

Sr.No.	Particulars	Amount (Rs)				
		1 Year	2 Year	3 Year	4 Year	5 Year
A	Sales realization					
B	Cost of manufacturing/servicing					
	i. Raw materials					

	ii. Utilities					
	iii. Salaries/wages					
	iv. Repairs and maintenance					
	v. Selling and distribution expenses					
	vi. Administrative expenses					
	vii. Interest					
	viii. Rent					
	ix. Depreciation					
	x. Misc. expenses					
	TOTAL					
C	Gross Profit/loss (A-B)					
D	Income Tax					
E	Net Profit/ loss					
F	Repayment					
G	Retained Surplus					

Nurturing Women Entrepreneurship in Agriculture- A Policy Perspective

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Women entrepreneurship in agriculture

Women constitute a dominant position in rural economy and play a key role in securing food, nutritional and economic security of farm households. They also form a significant position in the agricultural labour force, both as family and wage labours, and contribute to agricultural development at the grassroots level. Globally, the agriculture, forestry and fisheries professions together employed 326.63 million women in 2020, constituting highest number among all professions (Table 1) (Mastercard.com, 2021). However, proportion of women employed is only 37.1%, and much lower in self-employment including entrepreneurship.

Table 1. Women employment in agriculture, forestry and fishing during 2020 (pre- COVID)

Economic sector	**Level of Employment (Million)**	**Share of global employment (%)**	**Wage ratio**	**Share of Women (%)**
Agriculture, forestry and fishing	880.4	26.5	0.72	37.1
Education	176.6	5.3	1.23	61.8
Construction	257.0	7.7	1.03	7.3
Wholesale & Retail; Repair of Motor Vehicles & Motorcycles	482.0	14.5	0.86	43.6

*Adapted from Mastercard.com (2021).

The government of India (1984) defined woman entrepreneur as "an enterprise owned and controlled by a woman having a minimum financial interest of 51 % of the capital and giving at least 51 % of employment generated in the enterprise to women". Common forms of women entrepreneurship in agriculture are individual agripreneurs, small businesses and startups as well as group businesses like Self-Help Groups and Farmers Producers Organisations. Despite managing diversified forms of businesses, these women-owned enterprises operate the lower ends of value chains largely in the unorganised sector (Mastercard.com, 2021). The International Labour Organisation has classified such businesses as “Own-account workers” (ILO, 2020) – entrepreneurs who are working on their own account or with one or more partners, and have not engaged on a continuous basis any employees to work for them.

Evolution of women entrepreneurship in India

Historically, women entrepreneurship was promoted as a means of empowerment rural women. During 18th century, Indian women managed small businesses like retail, handloom and other farm-based enterprises. The Constitution of India in 1950 has created a favourable environment for nurturing women's entrepreneurship by legally eliminating the inferior status of women in the society. Laser during 1981, India had 1.5 lakhs self-employed women (5.2%of the total self-employed people). Due to few provisions for nurturing women entrepreneurship in the Industrial Policy of 1991, the women entrepreneurship in India has witnessed a surge and reached 2.95 lakh during 1995-96. The Sixth Economic Census conducted by Govt of India in 2015, revealed that India has 8.0 million women owned enterprises, which constitute around 13.76 % of the total enterprises and provide employment to 10.24 % of the total workers engaged in variety of economic activities in India (Govt of India, 2016). Recent surveys indicated that 35.5% of start ups have women as Directors and 58% of entrepreneurs started their business at the age of 20 t to 30 years (NCW, 2021).

Barriers and constraints in women entrepreneurship

The Indian women face several challenges while venturing into entrepreneurship. At the household level, the women are considered as "home-makers" and expected to perform multiple household roles. These disparities limit their role in decision-making and restrict access to household resources.

When the women venture into agri-business, they often had limited access to formal financial Institutions, problems in accessing quality training, access to market and other essential information for agri-business as well as access to markets (Walter, 2021). A recent survey by EdelGive Foundation (EdelGive, 2021) reported that the lack of easy access to capital severely hinders women entrepreneurs in India's semi-urban and rural areas. Since women are venturing into entrepreneurship only to supplement the family's income, their average investment for creating the business is just Rs 18,705. The average income from these business range from Rs 1,500/ to Rs 5,000/-. Further, it is found that 83% of women could not arrange mortgage for availing the loan, since they had no assets or property in their name (EdelGive, 2021).

In addition, the women entrepreneurship is largely "Own Account Workers", which follow an established business model which depends on local markets and domestic consumption, with limited growth prospects. The scalability of such businesses is poor and their local dependence limits its revenue and scope of expansion.

The Mastercard Index of Women Entrepreneurs, a global index on women entrepreneurship indicating how successful individual economies are in advancing female entrepreneurialism, has placed India in 49th position in 2020 three places better than its position of 52 in 2019 (Mastercard.com, 2021). Considering the need to create gender equality in entrepreneurship, in line with Sustainable Development Goals (SDGs) identified by the United Nations, Govt of India has effected several policy changes in the recent years to nurture women entrepreneurship in agriculture.

Policy framework for women entrepreneurship

The policy support for crating women entrepreneurship is implemented through various Five year plans, Industrial plans and policies.

Five year plans

The first three Five Year plans (1951-1966), focused on achieving woman's welfare through Community based extension services. Special assistance was provided to *Mahila Mandals* and NGOs to empower the women through education and training. During Sixth and Seventh Five year plans (1980-1990), the policy support was provided for enabling women to gain employment for economic upliftment. From Ninth Five year plan, the National policy for empowerment of women was adopted

National Policy for the Empowerment of Women (2001)

A comprehensive National Policy for the Empowerment of Women was enacted in 2001 with a broad goal of development and empowerment of women in the country. This policy advocated achieving empowerment of poor women by creating a variety of economic and social options for them along with necessary financial and other support. As part of the implementation of the policy, the central government and many state governments introduced specific policies, schemes and programmes to support women's livelihood, particularly through entrepreneurship

(a) National level policies and schemes

The women-centric entrepreneurship policies are implemented by several Ministries including Women and Child Welfare; Agriculture & Farmers Welfare; Commerce and Industry, Education, Corporate Affairs and Rural Development and Human Resource Development. However, the Ministry of Women and Child Welfare acts as a nodal agency for executing and monitoring programmes and schemes related to empowerment and welfare of women.

(i) Start up India Programme

The Govt of India has launched Startup India programme during January 2016, to build a strong ecosystem for nurturing innovation and startups in India that would drive sustainable economic growth and generate large scale employment opportunities. Over the years, India became 3rd largest start-up ecosystem in the world , and Startp India fuelled its growth by providing handholding, funding support, incentives, industry –academic partnership to provide conducive environment for start ups in the country. The Startup India Scheme has enabled 41,317 start-ups to register in DIPP of which 44% had at least one women Director. About 4700 registered startups are involved in agriculture, food and beverage businesses. The scheme has enabled 384 start-ups to mobilise funds to the tune of Rs 4,509 crore. Of the Rs 10000 crore corpus fund allotted to Startup India, 10% is reserved for women entrepreneurs.

(ii) Prime Minister's Employment Generation Programme (PMEGP) Employment Generation Programme

Implemented by Khadi and Village Industries Commission, this credit linked subsidy scheme designed to promote MSME'S as a means of generating employment in rural and urban areas. For setting up new enterprises, it provides subsidy to women and other special categories up to 25% and 35% in urban areas and rural areas.

(iii) Udyam Sakhi

Udyam Sakthi is a Ministry of Micro, Small & Medium Enterprises initiative, is a network for nurturing social entrepreneurship. I helps he women entrepreneurs to create business models revolving around low-cost products and services to resolve social inequities. It caters to the need of around 8 million Indian women and others to start, built and grow business and provide assistance for preparing business plan, incubation facility, training programs, providing mentor, market survey facility etc. Project with maximum cost of Rs.25 lakhs are covered under the Scheme (Rs.10 lakhs cost is for service based projects).

(iv) Stand up India Scheme:

This program was launched in 5th April 2016 for facilitating credit to women entrepreneurs with an objective of providing loans ranging from Rs.1 lakhs to Rs.1 Crore to at least one woman entrepreneur by one Bank each. . In case of non-individual enterprise covered under the Scheme, 51 % of the share capital and controlling stake should be that of the women. The scheme focus on only SC/ST and women entrepreneurs.

(v) Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE)

The Small Industries Development Bank of India (SIDBI) and Ministry of Micro, Small and Medium Enterprises launched the scheme to make available collateral-free credit to the micro and small enterprise sector. Both the existing and the new enterprises are eligible to be covered under the scheme. The extent of guarantee cover is 80% for Micro and Small Enterprises being operated and/or owned by Women; for credit facilities up to Rs 50 lakh.

(vi) Mahila E-Haat

"Mahila E- Haat" an unique direct on line marketing platform to support women entrepreneurs/ SHGs/ NGOs, launched in 2016. It is aimed at providing a marketing platform by leveraging technology for showcasing products made/manufactured/sold by women entrepreneurs/ SHGs/ NGOs as also showcasing services reflecting their creative potential. The USP of this online marketing platform is facilitating direct contact between the vendor and buyer. It is easy to access as the entire business of E-haat can be handled through a mobile. The vendor can be approached by the buyer physically, telephonically, by email, etc.

(vii) Mudra Yojana Scheme for Women

This scheme has been launched by the Govt. of India for individual women wanting to start small new enterprise and businesses like beauty parlours, tailoring units, tuition centers, etc as well as group of women wanting to start a venture together. The loan doesn't require any collateral security and can be availed for an amount up to Rs. 50,000 to 10 Lakhs.

(viii). Financing Schemes offered by Banks

A large number of banks have schemes to support entrepreneurship among women by providing certain concessions in the rate of interest, collateral security etc.

i. Shri Shakti Package for Women Entrepreneurs - A scheme introduced by State Bank of India for offering concessions to women with majority ownership over 50% in a business provides interest concession 0.05% on loans exceeding Rs 2 lakhs with no security for loan up to Rs 5 lakhs.

ii. Cent Kalyan Scheme - A Central Bank of India scheme for new entrepreneurs and self-employed women for macro/small enterprises. Loan upto Rs 1 crore is provided without any collateral security.

iii. Mahila Udyam Nidhi Scheme - Offered by Punjab National Bank and SIDBI to support women enterprises to set up new small scale ventures extending loan up to Rs 10 lakhs to be repaid in 10 years. Similar support to women enterprises is being offered and loan even up to Rs. One Crore , without any collateral security to women entrepreneur. To name a few, Oriental Mahila Vikas Yojana Scheme by Oriental Bank of Commerce, Bhartiya Mahila Bank Business Loan, Dena Shakti Scheme by Dena Bank, Udyogini Scheme by Punjab and Sindh Bank etc.

(b) State Specific Schemes and Programmes for Women Entrepreneurs

Apart from the Central schemes, several states are also implementing schemes for promoting women entrepreneurship.

Conclusion

Creating and nurturing women entrepreneurship in agriculture is considered as effective means of achieving women empowerment. In India, the women entrepreneurship is confined mostly in the unorganised, informal sector and operated with limited investment and returns. Emergence of rural based women enterprises such as Self Help Groups, Farmer Producers Organisations, agripreneurs and small businesses, which are directly linked to rural household security, open up new avenues for nurturing the women enterprises with a focus on business model development, incubation and sustainable link with markets and consumers.

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Promoting Women's Aquapreneurship through Collective Actions: Transforming Gender Relations

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India is the second largest fish producing aquaculture nation in the world. India contributes about 7.7% to the global fish production and the country ranks 4th in global exports of fish products. The total fish production during 2019-20 is 14.16 Million Metric Tonnes (MMTs) with a contribution of 10.43 MMTs from the inland sector and 3.73 MMTs from the marine sector (Handbook on Fisheries Statistics, 2020). The growth statistics of Indian fisheries clearly depicts a paradigm shift from marine dominated fisheries to inland dominated fisheries. Freshwater aquaculture sector has been identified as the fastest growing agri-food production sector having massive potential of doubling farmers' income and providing foodand nutritional security. Freshwater aquaculture has become the predominant source of fish protein (Golden *et al.*, 2017). As India's potential of marine fish production is only 4.5 MMTs by exploiting 80% of the resources, it cannot be stretched much more (FAO, 2018). Therefore, encouraging freshwater aquaculture could be the best potential option for achieving targeted production and income. In fact, the sector provides livelihood to about 25 million fishers and fish farmers at the primary level and twice the number along the value chain. It has immense potential to enhance income, employment and usher in economic prosperity to stakeholders (National Fisheries Development Board, 2020).

Why aqupreneurship?

The demand for human consumption of fish is growing significantly. The *"Pradhan Mantri Matsya Sampada Yojana"* (PMMSY) aims augmenting domestic per capita fish consumption from 5 kg to 12 kg by 2024-25. It is projected that the additional fish production will come only from aquaculture. It provides a great opportunity to entrepreneurs for large-scale aquaculture production to meet increasing domestic fish consumption demand. Aquaculture production is more eco-friendly and economical than livestock and crop production. Thus, aquaculture is gaining first preference to produce adequate high quality animal protein. Introduction of Artificial Intelligence technologies are making fish farming more predictable, traceable and profitable. The robust ecosystem, export market opportunities and increased technology interventions are providing a major opportunity for entrepreneurs to take up aquaculture as a viable commercial farming activity.

Women's entrepreneurship need

Globally, women play key roles in harvest and post-harvest activities both in capture and culture fisheries. The percentage of women in the fisheries workforce is 46% globally and 72% in India (FAO, 2018). Agricultural sector employs 80% of all economically active women in India; they comprise 33% of the agriculture labor force and 48% of the self-

employed farmers. Out of 432 million working age women in India, about 343 million are not in paid formal work. The overall unemployment in India is 7%, but unemployment among women is 18%. By 2030, the working-age population of India will surpass 1 billion which will be the highest in the world (Bain and Company, 2019). Entrepreneurship could be a potential and untapped opportunity for working-age women in India. According to the sixth economic census, 2016 by Ministry of Statistics and Programme Implementation, women comprise as much as 13.76% of the total entrepreneurs in India. Entrepreneurship enables women to play a pivotal rather than a peripheral role in the economic sphere. Despite decades of research documenting women's economic contributions, collective action to advance women's interests and rights, and more recent institutional efforts to mainstream gender inclusion in fisheries development programs, achieving gender equality and women's empowerment in this sector remains a challenge (Gopal *et al.*, 2020).

Collective action as a means of transforming gender relations

Collective action refers to the action taken together by a group of people to achieve a desired goal. Active participation in collective actions increases self-confidence and self-esteem among individuals. It is intrinsically linked with uplifting individual and social capacities to act differently and challenge the distribution of power that constrains the capabilities of men and women (Pierre-Marie, 2018). Collectivization of farm women through Self Help Groups, Women Cooperatives, Farmer Producer Organisations (FPOs), etc. is the most effective institutional mechanism to address challenges in production and post-production stages of any agribusiness value chain. Building collective action of farm women through FPOs not only help in achieving targeted income but also transforming gender relations at household, community and institutional levels by enhancing their stake in all aspects of agribusiness value chain in terms of increased women's ability to contribute more to their family's income, increased joint decision making on gender division of labour and how to use earned money, increased sense of independence and capability to perform their roles and responsibilities at home and society, increased ability to generate the cash resources needed to meet their financial obligations both in the home and towards developing their businesses, increased sense of hope and financial sustainability, increased access to resources and services, increased women's mobility and exposure to new economic and educational opportunities, strengthened women's capacity and confidence to speak and act on behalf of their business and community, etc. (Bolin, 2020). The framework of facilitating collective actions through women's group enterprises and how to transform gender relations is depicted in fig.1 (Bolin, 2018). Being gender transformative means, women's collective action needs to be facilitated. A recently launched central sector scheme for the formation and promotion of 10,000 FPOs across the country will be a good move towards facilitating women's collective action in the agribusiness value chain. The another flagship scheme called PMMSY also envisages development of entrepreneurship, promotion of ease of doing business, innovations and innovative project activities including start-ups, incubators in fisheries and aquaculture sector.

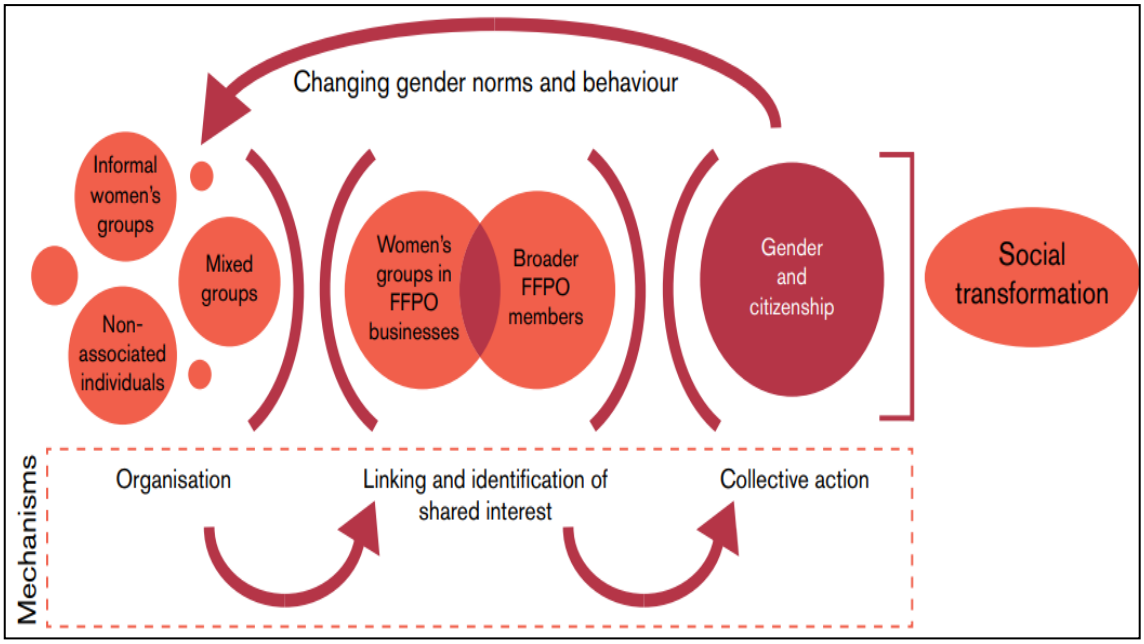

Fig 1. Facilitating collective actions through women's group enterprises ***(Adopted from Bolin, 2018)***

Provisions for promoting entrepreneur models in fisheries & aquaculture under PMMSY

a) Development of aquaculture: The related activities like construction of ponds along with necessary electricity and water supply facilities, development of hatcheries for seed production & brood banks, dissemination of new species *viz.*, Sea bass, Pompano, Cobia, Lobster, Crab fattening, integrated models for trout culture, feed mills/plant to produce fish/shrimp feed from the local ingredients, quality testing labs, cold storage/preservation facilities, pre-processing facilities, fish transport facilities, etc.

b) Integrated fish farm: Infusion of technology such as establishment of Re-circulatory Aquaculture System (RAS) of appropriate size and numbers, Bio-floc, aquaponics, ponds of appropriate size and area, water supply and electrification, hatcheries to produce fish seed required for RAS, feed mill, ice plant/cold storage, testing lab, fish transport facilities (insulated/refrigerated vehicles) and farm-based kiosk etc.

c) The cage culture, sea weed cultivation, processing & marketing, ornamental fisheries branding & marketing and recreational fisheries can also be taken up as integrated models under PMMSY.

Table 1. Financial assistance under PMMSY

Government financial assistance	Beneficiary contribution	Bank loan
1) Central Sector Scheme (Financial assistance from Central Government)		
a) General category - Up to 25% of the total project cost with a ceiling of Rs 1.25 crore per project b) SC/ST/Women - Up to 30% of the total project cost with a ceiling of Rs 1.50 crore per project	Minimum 10% of the total project cost	a) General category - Up to 65% of the total project cost b) SC/ST/Women - Up to 60% of the total project cost

2) Centrally Sponsored Scheme (Financial assistance from Central and State Government)		
a) General category - Up to 25% of the total project cost for with a ceiling of Rs 1.25 crore per project b) SC/ST/Women - Up to 30% of the total project cost with a ceiling of Rs 1.50crore per project	Minimum 10% of the total project cost	a) General category - Up to 65% of the total project cost b) SC/ST/Women - Up to 60% of the total project cost
The financial assistance is shared between Central and State Governments in the ratio of - a) For General States - 60:40 b) For North-eastern and the Himalayan States - 90:10 c) For Union Territories -100% financial assistance from Central Government		

(Source: PMMSY Guidelines, 2020)

Ways Forward

Promising women specific provisions in entrepreneurial schemes and programmes can make a difference in real sense. Improving women's access to aqua-production services and resources, increasing women's active participation in decision making related to aquaculture production aspects including marketing, strengthening their capacity through training and skill development programmes are pertinent for mainstreaming their concerns in broader perspectives of aquapreneurship. The promotion of crowdfunding can attract a large number of women investors and provide more funding to women entrepreneurs. Assessing the Impact of women's aquapreneurship development initiatives will help to understand how these initiatives encourage or deter women aquapreneurs. Certainly, the comprehensive sex-disaggregated data on aquapreneurship status help toaddress diverse issues of women aquapreneurs. Developing an aquabusiness model for women that takes into account the social norms impacting women, includes women's unpaid works and encourages healthy collaboration among family and community members is likely to ensure sustainability of women's aqua ventures. There should be a special thrust on formation of women Aqua Farmer Producer Organizations (AFPOs) under Government of India's 10,000 FPOs scheme which can collectivize women aqua farmers and link them to markets where they have better income opportunities through higher price realization. It is worthwhile to capture, integrate and scale out best bet practices for providing adequate access to financial services, changing societal attitude towards women aquapreneurs, promoting women's collective actions through FPOs, developing aquapreneurship skills and capabilities, formulating women specific aquapreneurship models and programmes in order to strengthen women's transition *from 'Job Seeker' to 'Job Provider'.*

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Economic Empowerment of Farm Women through Improved Post Harvest Technologies and Value Addition of Horticultural Crops

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Agriculture is backbone of Indian economy. It is the only sector to have clocked a positive growth at constant prices in 2020-21 even during Covid-19 pandemic. About 58 percent of the Indian population works in agriculture industry, contributing about 17.8 percent to India's GDP. Agriculture in India defines familiar tradition, social relations and gender roles. Female in the agricultural sector, either through traditional or industrial means, subsistence or agricultural labourer, represents a momentous demographic group. Agriculture is directly tied to issues such as economic independence, decision-making abilities, agency and access to education and health services and this manner has created externalities such as poverty and marginalization, and compounded issues of gender inequality. It is a way of life for majority in the country and mostly an estimation of 65% of the 1.3 billion people live in rural India among which 48% are female. The first farm reforms of independent India, known as the Laws of Divided Inheritance, the reforms were meant to limit the conglomeration of land, by mandating redistribution as land was divided among male inheritors from the prior generation. The perpetuation of these laws not only limits farm size but also bars women from ownership or inheritance. Furthermore, as small farmers face increasing competition with larger farm operations an increasing number of men migrate to city centers for higher wages and employment. Women are in turn left to support the family structure and support small farm lifestyle. They work hand-in-hand with the male work-force in the agricultural sector. Instead, they have huge workloads with dual responsibility of household as well as farm work. They play a catalytic role towards achievement of transformational economic, environmental and social changes required for sustainable development. But limited access to credit, health care and education are among the many challenges they face. These are further aggravated by the global food and economic crises and climate change. Certain hurdles like women being forbidden to touch a plough and dig the ground do not allow women to empower but in other agricultural operations which are arduous, women participate actively and traditionally. The worker population ratio (WPR) of female in rural area is only 176 (NSSO, 68th Round, 2011-12) compared to 535 in male. According to NSSO data, out of 405.9 m rural female, only 9.4% are self-employed, 12.2 % are regular waged/salaried and casual labourers besides 42.2 % attains domestic duties. About 39 % of rural female are agricultural worker (228.7 m). There are 30.8 m (7.6 % of rural female) self-employed (cultivators) as against 44.7 m (11.0 %) casual labours in agriculture (*Kumar, A et al*., 2021). The unemployment Rate (UR) for rural female is 29 %. In addition to work-in-hand with male, rural women those engaged in agriculture only 3% of women devoted about 118 min/day in marketing, processing of food products, beverages for their own final consumption (*Time Use Survey* data-2019; *Ministry of Statistics and Programme*

Implementation). This limits their time to be devoted to agricultural operation. After harvest of crops, female are contributed to a maximum activity from farm gate to plate. It includes harvesting, threshing, drying, storing, packing, backyard kitchen gardening, and all food preparation activities etc.

Thus, empowering them is essential, not only for the well-being of individuals, families and rural communities, but also for overall economic productivity, given women's large presence in the agricultural workforce worldwide. This has emerged as one of the important means of finding solutions to their problems. This also explores ubiquitous share of women work-force to the country's economy.

2.0 Participation pattern of farm women in post harvesting

Post harvesting is an important component of farm activities and is mostly performed by women. In order to understand the present participation pattern of farm women in post harvest activities an attempt was made under the Extension component of All India Coordinated Research Project on Home Science. The study conducted on 2999 farm families in rural Punjab represented by five agro-climatic zones and five distinct landholding categories clearly indicate an active participation of women in most of the selected activities in the area of post harvesting. The results varied between zones but the women were found to contribute substantially in drying, storage and cleaning. In other activities majority of the women were working with male members. An analysis of gender disaggregated data collected from 23,000 respondents of 11,500 families from 56 zones conducted by ICAR-AICRP on Home Science revealed highest independent participation of rural women was in homestead gardening (28.8%), followed by livestock management activities (22.3%) and post- harvest management (11.4%). The responsibility profile showed that women shouldered major responsibility in livestock management (29.3%), followed by homestead gardening and post-harvest management activities. Study on percentage share of women labour force in processing of fruit crops in India indicated that women's participation ranged from 20- 80% with 72 % in coconut, 84 % in cashew nut (*Nair and Das*, 1990). Women constitute 90 per cent of labour force in cashew processing industry. Most labour intensive operations like shelling and peeling in cashew are done by women workers, while 60 percent of grading of kernels was carried out by women (*Kannan*, 1983 and Das, 1985). *Tripathi et. al*., (2009), conducted study in five villages of Orissa and concluded that the role of women was less than men in large orchards but the role of women in maintenance of fruit plants in homestead garden was much higher. In south India, 80% of farm women engaged in post harvest and processing of fruits and vegetables (*Pandey and Pareek*, 1990). Rural women's participation in agro based activities is much more than what is statistics revealed. This is mainly due to the fact that most of the work done by women at farm and home is disguised as daily chores. Large number of unregistered, unsettled, and unpaid family workers who are women and girls supposedly witness that women's labour contribution to the rural economy is much larger than official records indicate. As a whole, women spend their labour in less lucrative, profitable or unpaid work and much of rural women's work is not included in official statistics.

Thus, increased participation of women in micro enterprises and labour force is a prerequisite for improving the position of women in society self-employed women. The entry of rural women particularly in micro enterprises is of primary importance to tackle various issues affecting their development. Food and Agriculture Organization of U.N. predicts that about 1.3 billion tons of food are globally wasted or lost per year. Food losses at the post-harvest stage are not only a threat to human consumption and returns to the farmers, but it can also harm the environment in various ways. Food loss is estimated to be equivalent to 6- 10 percent of human-generated greenhouse gas emissions. Thus, to sustainably achieve the goals of food security, food availability needs to be also increased through reductions in the post-harvest losses at farm, retail and consumer levels. Value adding opportunities that enhance the value of key commodities would also increase income generation for improving welfare and providing farmers with the financial resources for investment in resource enhancing technologies.

3.0 Reason for women empowerment

APJ Abdul Kalam once said that "Empowering women is a prerequisite for creating a good nation, when women are empowered, society with stability is assured. Empowerment of women is essential as their thoughts and their value systems lead to development of good family, good society and ultimately good nation." The economic empowerment leads to entrepreneurship development. Emergence of women entrepreneurs largely depends on changing social, psychological, economic, cultural dimensions which ultimately supplicate a positive effect in the financial growth of a developing country like India. Tackling and problem-solving gestures, willingness to take risks, ability to motivate people, and knowing how to win and lose gracefully are the key features of a good women entrepreneur. Those educated women who have these qualities cannot limit their lives in four walls of the house have become important players in their entrepreneurial landscape which shows that women are no longer adhering to the stereotype that only men can be the bread winners and wage earners in the family. Even house wives of the villages are touching success through their own businesses despite prevalent male chauvinism in country's villages (Gurnani, 2011).

The emergence of women entrepreneurs and their contribution to the national economy is quite visible in India. The number of women entrepreneurs has grown over a period of time. They need to be praised for their increased utilization of modern technology, increased investments, finding a niche in the export market, creating a sizable employment for others and setting the trend for other women entrepreneurs in the organized sector. The growth of modernization processes such as industrialization, technical change, urbanization and migration further encourage it. Entrepreneurship on small scale is the only solution to the problems of unemployment and proper utilization of both human and non-human resources and improving the living condition of the poor masses.

In terms of agricultural production, processing of the food produced is one of the major areas of thrust for the women entrepreneurs. Fig. 1 shows the reason for women aspired to be entrepreneur. Capacity building in food processing can draw favorable outcomes for the rural women. The aim of skill development in case of women is not only to prepare them for jobs but also to improve the performance of women workers by enhancing the quality of work in which they are engaged (*Diwakar & Ahmad*, 2015).

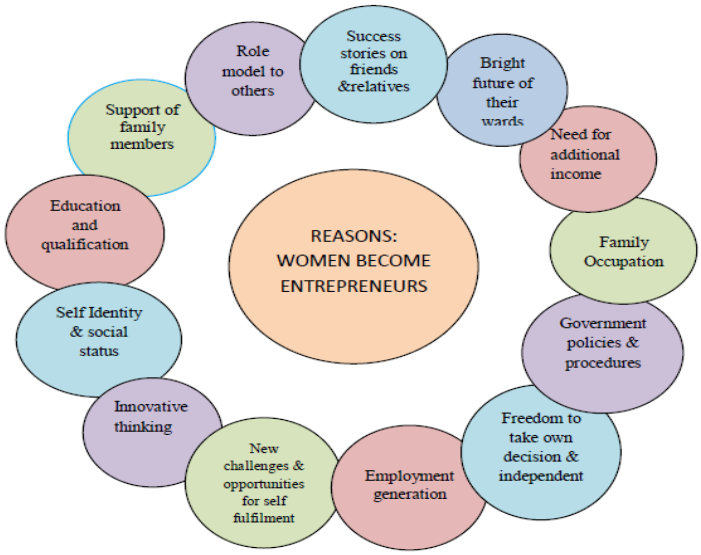

Fig. 1 The reasons for women entrepreneur

The Food and Agriculture Organization (FAO) estimates that giving women the same productive resources as men would increase yield by 20 to 30 %, reducing the number of hungry people by 100-150 million. Here, less than 10 per cent of agri-produce is processed, while an estimated 30 per cent is lost in wastage. Thus, Food processing can enhance farm productivity, combat wastage, and contribute greatly to the government's objective of doubling farmer incomes. Value adding opportunities that enhance the value of key commodities would also increase income generation for improving welfare and providing women with the financial resources for investment in resource enhancing technologies. The economic devastation caused by Covid -19 hits women workers hardest - Wide gender disparity in India's workforce likely to push female workers further into poverty, increase their dependence on men. By 2030, India's working-age population will surpass an unprecedented 1 billion, and up to 400 million women's economic potential may be left unaddressed (The times of India, Feb 18, 2020). So, eco-empowerment remains critical to harness the economic potential of women and thus, achieve the *sustainable development goals (SDGs) by 2030*.

3.1 Eco-Empowerment through Food Processing

Food processing dates back to the prehistoric ages when crude processing incorporated slaughtering, fermenting, sun drying, preserving with salt, and various types of cooking (such as roasting, smoking, steaming, and oven baking). Salt-preservation was common for foods that constituted warrior and sailors' diets, up until the introduction of canning methods. The recent turn by consumers to local agro-food produce offers significant prospects for small-scale industry and food-production workshops in rural areas. Consumers weary of mass-produced industrial products and sensitive to the nutritional risks of much industrially-processed food are on the lookout for local traditional food. Within this general context of seeking out foods offering safety and other specific qualities it often appears that "rural women's foods" could in themselves constitute a distinct category of local traditional food.

They benefit from their associations with inherited recipes, good housekeeping, and pure ingredients.

The creation of small women's enterprises for the production of local agro-foods answers to a twofold necessity:

(i) Empowerment of rural women & creation of additional income for rural households.

(ii) The demand for special quality foods by an increasing number of selective consumers.
Value addition to the agricultural produce can be a boon as women have the opportunity of setting up small scale enterprise so as to earn economic share to the household and at the same time, gender equality in the society. Value addition refers to increasing the customer value offered by a product. It ads feature to agricultural, marine, aqua cultural, forestry material used to make food products. Thus, the farmwomen would not only be involved in production of raw commodity but also take part in processing and also distribution of the product.

3.2 Micro-Entrepreneurship for women

Micro credit is promoting the small scale business enterprises and its major aim is to alleviate poverty by income generating activities among women and poor so as to improve the socio and economic development of women and improve the status of women in households and communities. The micro entrepreneurships are strengthening the women empowerment and remove the gender inequalities. Self Help Group's micro credit mechanism makes the members to involve in other community development activities. There are several schemes by Government of India for women ranging from relief oriented to supportive. Development of Women and Children in Rural Areas (DWACRA) offers training in income generating activities and access to soft loans for starting economic activity. Self- Employment Women's Association (SEWA) aims to ensure higher earning for women workers through increased productivity, improvement in condition of work and higher wages.

Advantages of Micro-Entrepreneurship for women

Empowering women particularly rural women is a challenge. Micro enterprises in rural area can help to meet these challenges. Micro enterprises not only enhance national productivity, generate employment but also help to develop economic independence, personal and social capabilities among rural women. Following are some of the personal and social capabilities, which were developed as result of taking up enterprise among rural women.

- **(i)** Economic empowerment
- **(ii)** Improved standard of living better health of family & self
- **(iii)** Gain self confidence & Attain sense of achievement
- **(iv)** Enhance awareness
- **(v)** Increased social interaction
- **(vi)** Engaged in political activities
- **(vii)** Increased participation level in Gram-Sabha meeting
- **(viii)** Improved in leadership qualities
- **(ix)** Involvement in problem solving related to self and community
- **(x)** Improve decision making capacity in family and community.

Economic empowerment of women by micro entrepreneurship led to the empowerment of women in many things such as socio-economic opportunity, property rights, political representation, social equality, personal, right, family development, market development, community development and at last the nation development.

Constraints of Women Entrepreneurs in India

- **(i)** Patriarchal male dominant social order.
- **(ii)** The financial institutions are unconvinced by the entrepreneurial abilities of women.
- **(iii)** Women in developing nations have little access to funds, because they are concentrated in poor rural communities with few opportunities to borrow money.
- **(iv)** Family obligations also bar them from becoming successful entrepreneurs. Indian women give more emphasis to family ties and relationships.
- **(v)** They have low-level management skills and have to depend on office staffs and intermediaries, to get things done.
- **(vi)** Getting raw materials requires high negotiation skills which is difficult.
- **(vii)** Many women in developing nations lack the education needed to spur successful entrepreneurship. They are ignorant of new technologies or unskilled in their use, and often unable to do research and gain the necessary training.
- **(viii)** Low-level risk taking attitude is another factor affecting women decision to get into business.
- **(ix)** Achievement motivation of the women is found less compared to male members.

3.1 Gender sensitization programme

This can contribute to women empowerment by hastening the process of both horizontal and vertical flow of ideas, knowledge, information and technology. It can reduce the chances of gender conflict, promote gender harmony and create a congenial climate wherein both men and women can perceive and play their role in mutually complementary mode. Lack of sensitization at different levels, i.e. household, project and programme levels, is an important reason for poor implementation and poor outcome of development interventions. Gender sensitization, therefore, can foster meaningful participation and better integration of women into development process and can lead to can lead to better impact on women of different projects, programmes and policies. Gender sensitization can induce restructuring of gender roles and can help realize higher productivity of men and women in household and outside work through rational and effective use of resources including their time.

Today, the discourse of entrepreneurship seems to have changed with the inception of eco-friendly women entrepreneurship in rural areas which proved as a panacea for societal development. In the agricultural sector, women farmers hardly have access to agricultural resources and services for production due to gender constraints. The double burdens of farming and family responsibilities and the lack of social services and government programmes to support women, women entrepreneurs seem to have go unnoticed. Therefore,

women entrepreneurs need excessive support from cooperatives, male-dominated society and government to strengthen eco-friendly entrepreneurship in rural areas of the country. This encompasses measures to facilitate the creation of women's enterprises, such as training programmes to hone the skills of women with essential entrepreneurship capabilities, monitoring programmes to give women peer support. The establishment of business incubators is another important mechanism of helping to shield and safeguard the subsistence of women's business. It is essential that there should be gender awareness in designing and supplying support measures focused at female entrepreneurs.

4.0 Economic empowerment through value addition

Value addition is a process that elevates a production into a product. Value addition is the enhancement added to a product or service by a company before the product is offered to the customers. It is a business strategy for creating new market demands or indulging renewed demand from the set of conventional customers. A value added horticultural product can ignore the risk of seasonality in crop availability and market vagaries. There are three ways in which value addition to farm produce is possible:

- The primary level involves cleaning, grading and packaging of fruits, vegetables and other horticultural crops
- The secondary level includes basic processing, packaging and branding, e.g. packed item
- The tertiary level includes high-end processing which requires supply chain management, processing technology, packaging of processed foods, branding and marketing.

Fruits and vegetables are highly perishable commodities due to high moisture content and higher metabolic activities. Spoilage to fruits and vegetables mainly occur due to microbial attack, auto-oxidation and insect pest attack. As a result, about 25 to 30% of the production is lost after harvest. The role of post harvest management is important for reduction of post harvest losses of fruits and vegetables and to make them available for longer period in the market.

4.1 Addition in Fruits

Fruits are rich source of several vitamins and minerals. Mango, papayas are rich in vitamin A. Cashew nut and walnut are rich in vitamin-B1. Bael, papaya, litchi are rich in vitaminB2 and Barbados cherry, aonla, guava are rich source of vitamin-C. Some fruits are also rich in some minerals like litchi is rich in calcium (Ca) and dry karonda is rich in iron (Fe). Fruits and vegetables are perishables and seasonal. Unless excess production is processed and preserved, it will be wasted. In India only 2.2 % of the total fruits vegetables produced are processed in the 3000 food industries and wastage is estimated to be very high.

Table: 1 Value added products of some fruits in India

Crops	Existing products	New products
Apple	Juice, jam, jelly, cider, wine, pulp	Osmotically dried rings, canned apple, vinegar, carbonated juice, apple seed for nurseries, pectin.
Apricot	Pulp, squash, Ready to Serve (RTS), jam, appetiser, dried apricot.	Osmotically dried apricot, oil, apricot oil-based cream, etc.
Mango	Pulp, RTS, squash, powder (amchur), slices in brine, pickle	Pulp/juice from in situ mangoes, pectin from just-ripe fruits
Pine apple	Pulp, RTS, squash, powder (amchur), slices in brine, pickle	Pine apple ring, bromolein from stem, concentrated frozen juices, marmalade,vandy, toffee
Banana	juice, ripe banana powder, banana fig	value addition of banana peel
Orange	Pulp, RTS, squash, nectare	Canned frozen pulp, Oil extraction from peel, carbonated beverages
Litchi	Juice, squash,	nectar/RTS Carbonated drink
Peach	Canned peach, pulp, jam/chutney	Wine, kernel oil
Pear	Canned pear, pulp, jam	Apple pear blend, sand pear candy

4.2 Value Addition in Vegetables

Vegetables are rich and cheaper source of carbohydrate, protein, fat, vitamins and minerals. Storage roots and tubers like potato, colocasia, yam, tapioca, elephant foot yam etc. are rich source of carbohydrate. The leguminous vegetables like pea, cowpea, French bean, lablab bean, cluster bean etc. are rich in protein and supply as high as 14% digestible protein. Major minerals obtained from the leafy vegetables are calcium (Ca), Iron(Fe) and phosphorus(P) and some of the leafy vegetables are rich in micronutrients like copper, manganese and zinc. Carrot, pumpkin, sweet potato, colocasia are rich in vitamin A. Vitamin B is present in appreciable amount in pea, beans, garlic, tomato, colocasia, asparagus etc. Vitamin C rich vegetables are cauliflower, cabbage, knolkhol, turnip, tomato, pepper, drumstick leaves, fenugreek leaves, amaranth etc. Most leafy vegetables are rich in carotene, riboflavin (vitamin B2) and minerals. Every year large amount of fresh vegetables are lost due to seasonality and perishability and lack of attention in value addition. The wastage of vegetables can be reduced by producing different value added products of vegetables.

Table 2 Value added products of some vegetables

Crops	Value Added Products
Potato	Fried chips (chips), French fries, frozen products (potato patties, potato puffs, potato cakes, defrozen products, packed frozen dishes), dehydrated products (like potato flour, granules and flacks), wine, canned potatoes, etc.
Tomato	Tomato paste, ketchup, paste, chutney, sauce, tomato chilli sauce, tomato seed oil, canned tomato (in the form of fresh tomato, tomato juices, tomato-vegetable juice blend, tomato sauce and tomato ketchup) tomatine alkaloid, soup powder, etc.
Cabbage	Package dry leaves, Sauerkrant.
Cauliflower	Dried cauliflower, frozen cauliflower, cauliflower pickle, etc.
Carrot	Carrot shred, frozen carrot, carrot powder, soup powder.
Pea	Dehydrated peas, frozen pea, pickle, soft drinks, etc.
Cassava	Fried chips, hot fries, crisps, nutrichips
Amaranth	Package dry leaves, Dry powder

Value Addition in Spices

India is traditionally known as the spice bowl of the world. According to the Bureau of Indian Standards, about 63 spices are widely grown in our country of which 15 spices are grown commercially in India. India is the largest producer, consumer and exporter of spices in the world with a 46 % share by volume and 23 % share by value, in the world market. Different value added products of spices available in India are spice oils and oleoresin, dehydrated pepper, freeze-dried green pepper, ginger candy, ginger beer/in brine/squash, ginger flakes, garlic pickle and paste, chilli powder, paste, oleoresin, etc. Processing of spices offers considerable business opportunities, despite the presence of several organized and unorganized firms involved in spice processing. Small scale utilization of spices through women in rural areas offers higher price realization that selling afresh.

Value addition in minor millets

Millets are nutri cereals comprising of Sorghum, Pearl millet, Finger millet (major millets) Foxtail, little, Kodo, Proso and Barnyard millet (minor millets). These are one of the oldest foods known to humanity. They are highly nutritious, nonglutinous and not acid forming foods. Hence they are soothing and easy to digest. Promotion of Nutri cereal for consumption among the people is need the hour and India have more than 20000 ha area of fallow land Scope for research is more in production of fortified foods by using nutri cereal. This is one of the promising means for achieving the goal of doubling the farmers income. Significant Achievements made under ICAR-IIMR, Hyderabad for the popularization of millet based processed products.

Value addition of underutilized food crops

In India, underutilized crops make significant contributions to the human and animal food web and are often a means of survival for millions of poor rural households. Uses of non cultivated foods, of which wild fruits form a part, as a diet supplement, or as a coping mechanism in times of food shortage, provides an important safety net for the rural poor. Minor crops crops such as Bael (*Aegle marmelos*), Jack fruit (*Artocarpus spp)*, Custard apple (*Annona squamosa*), Wood apple (*Feronia limonia*), Jamun ((*Syzygium cumini*), Aonla (*Emblica officinalis*), Star fruit (*Averrhoa carambola)* and Malabar Ebony (Kendu) (*Diospyros melanoxylon*) etc grown throughout the state spanning over northern to southerned odisha. Tribals use these plant resources regularly as foods and to cure different ailments. So, there is an urgent need to scientifically study above crops and to develop value added products enhancing the shelf life by which it can be properly utilized in rural level at large. There is now greater recognition that products from the wild may support household subsistence and also that income may be generated from their sale, either in raw or processed forms. This recognition has prompted investigation of the diversity of species that are used and their relation to the socio-economic status of those who use them. Wild fruits contribute to diet diversity and flavour as well as providing essential micronutrients in an otherwise bland and nutritionally poor diet. The majority of households stated that fruit consumption was sporadic, and except for the four or five most prized fruits or seed, most are collected as a result of chance encounter by people in the forests for other purposes.

On account of low returns from agriculture and lack of other economic opportunities, households engage idle family members, mostly women, in the extraction of natural products from wild fruits for sustenance. Sale of wild fruits in tribal eastern India takes place on a small scale and supports livelihoods by way of income diversification. A strategy to promote commercial production in order to boost the local economy would depend not only on increasing the volume of production, but with initiating processing and value addition for raw fruits—imperative for creating market niches for selected species. A database on availability of different species of wild fruiting species and their uses should be compiled to aid such developments of poor tribal areas.

Economic empowerment through organic production

Women entrepreneurship in green/organic production provides new opportunities to small farmers in developing countries like India. There are all symptoms that traditional small-scale farming technology is adjacent to the green/organic farming system, that organic systems are more labour intensive and that small women farmers can potentially produce green/organic products at relatively low labour costs which may give these women cooperative entrepreneur a comparative advantage in the production of green products. Moreover, organic system may result in more work opportunities for women throughout the year with its crop diversification practices as well as value adding activities such as processing and marketing. At the same time, many Asian countries possess strong market potential for producing specialty, value-added products that sustain the agroecological environment. The green cooperative model of

enterprise enables smallholders to make best use of these potentials by supporting the identification of specialty products and its marketing opportunities, providing financial and business-related services, linking farmers to effective marketing channels and creating key networks with partners in the local, governmental, and international agencies. They reach a broader market and strengthen partnerships, green cooperatives entrepreneurship and e-business development. To conclude, to ensure the effectiveness of rural poverty reduction strategies through the promotion of rural entrepreneurship, in particular among cooperative enterprises in the green products business, it is essential to consider gender main streaming into the planning process (Kesavan & Swaminathan, 2007). An eco-friendly women entrepreneur may identify a situational context where she can capitalize the abundance of untapped value in the social and/or natural eco-system without interrupting the symmetry between the ecological and social sub systems. The use of renewable energy sources like solar energy, wind energy, tidal energy or hydraulic potential of waterways is the pertinent examples of maintaining the equilibrium of ecological and social sub systems.

Capacity building of farm women

Training modules on value-addition to tomatoes, mango, pine apple, banana, aonla, orange, jamun, bael and lemon etc, fruit preservation, vermi-compost, bee-keeping, mushroom cultivation and production of biofertilizer is requisite for the establishment of micro-enterprises for economic empowerment of women. For drudgery reduction of women in agriculture, improved agricultural tools/technologies, namely, fertilizer trolley, manual seed drill, mat nursery, vegetable plucker, vegetable bag, water bag, face protector, dung collector, fodder chopper, fodder collector, groundnut stripper, groundnut decorticator, groundnut stripping frame, long handle fork, manual maize sheller, mango harvester, potato picker and revolving stool have to be field validated. For promotion of vocational skills among adolescent girls and young mothers, need-based skill oriented training programmes may be organized for their capacity development benefiting adolescent girls/ mothers and anganwadi workers. Value-addition and income-generating technologies should be disseminated in the adopted villages for empowerment of women.

A pre-requisite in value addition and marketing

Due to globalization, liberalization and privatization of the economy, agricultural marketing has become the key driver of the agricultural sector. Though women have succeeded in the production front, they have not achieved appreciably in terms of price realization for their produce owing to their inaccessibility to efficient and scientific marketing system. The middlemen, commission agents and traders are depriving them of their due share of profit. An efficient and organized marketing system would ensure the maximum price realization to the farmers, which will induce them to produce more and market their produce in an increasing proportion. Presently, marketing system (including collection, handling, storage, transport, processing, wholesaling, retailing, exports and associated infrastructure and support services) is fragmented and is uncoordinated, with inadequate infrastructure and supply chains involving high wastage and losses. As a result, the producer gets about only 30-40 percent of final price, as compared to around 60 percent in advanced countries. Even an additional

margin of 3 percent in final price translates into 10 percent increase in net income of the farmers and that itself is a powerful incentive to invest in agriculture. But, this requires cutting down of the long chain of intermediaries, which can happen only with improved market access by farmers, interconnected markets, efficient supply chain and a robust marketing information system.

Most of women farmers are small and marginal farmers, often lacking the ability to produce enough marketable surplus for larger and remunerative markets. As a result, farm gate sales are high in the State (about 45 percent) and this is due to lack of information on market prices and on required quality parameters. If farmers are to get better prices, level of farm gate sales has to be brought down by giving the farmer, access to distant and bigger markets. Currently, agricultural markets are regulated under 'State Agricultural Produce Marketing (Regulation) Act 1987 and Rules 1991. Value added product based economic empowerment of rural women can be started by smaller women group with minimum initial investment. Selection of horticultural crops should be based on suitability of the crop to a particular climatic condition, easy availability of raw materials at lower cost, demand of the value added product in nearby cities, good transportation facility and smooth marketing channel. Steps to develop small scale entrepreneurship Identification of suitable value added product of the region: It can be made by survey of the local/adjoining markets, depending on supply of raw material, their purchasing price and marketing opportunity of the processed product.

Govt policies for women economic empowerment

The Economic Survey observes that the major announcements for agriculture and food management under the Atma Nirbhar Bharat Abhiyan have been Rs. 1 lakh crores Agriculture infrastructure fund; Rs. 10,000 crores scheme for Formalisation of Micro Food Enterprises (MFE)- with special attention to women; Rs. 20,000 crores for fisherman through Pradhan Mantri Matsya Sampada Yojana (PMMSY); Reforms in Essential Commodities Act, Agriculture Marketing and Agriculture Produce Pricing and Quality Assurance; PM Garib Kalyan Ann Yojana; One Nation One Ration Card.

Capacity building in food processing can draw favorable outcomes for the rural women. The aim of skill development in case of women is not only to prepare them for jobs but also to improve the performance of women workers by enhancing the quality of work in which they are engaged. Mechanization and easy availability of labour provide more time to energetic women to engage themselves in self employment or entrepreneurial ventures. Rural women having a pool of human and non human resources to take up an enterprise need only an innovative mind and motivation.

Pradhan Mantri Kisan SAMPADA Yojana (PMKSY)

Ministry of Food Processing Industries is implementing the Scheme for Integrated Cold Chain and Value Addition Infrastructure as one of the component of Pradhan Mantri Kisan Sampada Yojana (PMKSY) with the objective of reducing post-harvest losses of horticulture & non-horticulture produce and providing remunerative price to farmers for their produce. Under the scheme, Ministry provides financial assistance in the form of grant-in-aid at the

rate 35% for general areas and 50% for North East States, Himalayan States, ITDP areas and Islands for storage and transport infrastructure and at the rate of 50% and 75% respectively for value addition and processing infrastructure subject to a maximum of Rs.10 crore per project for setting up Integrated Cold Chain projects including Irradiation facility. Standalone cold storages are not covered under the Scheme.

Conclusions

Woman has been as important as man. In fact, the status, employment and work performed by women in society are the indicators of a nation's overall progress. Without the participation of women in national activities, the social, economical or political progress of a country will be stagnated. A successful intervention for empowering women necessitates several elements – an important one is imparting of new skills: the consequence of women assuming new roles. Trainings have to make women recognize clearly how society structures their perceptions. The training programme must promote critical analysis in women and encourage them to think independently and challenge unequal gender relations and exploitation. To uplift the livelihood and financial conditions of the rural women value addition of horticultural crops can offer tremendous opportunity. Value addition, product diversification and by- product utilization has been given top priority in the recent years. The post harvest and value addition industry are expanding to utilize new opportunities. Since women are traditionally engaged in this sector, more women need to be trained about the new technologies and policies in the post harvest handling and processing of various horticultural crops to fulfill the growing needs of the sector. Women are involved in the small scale marketing especially the informal marketing of vegetables in most part of the country. In some areas the women comprises 60 to 80 percent of the workforce in trading of fruits and vegetables. The expertise and the knowledge about the local market practices may be helpful and they can easily be partner in the larger chain of supply of these produces. Modifications and improvements of food-processing technologies on a large scale would serve to safeguard the continued practice of nutritionally desirable techniques. Also, mobilization of technologies still in the hands of women may represent a force towards self-reliance in food. Action-oriented research with emphasis on the existing potential of local food conservation technologies will have to be an interdisciplinary enterprise, involving nutritionists, food technologists, social scientists, and economists. Women are, however, not easily reached by research, particularly since most researchers are men. The increased recruitment of female professionals into research and planning is therefore of greatest importance.

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Custom Hiring Centres: A Mechanization Opportunity for Women Farmers

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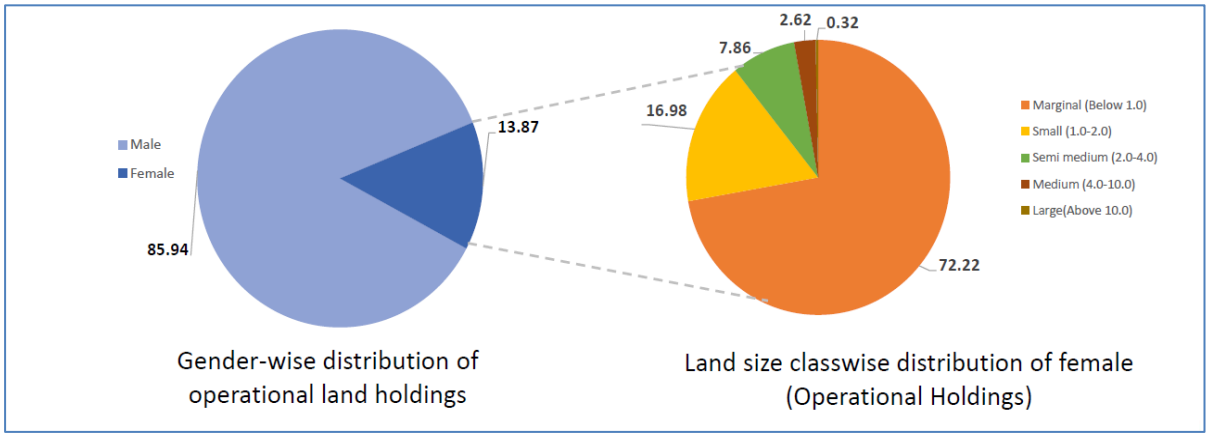
It is observed in agricultural census, that women own 13.87 % operational land holdings and 11.57 % of area operated in 2015-16 as compared to 12.79 % and 10.36 % respectively in 2010-11. Thus, more females are participating in management and operation of land. But of this 13.87 % land owners 72.22 % are in marginal class with an average land size of 0.35 ha.



Meanwhile, there has been a decline of men's participation in the agriculture in recent years due to their migration in other sectors. But the Periodic Labour Force Survey 2017-18 also shows a sharp decline in the worker to population ratio for rural women. It has dropped from 24.8 per cent in 2011-12 to 17.5 per cent in 2017-18 (*all ages data*). This decline is observed more in group of lower income and lower literacy. Considerable proportion of this decline is accounted in the decreased participation of women in agricultural and allied activities. The report stated that, among the female workers engaged in agricultural activities the proportion decreased from 88.1 per cent in 1977-78 to 73.2 per cent in 2017-18. There is a need to counter this decline and retain the women in agriculture and allied sector by providing drudgery reducing tools and equipment for achieving sustainability.

As per Monitoring, Concurrent Evaluation and Impact Assessment of Sub-Mission on Agricultural Mechanization, 2018 report by Mechanization & Technology Division of Ministry of Agriculture & Farmers Welfare, the current national farm power availability in India is 2.03 kW/ha. For achieving desired intensity of cropping average and productivity, farm power requirement of2.5 kW/ha by 2022 and 4.00 kW/ha by 2030 is considered essential.

Need for Farm Mechanization:

Increased farm mechanization has positive impacts the crop productivity. It also ensures efficient use of energy and input, thus reducing the input cost. It also reduces the losses in storage, processing, handling and transportation. This saving in the resources at an early stage and control of losses translates to increased profit in the end.

The changing climate is reducing the number of workable days in the agriculture. This creates a very small time window between the harvest of the first crop and sowing of the next. Possibility for higher cropping intensity is opened due to mechanized farm operations, as the machines ensure timeliness of the operations.

The rise in adoption of farm machines also raises employment, creates entrepreneurship opportunities in the manufacturing, service and repair sector.

Thus, it can be said that the mechanization in Indian agricultural system in inevitable to boost input use efficiency, reduce human drudgery, increase production and productivity of food grain, reduce cost of production and address issue of labour scarcity and timeliness of operations.

However, it is pertinent to note that there is wide gap in technology absorption capacity across various farm categories and farming systems. In spite of providing subsidies, undertaking various schemes by government, the small and marginal farmers are not able to take advantage of improved mechanization systems.

Need of Custom Hiring Centres:

The women farmers, marginal and small farmers even though they could not afford to buy the machines themselves, could not avoid their usage for certain agricultural operations. A tractor is not a scale free technology, as its purchase is justified if it is put to use throughout the year, beyond the field operation. Hence, and individual farmer purchasing a tractor or machinery for only self utilization was not a viable venture. Some farmers did not have capital to purchase the machine, while others did not wish to invest time and skill to operate the machines themselves. Hence, there was needed a system for these farmers to hire machines from the machines owning farmers, whose machines were sitting idle after working one field only.

Due to climate change, the weather has become erratic with frequent draughts, floods, and other extreme weather events. This has lead to condense the workable days in agricultural operations. As the small and marginal farmers along with women farmers are also affected due to these events, they are forced to adopt the mechanized way. It can be easily done through Custom hiring centres.

History of Custom Hiring Centres:

The concept of giving agricultural machinery for hire surfaced during the early decades of 19^{th} century. CHCs were common place occurrence by mid 1960s due to establishment of

Agro-Industries Corporation (AIC). Government of India initiated a scheme to setup Agro-service centres all over the country by 1971. This scheme had various criteria to set up an agro service centre. They were as follows:

i. Provision of on farm maintenance and repair facility for all types of agricultural machinery;
ii. Provision of machinery custom hire service particularly to the small and medium farmers;
iii. Provision of sale of spare parts, fuel, oil, lubricants and agricultural machinery and equipment;
iv. Supply of agricultural inputs such as seeds, fertilizers and pesticides etc
v. Provision of facilities for soil testing.

Thus it can be seen that the idea of CHCs is not novel and has been in place for several decades. The benefits of which are profound, especially for small and marginal farmers. There is a need to extend these proven benefits to the emerging women farmers.

Benefits of Custom Hiring Centres:

The custom hiring centres make Farm machinery and equipments available to women, small and marginal farmers at affordable rent. It adheres to the timeliness of the operations through matching machinery. When the operations are done with machines even the small women farmers are able to reape the benefits of the innovative crop management practices with specific machinery. Thus it leads to increased productivity and cropping intensity by making ample power available at farm level. It solves the problem of labour shortage in uncertain weather conditions. Even the small women farmers get benefits of advanced technology. The custom hiring centres spread the ownership cost over larger area, thus making purchase viable for the farmers. Better matching equipments are made available to the farmers instead of the few that are owned.

Custom Hiring Centres for Women:

As it has been mentioned before that owning costly farm machinery individually is not feasible for marginal, small and women farmers. Hence, formulation of an SHG by women to establish a Custom hiring center is successful way to ensure women farmers are equal beneficiaries of growing mechanization in agricultural sector of India. Steps to formulate CHC are described below.

A. **Assessment of Village**

Village is needed to be done before setting up a CHC. Following aspects are needed to be assessed:

- **Crops**: The crops that are cultivated will dictate the type of tools to be stocked in the CHC. The cropping intensity of the area should also be taken into consideration while purchasing multiple sets of tools. If the area has mono-cropping then a single set of heavy machines should be sufficient. Higher number

of small manual tools may be more economically feasible. While if the village has higher cropping intensity with less days available between harvest of first crop and sowing of the second, then capital may be invested in purchase of mechanical harvesters.

- **Geography**: The topography of the village is also an important factor while deciding the type of tools included in the CHC. For hilly areas, power tiller is a better option that the tractor. Similarly, the weather will dictate the housing and maintenance regime of the machinery.

For the custom hiring centre to be successful beyond the time of the schemes it needs to be ensured for following:

- **Availability of electricity supply**: If power operated stationary equipments like thresher, pumps, winnowers etc are to be included in the CHC, and then there has to be uninterrupted electric supply to the village, especially during the time of operation. If the case is not so, then based on the capacity of operation either manually operated equipments or diesel engine power equipments may be given.
- **Availability of Fuel:** If tractor, combine harvester is to be included then a fuel supply should be available in the vicinity. Smaller equipments like power weeder, power tillers, diesel engine etc are also dependent on fuel. Thus, for smooth functioning of these machines, the fuel should be easily available to women in the nearby area. Women's time should not be spent on long distance journeys just to purchase fuel to run these machines.
- **Availability of Spare parts:** It needs to be ensured that there is a shop available in the vicinity of the village which sells general spare parts like nuts, bolts, spanners, gaskets etc as these are required in day to day maintenance of the machines. Also there should be a market link available to purchase specific spare part of machines. These salers should also supply generic maintenance material like lubricating oil, grease, oil cans etc for purpose wear and tear.
- **Availability of maintenance:** Proper maintenance of machinery is the key to prolong its life and durability. It also reduces the need for frequent repair. Thus the women should ne made familiar with basic maintenance practices. It must also ensured that there is a basic mechanic shop in the village for working out minor repair issues. Women should be properly linked with the supplier of machines for after purchase maintenance services.

B. **Training**:

The Skilling of the women is required along with the setting up of the CHCs. It can be done by:

- Creating awareness regarding the tools and imparting knowledge of operation
- Front line demonstrations of the machinery
- Training of master trainers

The training should be given in following aspects:

- Assembly of the tools: As the tools that will be delivered will be disassembled at the time of transportation, the women should be encouraged to assemble them at the time of delivery, especially for the small hand tools. This will familiarize them with the parts of machine, which will help them with the maintenance.
- Operation: Proper in field training should be imparted to women. Al the queries should be addressed regarding amount of force to be applied, direction of force applied during operation etc. this will dissuade them from improper using practice and will avoid and hazard or drudgery.
- Maintenance: Women should be taught basic maintenance of machinery like cleaning of arts after use, tightening of frequently loosing bolts, lubricating the moving parts. This regular maintenance will help in avoiding heavy repair cost in long run.
- Management Structure: Proper management structure should be inculcated in the SHG of CHC. This will help in quick decision making regarding operation of CHS. Ultimately it will give a sense of belonging and make the CHC sustainable
- Logbook keeping: It is important to keep proper record of hiring, usage, income received. This record will hold the time of usage of machine thus will help for on time servicing. The record of income is important not only to share profits with the members, but also on making decision for repair, investment in buying more equipments etc. Reinvestment and purchase of higher machinery will lead to growth of the Custom hiring centre.

C. Tangent businesses to the Custom Hiring centres:

There is also a possibility to start a tangent business for women to support not only their custom hiring centers but also other farm machinery owners like:

- Spare parts supply
- Repair and maintenance
- Training center
- Skill on hire

During study Agro Machinery Service Centers of Punjab state, it was observed that the operations of AMSCs were economically viable as they generated profits to the extent of 2 to 30 per cent of the annualized costs. Thus it can be stated that if properly managed a custom hiring center is a profitable venture for women entrepreneurs.

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Digital Technologies: A Way Forward for Developing Gender Sensitive Agripreneurship

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As we all know that Agriculture sector is facing multiple challenges of different kind e.g. production, natural resources, climate change etc. The fourth industrial revolution (i.e. Industry 4.0) may be a solution for larger extent. To implement the industry 4.0 India has a lot challenges in form of literacy and digital divide. Digital literacy in urban and rural areas are not same. According to household-level figures from the 75th round (2017-2018) of the National Sample Survey (NSS), only 4.4 percent of rural households own a computer, compared to 23.4 percent of urban households. In terms of internet access, 42 percent of urban households have access to the internet, whereas only 14.9 percent of rural households have access. Due to lack of implementation intelligent technology like IoT, Cloud Computing, Edge Computing and Unmanned Aerial vehicles, agriculture domain still have many pitfall, in terms of technology. The subsequent sections describe the challenges in digital agriculture and possible solutions for it.

Digital divide in India

There is a vast gap in the digital eco-system between rural and urban India. The covid pandemic had exposed the previously unexposed data related to the digital divide. For example only 15% children in rural India have access to internet. For a state like Uttar Pradesh that has a huge shortage of teachers and does not have the requisite facilities for running computers or the internet-based classes, e-learning was going to be a problem; a nightmare even. In UP, merely 51% schools have electricity and just about 3% schools in the state have a functional computer [3]. So the online study due to the pandemic has brutally affected the rural children. The situation of digital eco-system in the state like Kerala is far better than Uttar Pradesh and Bihar. This shows that there is a vast digital diversity exists in India.

Digital literacy in agriculture

Agriculture has gone through a number of revolutions throughout history that have increased efficiency, production, and profitability to previously impossible levels. The digital infrastructure is the much essential facility to attain digital equality but not sufficient, due attention should be given to enhance digital literacy, sustained use over time with substantial benefit. Only 3% of farmers acquire agricultural information from government institutions, but 94 percent rely on “fellow farmers,” followed by agricultural input merchants (10%), and television/radio (4%). According to a "Situation Assessment of Indian Farmers," just approximately 28% of all farmers use any kind of available as per their need. Around 72

percent of farmers, particularly small farmers, do not have access to any information distribution system that can assist them in adopting new technology. Furthermore, farmers are unable to take use of a number of institutions, organisations, and agencies formed to provide support services [credit, insurance, marketing, and so on]. This results in issues of low productivity, high input cost [4].

IT eco-system in Rural and Urban area

India is known for vast diverse culture, heritage and tradition. The vast diversity of digital ecosystem also found in rural and urban areas. The difference in specific differentiation in digital ecosystem is as follows:

Figure 1: Data on mobile and internet user

Mobile subscriptions: As the graph above shows the total moblie users in India is 1.1 billion (Both smart phone and normal phone) with urban tele-denisity of 139.01% and rural 59.08% (Deptt of telecom.)

Internet access: The web client internet base in 2020 was 299 million. The investigation report indicates India had 622 million dynamic web clients in 2020, when the all population was assessed to be 1,433 million people. This implies around 43% of the population is using internet services, characterized as somebody who had accessed to the web in the earlier month.

ICT education: ICT is the best way for improving the efficiency and reach of the mainstream production of goods in every corner of rural India. It is very useful in creating agripreneural activities and has potential to impact the livelihood strategies.

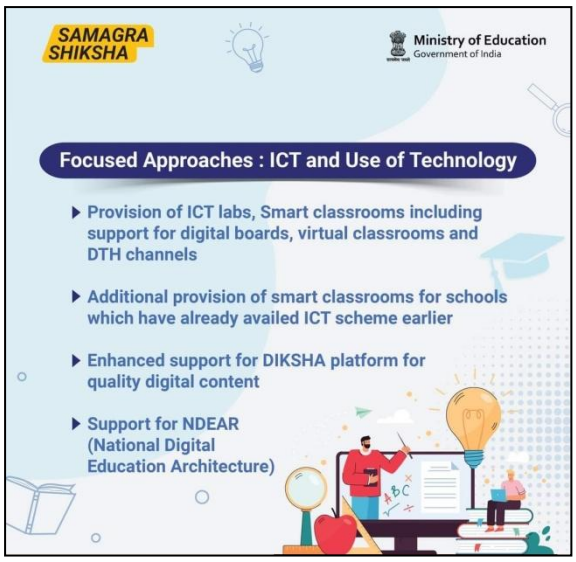

Figure: 2 (a) Ministry of Education promoting ICT Education and (b) Digital India Initiatives for Digital Payment Solutions

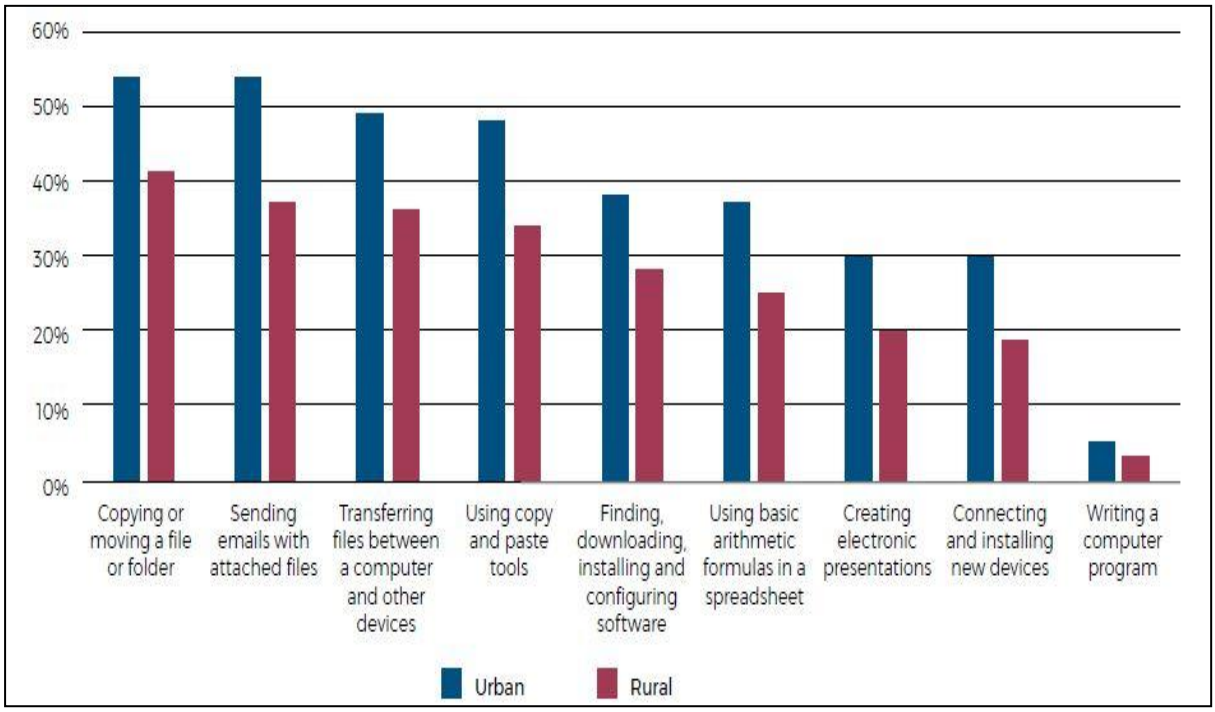

Figure 3) Knowledge for Levels of ICT Activities in rural and urban areas (global status)

Policies and programmes for enabling digital agriculture

Digital India: The vision of Digital India programme is to transform India into a digitally empowered society and knowledge economy. The programme was started in 2015 and impacted almost every sector. Digital India has brought major changes in agriculture sector too. Today almost every agriculture related website have a dashboard and mobile application to help the stakeholders.

PMGDISHA: It is the scheme to make six crore persons in rural areas, across States/UTs, digitally literate. It is basically for empowering the rural citizens of India specially targeting marginal section of society.

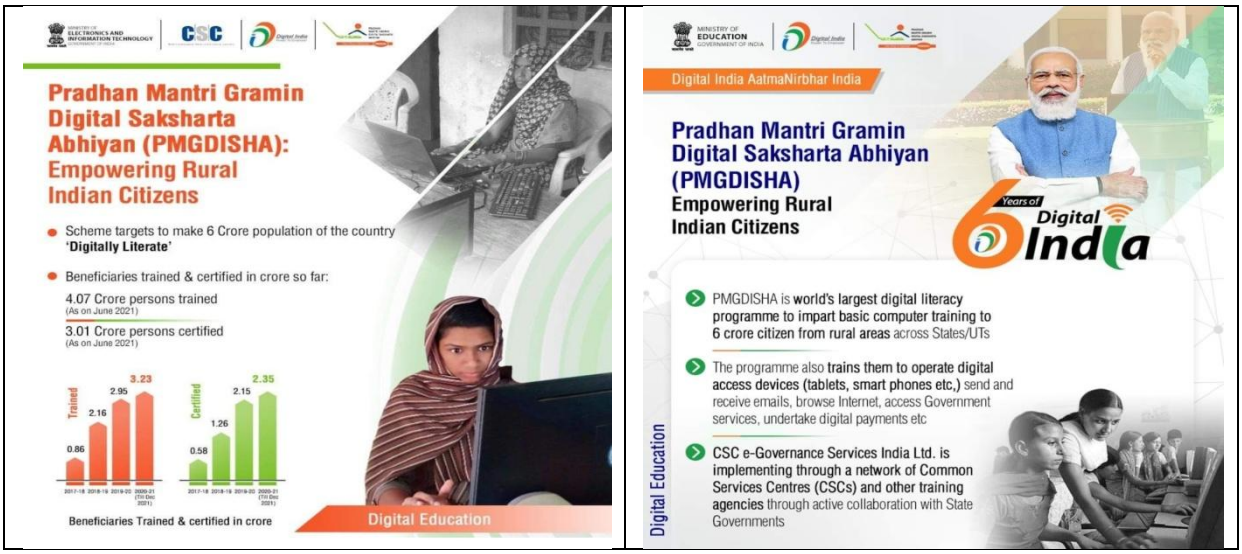

Figure 4: PMGDISHA initiatives for digital literacy

Digital technology supporting modern agriculture

Drone Technology: Drone technology has changed the scenario of modern agriculture. The manual intervention has reduced drastically. The technology is able to perform various task like Soil Analysis for field planning, Seed Pod Planting, Crop Monitoring, Crop Spraying, Irrigation, Crop health assessment, Crop surveillance, Controlling weed, insect, pest and diseases, Scaring birds etc.

Artificial intelligence: Artificial Intelligence has already proven its efficiency in other fields so it must be used in Agriculture sector. There are various AI-enabled apps available in market for different sectors. It is well suitable in monitoring health of the cattle, vaccination of the cattle, etc. Due to its efficacy it is widely adopted by different sectors.

The use of artificial intelligence in agriculture helps farmers understand information from data such as temperature, precipitation, wind speed, and solar energy. Analysis of historical stock data provides a better comparison of ideal results. The best aspects of artificial intelligence implemented in agriculture will not eliminate the work of human farmers; on the contrary, it will drive the procedures.

The implementation of AI emphasizes defective crops and strengthens the prospects for the production of healthy crops.

The development of artificial intelligence technology is better managed by agrobased companies.

AI is used for use in applications such as weather forecast and pests or pest identification.

Artificial intelligence can improve crop management practices, resulting in investing in algorithms that many technical companies are useful for agriculture.

IoT: The Internet of Things is also the latest technology adopted by the agricultural sector. The IoT devices communicate with each other, and the artificial intelligence enabling mechanism can make decisions. Intelligent agriculture based on the Internet of Things is a system designed to monitor farmland and realize irrigation automation with the help of sensors (soil moisture, humidity, light, temperature, etc.). Farmers can observe field conditions from anywhere. Irrigation systems equipped with IoTe not only save water, but also ensure that crops receive the right amount of water for optimal growth. This irrigation method is based on soil moisture levels rather than watering at predetermined intervals. Real-time data can be used as input for crop monitoring and yield modeling. However, using existing platforms to record information in real time to model and monitor crops is puzzling.

Figure 5: Mobile application showing usage of Smart farming

In the Covid era, specifically in India (Unmanned Aerial Vehicles) UAV can be used for monitoring the agriculture land to helps the farmers using computing paradigm. By the use of artificial intelligent techniques and Meta-heuristic optimization technique, we can optimize the task evaluation, efforts done by the farmers and compare the outcome with previous results in agriculture.

We can easily access above optimized results in out mobile devices by the use of Edge application. The cloud computing provides us the facility to store data coming from sensor, as a outcomes of agriculture land (whether in case of use of treatment of crops, find the soil water level etc) using IoT and UAV services.

Portals Helping Farmers

Integrated Scheme for Agricultural Marketing (ISAM) : The one of main objectives of this scheme is " to use ICT as a vehicle of extension to sensitize and orient farmers to respond to new challenges in agricultural marketing ". So due to the issue of digital literacy the stakeholders are not taking benefits as up to the mark.

Farmer Portal

The portal is intended to provide relevant information and services to the farming community and the private sector through the use of information and communication technologies, to complement the existing distribution channels provided by all 'supply. The Farmers Portal is an attempt in this direction to create a one-stop-shop for all information needs related to the field of agriculture, animal husbandry and fish production, sale / store of an Indian farmer. With this Indian farmer, there will be no need to sift through the maze of sites created for specific purposes

E-NAM: The NAM portal provides one aggregator for all APMC related information and services. This includes incoming goods and prices, commercial offers for buying and selling, providing responses to trade offers, among other services. While the flow of raw materials (agricultural products) continues through the mandis, the online marketplace helps to reduce transaction costs and information asymmetries.

MKISAN

mKisan SMS Portal was designed to provide a leap in farmer coverage and geographic area by disseminating timely, specific, comprehensive and essential knowledge to farmers. farmers, but also to respond to their concerns and questions.

Different mobile applications: Hundred of user friendly mobile applications have been developed for Farmers. The different mobile apps covers all sectors of agriculture's. e.g Horticulture, fisheries, animal science, crop science etc. A brief list of apps are also given at ICAR website for their help.

Figure 6: Smart agriculture using the mobile application

Benefits related to the Movement towards digital agriculture:

Global reach: The digital technology has a global reach or world wise access of farming techniques. farmers may be benefitted from many sources digitally.

Enhanced Data collection: data is an asset in modern world. Based on the data, the automated systems are able to take decision accurately about the showing time, soil test, pest management etc.

Low time: As we have fast computers today the collection, analysis and decision making process takes less time.

Provides better suggestion: Based on the data accuracy the modern systems are able to take decision wisely. The invasion of AI plays a pivotal role for this purpose.

Efficient in terms of cost: In today's digital era the digital devices are not too much costly, so it can be used as one time investment for taking benefits for years.

Increased productivity: The productivity must be increased if the digital technology will be used in agriculture sector.

Conclusion

Digital technology has potential to change the scenario of agriculture. In today's digital era, from field to market every action can be performed with less physical participation. The biggest hurdle to implement the digital eco system is the ICT education of farmers. The adaptability of using mobile apps and digital devices by farmers may increase the use of IOT, AI practises in agriculture. Definitely it can be said that IoT has full potential to bring second wave of green revolution.

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