

COMPENDIUM

ICAR SPONSORED SHORT COURSE ON **Gender Gaps and Interventions to Address Gender Issues in Agriculture**



भाकृअनुप-केन्द्रीय कृषिरत महिला संस्थान
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ON
Gender Gaps and Interventions to Address Gender
Issues in Agriculture

(17-26 September, 2019)

Dr. S. K. Srivastava
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ICAR - CENTRAL INSTITUTE FOR WOMEN IN AGRICULTURE, BHUBANESWAR



Gender Gaps and Interventions to Address Gender Issues in Agriculture

(Compendium: ICAR Sponsored Short Course on 'Gender Gaps and Interventions to Address Gender Issues in Agriculture' organized at ICAR-CIWA, Bhubaneswar during 17-26 September, 2019)

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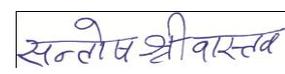
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FORWARD

Women play a pivotal role in agriculture as agricultural labour, as farmers, co-farmers, family labour and as managers of farms and agri-entrepreneurs. Despite being the backbone of agricultural economy in developing regions, they remain relatively unattended group. Less access to knowledge and technology, a host of other socio-economic factors have an adverse impact on the lives of farm women and they have often not been able to take advantage of opportunities from new technologies, markets, or contract farming. Rural-urban migration, growing pressure on land, water, agro-biodiversity and firewood and natural disasters associated with climate change have also affected them. The role of women in using, managing and protecting the environment generally is increasing day-by-day in view of the male migration. These are some major constraints identified by ICAR-CIWA to address the gender issues through research and capacity building.

Today, gender mainstreaming and women empowerment have become major strategies for sustainable and inclusive agriculture. There is need for gender sensitive approaches and methodologies to enhance access of women to critical resources, programmes and services. Lack of reliable data and evidences on women in agriculture and lack of gender sensitivity in the system are the major impediments in engendering agriculture. Research on evaluation of existing systems from gender perspective, alternative approaches, models and methods are required to address the information and extension needs of the rural women. Since women in agriculture is an important area of research, capacity building of all the stakeholders is required. In this context, ICAR-CIWA has a larger role to play in the NARES. Keeping this in view, the course contents for ICAR sponsored short course have been planned accordingly, and this compendium has been brought out for the benefit of stakeholders.

I appreciate the efforts of resource persons in developing and sharing materials for the short course, and compliment Dr. Lipi Das, Course Director and Dr. Ananta Sarkar and Ms. Gayatri Moharana, Course Coordinators for bringing out the compendium on *Gender gaps and interventions to address gender issues in agriculture*. I hope the compendium will be immensely useful to the participants for effective planning of the activities related to gender and making farm women an empowered partner in agricultural development.


DIRECTOR

PREFACE

Women contribute enormously in agricultural growth and development through their involvement in crop production, horticulture, animal husbandry, fisheries, natural resource management *etc.* In spite of decline in number of women cultivators and increase in number of women agricultural labourer they constitute a significant workforce in agriculture. Region-wise figures show that agriculture supports a very high proportion of economically active women, particularly in Asia and Africa and in India, it is about 65%. Women's contribution varies across regions, socio-cultural and agro-production systems. On the other hand, the persisting gender gap in access to and control over resources remains an important concern which has not only kept women in a vicious circle of low productivity but also has thrown up questions about inclusive and sustainable growth of the sector. Today, how to bridge the gender gap and empower women with new knowledge and technology is a great challenge, particularly in the context of socio-economic and climate related changes. Importantly, our approach to research has not been gender sensitive and there is a general reluctance on part of a large section of researchers to include gender component in research programmes. Considering the above, the Short Course on 'Gender Gaps and Interventions to Address Gender Issues in Agriculture' is organized to sensitize stakeholders about the paramount concern of gender disparity in agriculture and realizing the potential roles of women farmers, updating with recent gender analysis tools and to design and develop suitable interventions and approaches for assessment and bridging of gender gap in agriculture. The course was designed keeping in view the requirements of the participants with different backgrounds. The contents included issues related to women in agriculture in various domains of Research & Development, methodologies for strengthening gender perspective in interventions, gender disaggregated data, monitoring and evaluation of gender based R&D projects. All these were compiled to develop this Compendium which, we hope, will be useful for agricultural R&D stakeholders.

The financial support provided by the Indian Council of Agricultural Research (ICAR), New Delhi in organizing this Short Course is sincerely acknowledged. We are grateful to Dr. S. K. Srivastava, Director, ICAR-CIWA for his guidance and support in organizing the programme. We are also thankful to all the resource persons, who accepted our request and shared their valuable knowledge and experience with the participants. We thank all the Scientists, Technical, Administrative, Finance and other supporting staff of ICAR-CIWA for their whole-hearted support for the programme.

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GENDER CONCEPTS, GAPS AND SENSITIZATION OF STAKEHOLDERS

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INTRODUCTION

Agriculture remains as prime source of women's livelihood and women remain as backbone of agricultural workforce. Today, they represent 43 percent of the global agricultural labour force. Although women are responsible for over half of the world's agricultural production, only 2 percent of women in developing countries and 20 percent in developed countries own land. Their work is often overlooked in agricultural and rural development initiatives. (IFOAM, 2007). Both men and women contribute significantly to agricultural production yet, their access to agricultural production resources differ (FAO, 2010). Women's low participation in decision making is a typical aspect of gender inequality in agriculture. This inequality in access to and control over production resources between men and women is called as gender gap in agriculture. It hinders women's productivity, limits their livelihood options and exacerbates financial strain on them.

Another side, farming is the most dynamic and rapidly growing sector in India. By improving farm women's access to agri-production resources, their potential could be unlocked, thereby enhancing their efficiency and productivity in farming. Farm women's capacity to adopt improved farm technologies mostly depends on their access to agri-production resources. If women had provided the same access to productive resources as men, they could boost yield by 20-30 percent; raising the overall agricultural output in developing countries by 2.5-4 percent. This gain in production could lessen the number of hungry people in the world by 12-17 percent (FAO, 2011). The contribution of women to food and nutrition security cannot be overlooked. Nutrition security of all human beings continues to be an important development agenda of the global community. This is clearly reflected in the Sustainable Development Goals (SDGs) of the United Nations Organisation to be achieved by 2030. Out of 17 SDGs, gender equality has significant implications for creating a nutrition secured society- a target that is still elusive despite the collective efforts of countries and organizations across the globe.

The role of women in agricultural and rural development is intimately related to the goal of comprehensive socio-economic and political development. Agriculture is one of the foundations of human society, and a key economic sector in India. Women are central to agricultural and rural development everywhere. It is impossible to talk about the processes occurring within an economy without mentioning women. More than half the population of India lives in rural areas. Male urban immigration, both permanent and seasonal, is occurring at an ever-increasing rate. The proportion of rural women to men is growing. Almost two-thirds of rural women are from low-income households. Indeed, the poorest group of all are female-headed households. In some areas, this category exceeds 35-40 percent of all heads of household.

- ❖ Women spend 354 min/day and men spend 36 min/day on household activities
- ❖ 65 percent of economically active women are in agriculture
- ❖ Represent 43 percent of the agricultural labour force worldwide
- ❖ Devote 45 - 50 percent of their time to agricultural activities

- ❖ Access to only 5 percent of agricultural extension resources, globally
- ❖ 79 percent of women continue to be engaged in agriculture and allied activities as against only 63 percent of men

(Courtesy: Gender Reference Manual, 2016, ICAR-CIWA)

WOMEN, SEX AND GENDER

Gender applies to one sex or the other, and relates to the way each behaves in a given situation. While sex is biologically determined, and cannot normally be changed, gender is a result of socialization into a male or a female role which ascribes certain behaviour according to socio-cultural norms for one's sex. Agricultural policy makers have for decades turned a blind eye to women farmers because they think of farmers as men, thus denying women's claim to participation in farming and other activities which directly affect their lives. As a result, rural women have lagged visibly behind men by most social and economic criteria. If the bias in favour of male farmers had no negative impact on agricultural production, gender issues would probably still remain unrecognized. Until an economic imperative, such as labour shortages, declining yields, or recognition of the need for the special knowledge which women have, demands a change, most agricultural policy makers see little need to address gender issues. Some startling revelations about women farmers, derived from alternative data sources are:

- Majority of women are farmers in India, although invisible because their work is uncounted.
- Women's work day is longer than men's, and most have reached the limits of endurance in stretching their day.
- Due to experience in indigenous farm implements, women harbour specialized knowledge, and represent a pool of highly-skilled labour in many areas of agricultural and rural development, which men lack.
- Women increasingly head rural households, and are the chief economic providers for their families. About 12 percent of rural households in India are now female headed with small holdings. About 48 percent of India's self-employed farmers are women (NSSO, 2010).
- Women's productivity is severely constrained by the fragmentation of their time, their dual and triple responsibilities, and their lack of access to essential inputs including knowledge.
- Small farm production is increasingly unattractive to males who too frequently abandon agriculture in favour of better remunerated work in other sectors, leaving women to eke out a living on often degraded land.
- There is no biological imperative for men to maintain a stranglehold on technology, whether biotechnology or machines.
- Agricultural research and extension largely ignore the major concerns of women farmers - nutritious food crops, hardy planting materials, household food security, home storage and small-scale processing, for example.

RIGHTS AND STATUS OF WOMEN FARMERS

In most countries, legislative changes have been made to facilitate women's rights to inheritance and ownership of land, but in practice they still have great difficulty in realizing the benefits which should flow from this. The same is true of credit programmes. Where women's direct access to agricultural credit was previously barred, many women found the de jure rifling of these barriers did little to change their de facto situation. Furthermore, many bankers themselves were party to these infringements by omission. Institutions have to adopt facilitating policies and practices to promote the participation of women according to their rights. Their lower status and self-esteem will otherwise act as powerful constraints to their participation, a situation not always recognized as a major reason for women's failure to take advantage of rights. Facilitating policies will accommodate such realities as those where women farmers need special considerations which recognize their dual and triple responsibilities in "productive and reproductive" work, their lower education, their lack of mobility, lack of access to capital, and socio-cultural constraints imposed by caste, purdah, class and religion.

CHALLENGES IN WOMEN'S LAND RIGHTS

More than 80 percent of women in rural India are dependent on agriculture, yet less than 10 percent own land, the most important asset for supporting families and providing food, income, and security. Land in the rural context is the most important asset available to a family, yet women are systematically excluded from land and asset ownership and control both in their parental and marital homes. Because of their lack of legal rights and documentation, many have not enjoyed access to government services and poverty alleviation programs. Without land in their names, women face constraints to access institutional credit, such as bank loans.

A CIWA study conducted among tribal farm families in Odisha, found the systematic exclusion of tribal women from land ownership, which is as seen in mainstream Hindu societies. The study revealed that 94 percent of the tribal farm women don't own land, 96 percent don't insist for land ownership/ don't even perceived the need for land in their names, to avoid conflicts within the families. In an attempt to understand the perception of men about the land rights for women, nearly 100 percent were not in favour, which was justified by them in lieu of expenditure spent on daughter's marriages. Only about 6 percent of tribal women own their land, either through inherited from husband being women headed families (4 percent), or through inheritance from parental families (2 percent). Almost, 98 percent didn't inherit parental land, though 2 percent could inherit parental land due to lack of siblings. Though lacking ownership rights, 88 percent had control rights, which related to decision making on land use pattern, and 98 percent had access rights, which related to use of the land for productivity. On a query to express the perceived constraints due to non entitlement to land, almost 100 percent of the women expressed 'nothing', which necessitated the need for sensitization of tribal societies on land ownership for women and associated benefits.

Societal norms and traditions are patriarchal in nature, even in tribal societies there is strong resistance to the idea of land and asset ownership by women stemming from societal norms and traditions that are patriarchal in nature. The social factor of maintaining a harmonious relationship with natal family is a key factor for women not claiming their inheritance rights. Lack of land titles in women's names limits their access to credit. Lack of social mobility also restricts women's access to bank loans/ micro credit. Making the tribal farm women, realize the need for land ownership itself is a great challenge, rather addressing any external challenges. Further, enhancing women's productivity and livelihood security by securing access to land

ownership, credit access, information support, and marketing support can go a long way in ensuring social and economic empowerment of tribal farm women.

GENDER AND RESEARCH

It is rare for any research not specifically on women in some way, to adopt a gender-sensitive approach, and this reflects research policy beginning with the research agenda. Agricultural research is biased in favour of "male" agriculture, in cash crops, agro-industry, export commodities and mechanization. The resulting biases in "findings" and, therefore, conclusions create a cycle of skewed data that provides misleading information and emphases, which in turn lead to policies which reflect and reinforce bigoted stereotypes. A classic and universal example is in the reflection of women's work, where gender-blind definitions, concepts, and data collection methods make accurate enumeration impossible. Labour statistics thus tell us that women are merely the idle dependents of men.

Both male and female researchers have been guilty of adopting official definitions and concepts of economic activity and resources, legal and conceptual frameworks and boundaries, and the gender-insensitive tools traditionally applied in analysis. Gender-sensitizing usually brings as many surprises to women as to men. So universally is patriarchy institutionalized in most societies that it is difficult for many to see it as such. Research policy, for example, recognizes the "natural" rights of men to own land when studies of land tenure are made and data is collected from the "heads of household". Such will generally exclude data about women's de jure and de facto rights to inheritance, ownership and various forms of female tenure because a male head of house is often ignorant about land tenure not concerned with his own particular title.

The traditional tools of analysis also reflect patriarchy and male-biased concerns. Cost-benefit analysis excludes much of the subsistence production of women. Yet for many rural women, this represents the overwhelming majority of their output. Productivity, production and profit are measured by the market values of goods and services, so women's non-market production and reproductive work is ignored. Economic benefits are assumed to benefit everyone even when researchers know this is untrue.

The gender issues in agricultural research policy are very wide, and each policy would need careful examination to identify the issues and linkages. In general, it is true that the priorities are set by men and some women, who are unaware of gender issues, and that these are seldom considered unless the research is sociological. But even social research can be totally gender blind. The underlying causes of imbalance in food production which affect food security at national, regional or district and household levels, for example, influence food and nutrition security at the individual level, and are clearly gender-linked. They relate to increased demands on female labour; changing sex roles and responsibility for farm management, especially on small farms; gender differences in access to resources, including land, water, credit and technologies; time use and the division of labour; demographic changes relating to family size; dependency ratios; migration patterns and land use planning; the loss of indigenous knowledge and technology without appropriate substitutes; the competition for land, water and other resources, and between food and non-food crops; seasonal fluctuations and economic access to available food, pricing policies; items qualifying for subsidy - cash vs. food crops, male vs. female crops; credit and marketing policies; resettlement and transmigration programmes, environmental issues. The list is endless.

GENDER AND TECHNOLOGY

No agricultural technology is gender neutral. Whether a hand tool, a machine, a storage bin, or biotechnology, all carry different implications for men and women. Technology is developed by men and women for use by women and men, or specifically for one sex or the other. Most are developed with a male or a female user in mind. Such implements respond to the demand created by those who want to use them and can afford to buy them. This results in a bias determined by the culturally-ascribed division of labour, and the limits placed on women's access to finance. Policy makers who have made such sex-discriminatory norms automatically will set the agenda for technology development accordingly, and planners will allocate resources based on the same set of norms. Thus we find farm women concentrated around the most menial, boring, low-paid, "low-tech" activities, while men clamber aboard tractors and combine harvesters. In a market-led economy, technology always addresses the needs of the monied clientele first. And it is men who have the money. In a centrally-planned economy, patriarchy dictates that machines are for men; that girls and women are "incapable, by reason of their sex, to understand, operate and maintain machines." In very few countries has this stereotype been challenged. Hand tools to speed up women's work in transplanting, weeding, harvesting and threshing, "yes." Machines for women? "No."

Governments that allow technology development and transfer to be totally market-driven abrogate their responsibilities to the poor, most of whom are women, when they fail to introduce checks and balances into such a system. As long as discrimination precludes women's participation as equal partners in development, Governments must assume some responsibility for ensuring gender-related research and development as well as they must oversee the transfer of proven technologies to address rural women's work. The primary aim should be to help women achieve the following:

- reduce the time spent on tasks
- increase productivity and income
- reduce drudgery
- diversify their production
- improve and standardize product quality
- participate in their own technology development programme so that all the above occur naturally and without pain or unnecessary conflict

SOCIO-ECONOMIC AND GENDER ISSUES

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 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 percent 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) Restricted 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) Limited access to extension services:** There is huge gap in number of men and women extension workers in India. About 85 percent 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) Inadequate 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) Lack 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) Less participation in decision-making:** 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 hazards:** 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.

EXTENSION STRATEGIES FOR GENDER MAINSTREAMING AND IMPROVING LIVELIHOOD

Women farmers are less productive because they do not have enough access to technical information, credit facilities, extension services, inputs and markets. This less productiveness occurs despite their working longer hours than men. Hence, it is pertinent to build their capacity and ability to shoulder new challenges and increase their efficiency. Important extension strategies to improve women's access to productive resources are as follows;

- a) **Gender balanced extension system:** Agricultural knowledge is transferred inefficiently from men to women and vice-versa. Hence, there is need to increase number of women extension workers thus leading to a gender balance in extension system. Thus, women farmers will have easy access to agricultural information and technologies.
- b) **Mass media support:** The access of farm women to mass media is limited due to number of reasons. But it has potential to carry messages to a large number of farm women. However, we should examine how different media support and extension model can contribute to the dissemination of farm information and technologies to the women.
- c) **Women friendly technologies:** The scope of agricultural knowledge & technologies for women farmers is increasing gradually. There are many technologies developed and standardized for agriculture by the National Agricultural Research System, but their potential for women and agriculture has not been adequately demonstrated. There is dire need to harness the potential of science and technology by demonstrating their benefits thus empowering women. Extending the women friendly tools and technological innovations will reduce the burden, and save time and energy of women.
- d) **Credit and technical support:** Technical support should be provided to farm women which facilitates their multiple tasks. Credit facility should be given to women SHGs to increase income by way of developing micro-enterprises.
- e) **Capacity building of women:** Different agricultural training programmes in different areas will largely improve the access to agricultural knowledge and information among farm women. Therefore, gender sensitive extension training materials should be developed.
- f) **Reorientation of extension and research system:** Extension and research system should be reoriented and priorities should be given to women farmers.
- g) **Women farmer groups:** There is need to organise the women farmers into groups in order to strengthen their way from subsistence cultivator to commercial cultivator. Extension workers can be trained to work more closely with women and organise them into groups.
- h) **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.

CONCLUSIONS

The above overview leads to the conclusions that:

- Women's participation in agricultural production is extensive. Women work in crops and livestock production, cottage industry and household and family maintenance. The exact nature of each activity is determined by social class, season, specific crops, region and size of holding.
- Without female input most rural households would cease to be economically viable.
- Women work predominantly on their own holdings.
- Recognition of women's work in agricultural and rural production processes does not necessarily lead to policies directed at women. Policies for women are usually adhoc.

- When drafting agricultural policies, planners do not take into account the impact on women. Such policies, therefore, often have negative effects on women.
- A major drawback in policy formulation is the lack of adequate statistics. Disaggregated data on women and their activities, particularly in non-farm households, is not available to planners.

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.

Annexure : Salient Gender Concepts (Source: Sabita, M. & Abha, S., 2015)

Sex: Biological differences between women and men, which are universal, obvious and generally permanent.

Gender: The socially constructed differences in roles and responsibilities assigned to women and men in a given culture or location and the societal structures that support them. Every society has different 'scripts' for male and female members to follow. Thus members learn to act out their feminine or masculine role, much in the same way as every society has its own language.

Triple roles: Are roles (tasks and responsibilities) men and women may have related to: production (producing money value), reproduction (the child bearing and rearing responsibilities required to guarantee the maintenance and reproduction of labour force), community management/ community politics (producing community goods and well beings).

Gender analysis: Gender analysis is a tool to better understand the realities of the women and men, whose lives are impacted by planned development. These include gender issues with respect to social relations; activities; access and control over resources, services, institutions of decision-making and networks of power and authority and needs, the distinct needs of men and women, both practical and strategic.

Gender equality: Gender equality means that women and men have equal conditions for realizing their full human rights and potential to contribute to national, political, economic, social and cultural development, and to benefit from the results. It is therefore the equal valuing by society of both the similarities and differences between women and men, and the varying roles that they play.

Gender equity: Gender equity is the process of being fair to women and men. To ensure fairness, measures must often be available to compensate for historical and social disadvantages that prevent women and men from otherwise operating on a level playing field. Equity leads to equality.

Gender blind: Gender blind is a person who does not recognize that gender is an essential determinant of life choices available to people in society.

Gender bias: Perception that both sex are not equal and do not have similar rights to resources.

Gender discrimination: Unfavorable treatment of individuals on the basis of their gender

Gender mainstreaming: It is the process of assessing the implications for women and men of any planned action, including legislation, policies and programmes, in all areas and at all levels. It is a strategy for making women's, as well as men's concerns and experiences, an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal is to achieve gender equality

Women and development: It emerged from a critique of the modernization theory. The theoretical base of wad is dependency theory and focuses on relationship between women and development process and examines the nature of integration. It is concerned with women's productive role and assumes that once organizational structures become more equitable, women's position would also improve.

Gender Budgeting: It is the process of entailing a gender-based assessment of budgets, incorporating a gender perspective at all levels of budgetary process in order to promote gender equality. Gender Budgeting is a powerful tool for achieving gender mainstreaming so as to ensure that benefits of development reach women as much as men. It is not an accounting exercise but an ongoing process of keeping a gender perspective in policy/ programme formulation, its implementation and review. GB entails dissection of the Government budgets to establish its gender differential impacts and to ensure that gender commitments are translated in to budgetary commitments.

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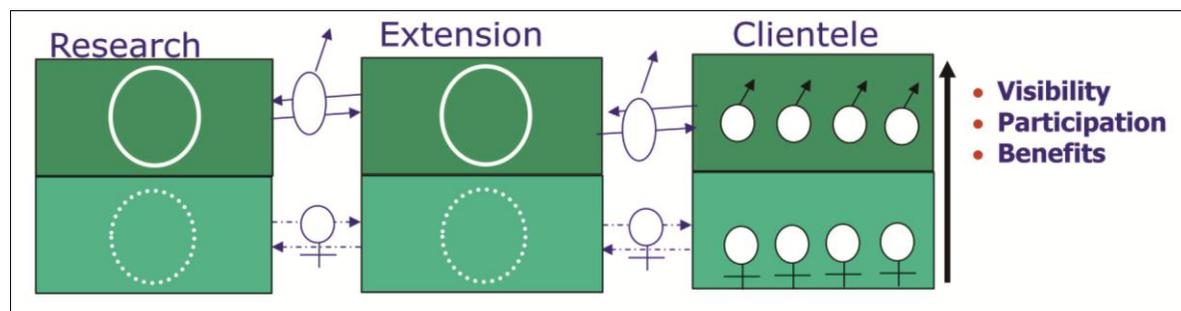
INTEGRATING GENDER DIMENSION INTO AGRICULTURE RESEARCH AND DEVELOPMENT PROJECTS

B. N. Sadangi

Introduction

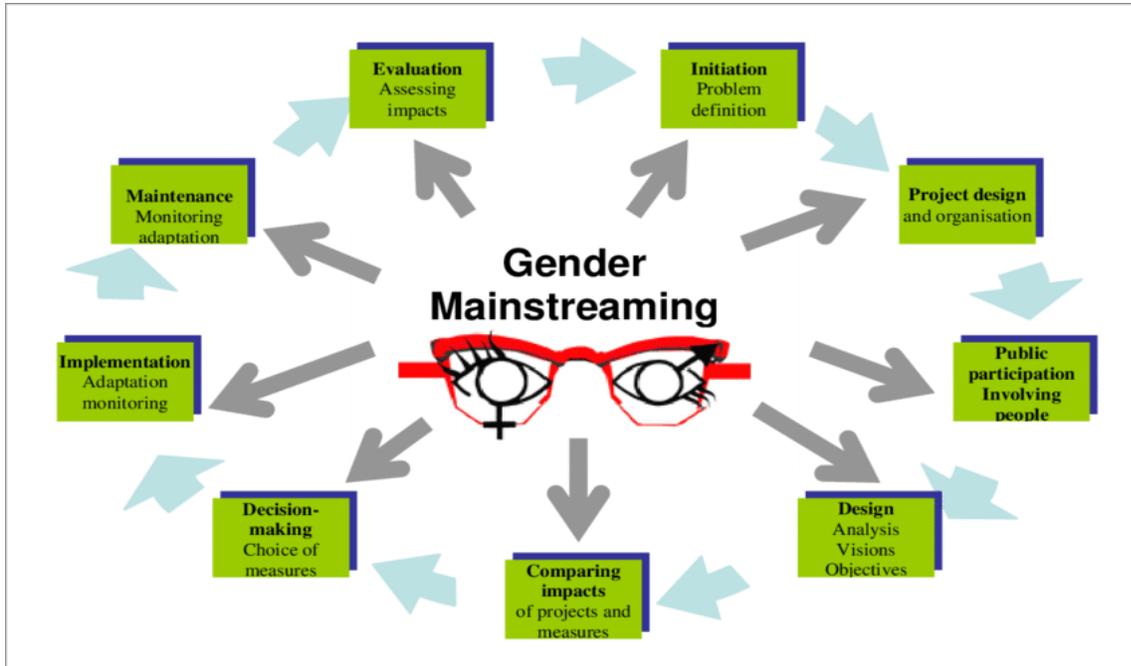
Agrarian Development in India is heading towards a crisis due to complex situation arising out of changing goals, biotic and abiotic stress, labour constraints, market glut, loss making farms, poor growth of agro industries and lack of interest among the youth towards agriculture. The said scenario has impacted the Central and State Government to implement pro farmer agricultural policies and programme to mitigate their sufferings and maintain pace agricultural development. Socio-economic development in rural areas cannot be thought off for about 60% of the population who are dependent on agriculture and contributing only 13% to GDP. Gender mainstreaming in agriculture has come up as a new trend worldwide to address the inequalities between men and women and ensure gender equity. In the said context the World Conference on Women, Beijing Platform Action (1995) and United Nation's Millennium Development Goals (MDGs) have developed objectives and guidelines for all the participating countries and suggested action plans for empowerment of women and mitigate their problems. India's position with respect to gender inequality as reported by Human Development Report (2018) of United Nations Development Programme (UNDP), is 130th(0.841 out of 1.000) among 189 countries of world. Can rice farming be taken up in a gender sensitive perspective and bring socio-economic changes in their lives?

Research and Development Scenario



Gender Mainstreaming

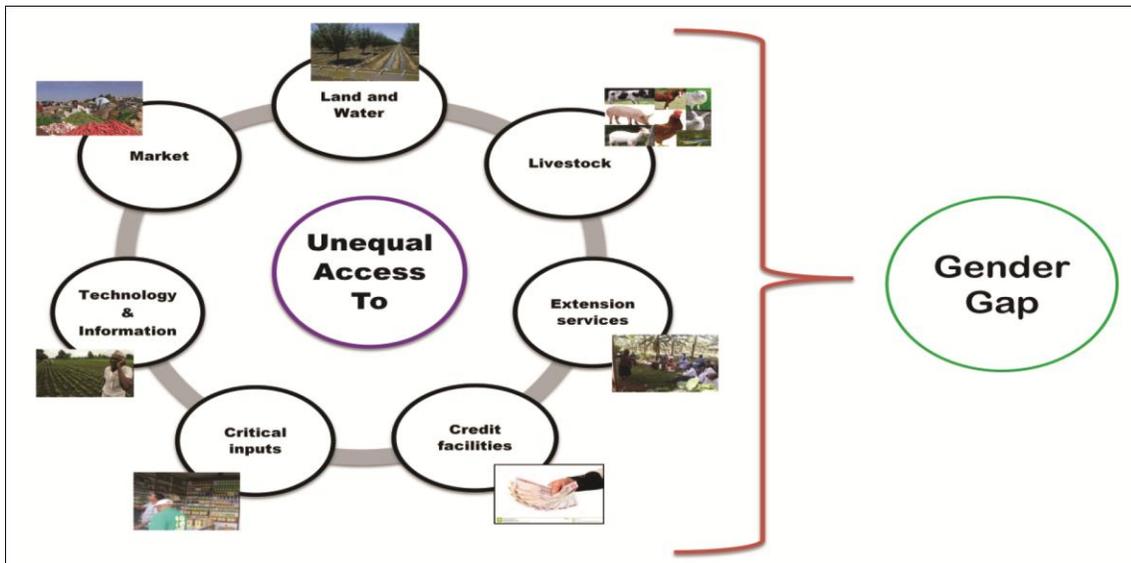
“Mainstreaming gender perspective is the process of assessing the implications for women and men of any planned action, including legislation, policies or programs, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programs in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal is to achieve gender equality.



Gender Gap

The gender gap is the difference between women and men as reflected in social, political, intellectual, cultural, or economic attainments or attitudes.

Goal: To reduce Gender Gap



Gender Scenario

In spite of enormous contribution of women to rice farming, they remain invisible and do not derive the benefits from the farming due to them. The gender equity in the household allocation of resources as well as Research and Development (R&D) is the missing link which affected the sustainable development of rice and empowerment of women in rice farming. Studies and experiences in rice based farming system especially in

the rain fed situation have shown that women have less access than men to critical productive resources and services including credit, farm inputs (e.g. seeds, fertilisers, pesticides), marketing facilities, extension and information. Lack of land titles in the name of women, make the women ineligible to take institutional credit for agriculture. Further small holder households particularly women may have specific needs and priorities which are not given due attention by the community and development agencies. According to FAO (2011), if women had provided the same access to productive resources as men, it would boost yield by 20-30%, raise overall agricultural output by 2.5-4% and reduce hunger by 12-17%. In 2000, IRRI initiated micro level studies on the incidence, patterns and impact of labour out migration on rice productivity and gender roles in Eastern India. Synthesis of findings revealed that migration of males is higher in rainfed than in irrigated rice ecologies. Men migrate on a short term (seasonal) or long term basis. The women, particularly from the lower socioeconomic status have higher illiteracy rate, low access to resources and suffer from social exclusion. Women in migrant families have shown greater capability and decision making power than women without migrants (Paris *et al.*, 2006).

Gender Sensitive Research

It is important to identify key areas, activities and processes within the research cycle and ensure these are gender sensitive. Some of these could include;

- ✓ Make research objectives, hypothesis and research questions gender sensitive. If the key objectives of the research are gender blind, it is likely that the methods and activities are going to be gender blind.
- ✓ Use gender sensitive research methods, and methods that take into account the needs, opportunities and constraints of men and women.
- ✓ Have mixed teams of men and women; ensure equal gender representation at different levels of the organization. It is especially important to include young researchers and women researchers as team leaders.
- ✓ Collect sex disaggregated data. There are good practices for collecting and analyzing sex disaggregated data (Doss and Kieran, 2013). Most often, researchers analyse data by head of household which can often mask important intra-household dynamics.
- ✓ Collect data from men and women and ensure the voices of women and young people or other marginalized groups are heard in the research.
- ✓ Analyze and present gender data and indicators in reporting
- ✓ Value and pay equally for men and women's work and create conditions at work that are conducive for men and women
- ✓ Use gender sensitive language

Steps for Developing Gender Sensitive Research Proposal

- Understanding gender roles
- Defining gender relations
- Assessing resource endowments
- Identification of gender specific problems and commonness
- Evaluation of problems and prioritisation
- Conceptualising interventions
- Assessing people's perception about the line of action

- Selecting the most feasible course of action

Examples of Research Proposals in Rice

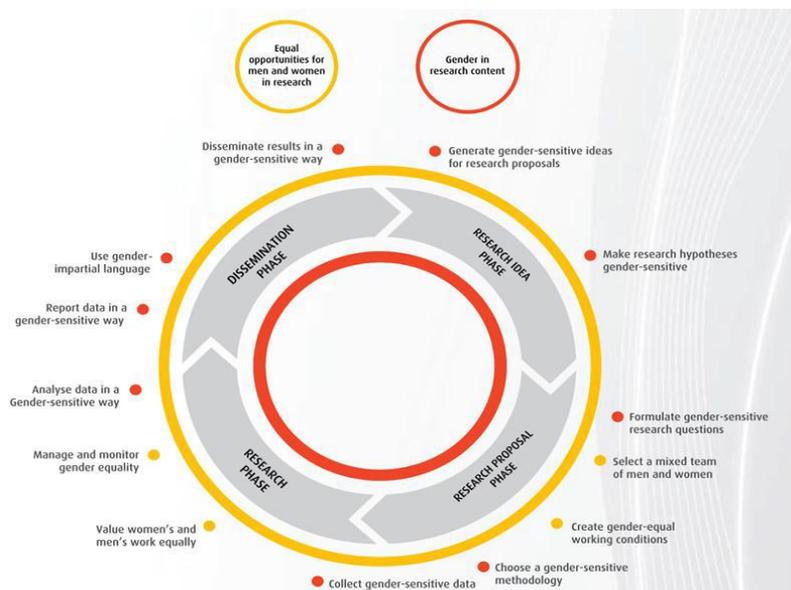
1. *Crop improvement*- Emphasis given for yield maximization, disease and pest resistance and suitable ecology but the quality aspect of rice which is women's priorities is often over looked. We find women mostly concerned with rice quality suitable for parboiling, flaking, and puffing, traditional Cake/ Pitha preparation. Even women's demand for rice suitable for Dosa and other commercial Cake is not attempted. Women and children in rural areas suffer from malnutrition and rice grain with high nutrient like protein, iron and zinc may attract the women for adoption decision making. Quality of paddy straw has great potential for its use as feed and medium for mushroom cultivation which can enhance the income of women.

2. *Crop production* – Analysis of drudgery of women in different activities of rice farming and designing suitable farm machineries and tools to reduce drudgery. Suitable methods for production of blue green algae, farm yard manure, compost, bio-char, and vermicompost can be absorbed by women as a cost cutting technology. Effective energy management of households by women through use of paddy straw and chaff. Minimum water use techniques for rice production.

3. *Crop protection* – Production of bio-pesticides and integrated pest and disease management.

4. *Social science* - Gender sensitive transfer of technology in rice including capacity building models, approaches for rice, supply chain, value chain, women rice seed producer group, opportunity for women self help group in rice.

Research and Development Process



Source: European Commission, Directorate General for Research (2009)

Research phase/ Project Implementation

While implementing the project, the treatments decided by the scientists to address the gender sensitive needs or problems must be carefully planned. It is very essential that the treatments should be very well

relevant to women's skills, interest, resource base and workability. If any one of the treatment is found to be effective while testing the experiment in the lab or in the campus then that would be very important outcome for gender mainstreaming. The testing and validation of the outcome should be taken up through participatory on-farm research and participatory on-farm trials. Well documented steps are available to implement the research with the active participation of men and women. It is desirable to have a gender balance in the research team preferably women researchers are team leaders. Data collection on different research/trial units should be from both men and women. Participating men and women in the On-Farm Trials may give their perceptions and experiences with the treatments/ approaches/ models. The men and women during field trials should get equal opportunity and conditions as per the objectives of the project. The sampling methods, methods for collecting sex and analyzing sex disaggregated data should form important part of research method. The language and responses for recording and interaction should be gender sensitive. A comparative analysis of men and women's response for different interventions should be analyzed and presented.

Monitoring and evaluation

Research projects should clearly state the steps to be completed with a time line and gender related activities/events should get special attention to monitor the progress of research. Gender disaggregated data on labour, income, saving, sharing of benefit, incremental gain, perception etc. may be gathered for concurrent evaluation.

Impact assessment & Dissemination Phase

The gender impact of the technology/model/approaches that emerged from the research should be assessed. The men and women from different socio-economic groups exposed to the intervention should be studied with respect to some selected gender sensitive indicators. It is desirable that women should get the desired variety, labour productivity, capacity to manage the enterprise, enhance the quality of life, status and earnings from rice based farming system. Differences between men and women on benchmark data as well as on-farm research and on-farm trial should be studied to draw implications for gender mainstreaming.

Conclusion

A strong logic is brewing that gender sensitive Research and Development (R&D) can usher prosperity to agriculture in terms of sustainability and profitability of the farms. We want a change in the mind set of the scientists, extension professionals and farmers and give the farm women their due share in agriculture development. Capacity building of the research institutes on innovative mechanism for participation of farm women in different stages of project planning and implementation, engaging gender experts for consultations and undertaking gender analysis in different broad areas of technology development and application can provide a strong footing for gender sensitive research. Besides in-house experimentation on the objectives, elaborate participatory on-farm-research and on-farm-trials should be conducted to assess exactly the contribution of research outcomes to gender equity. The extension system should take the research accomplishments to the end-users through large scale demonstrations, farmer field school and other methods.

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GENDER DISAGGREGATED DATA - IMPORTANCE IN PLANNING AND POLICY MAKING

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Looking at the importance of gender in development, gender disaggregated data (GDD) are a prerequisite for effective gender planning. By data we mean known facts that can be recorded and that have implicit meaning. Gender disaggregated data mostly refers to data on different variables pertaining to both men and women at lower level of aggregation particularly at household level. Importance of GDD equals to importance of disaggregated data plus importance of gender roles, relations and inequalities in society. Data on gender are usually collected or generated with respect to different variables.

Functions and importance of GDD

Gender disaggregated data simultaneously perform three functions. Firstly, it recognizes the roles of women and men and makes them explicit. Secondly, it describes value of their contribution or extent of involvement. Thirdly, it sensitizes people about the gender concerns in different spheres. Lack of sufficient and reliable gender disaggregated data is a serious handicap for properly assessing and appreciating women's contribution to farm-household systems.

Basically speaking GDD is quite useful to know the structure of socio-economic phenomena involving gender, to assess the consequences of socio-cultural and techno-economic changes on gender. Ultimately GDD provides important insights and base for effective gender planning both at micro and macro level. Gender is getting global attention at every platform of research and development. Out of 17 Sustainable Development Goals (SDGs), one is especially focused on gender equality while 10 SDGs are having indicators related to gender. To develop effective policies to promote gender equality in a real sense, it is necessary to have appropriate data on women's and men's gender dynamics and gendered constraints that they face. By building gender disaggregated data, one can contribute simultaneously to strengthen research, policy and extension. Lack of comprehensive data hinders understanding of the impact of programs and policies in real sense. Accurate data on women's and men's contribution in agriculture and household production are critical for understanding the gendered constraints faced by them in sustaining their livelihood and designing suitable gender sensitive policies.

In agriculture, there is scant availability of GDD. Some of the reasons for this situation are biasness in our System of National Accounts against women's work, lack of thrust on gender by data collection agencies complexity of gender involvement in the sector, multiplicity of women's activities, lack of requisite skill and capability of the persons involved in collection of data and so on. Notwithstanding these shortcomings, today we find a greater sense of urgency being expressed by policy makers, development experts and researchers alike for GDD. Some of the crucial areas that can be considered on priority for collection of GDD are;

- Assessment of the extent of gender involvement in different activities
- Level of technology adoption
- Quantifying gender contribution to households and different sectors
- Understanding and measuring gender inequity
- Identifying and assessing constraints and opportunities

- Intra-household resource allocation
- Decision making process within household

Gender disaggregated data are the facts and figures (information) collected, analyzed and summarized for presentation and interpretation for each gender. All the data (information) collected in a particular study are referred to as the *data set* for the study. *Elements* are the entities/individuals on which data are collected. A *variable* is a characteristic of interest for the elements. In gender disaggregated data 'gender' is a mandatory variable. Measurements collected on each variable for every element in a study provide the data. The set of measurements obtained for a particular element is called an *observation*. Hence, the number of observations is always the same as the number of elements. The number of measurements obtained for each element equals the number of variables. Variables in gender disaggregated data can be either **qualitative** or **quantitative**. The data can be cross-sectional and time series data.

Qualitative data use labels or names to identify an attribute for each element. Scale of measurement of qualitative data is either nominal or ordinal. It may be nonnumeric or numeric.

Quantitative data use numeric values that indicate how much or how many. Scale of measurement of quantitative data is either interval or ratio. Quantitative data may be discrete or continuous. Quantitative data that measure how many are discrete. Quantitative data that measure how much are continuous because no separation occurs between the possible data values.

A qualitative variable is a variable with qualitative data and a quantitative variable is a variable with quantitative data. The type of variable (qualitative or quantitative) decides the statistical analysis appropriate for a particular variable. If the variable is qualitative, it is possible to summarize the data either by counting the frequencies in each qualitative category or by obtaining the proportion of the frequencies in each qualitative category; arithmetic operations are not feasible in such cases, whereas, arithmetic operations often provide meaningful results for a quantitative variable. Therefore, statistical analysis is limited for qualitative variables than that of the quantitative variables for which more number of alternatives are available in literature.

Further, two more type of gender disaggregated data is possible: *cross sectional data* and *time series data*. This classification is based on time dimension. It is possible to obtain data for a number of variables at same point of time or at different time periods. If the data is collected at same point of time, it is known as **cross sectional data**, whereas, if the data is collected over several time periods is known as **time series data**. For cross sectional data, it is expected that all the data on different variables from different individuals/ units are independent. For time series data, as observations are taken from same set of individuals/ units over different time periods, it is expected that some relationship is present in the data. Therefore, it is important to distinguish between cross sectional data and time series data as different statistical tools are being used for analysis of these types of data.

Talking of time series data on gender, it is a great constraint. Review of secondary sources amply demonstrates this limitation. Because gender has not been considered explicitly as a factor in development, data collection agencies have not paid due attention to GDD. In absence of time series data it is difficult to trace the changes that have taken place over a period of time in different domains.

On the other hand large number studies are available based on cross section data. Even though such studies have their inherent weakness, nevertheless they have contributed significantly to the understanding of women's role in agriculture. Cross section data are quite important for explaining and analyzing a situation and bringing out differences in respect of men and women.

How to collect information?

- Observation
- Consultation
- Negotiation
- Research/studies
 - Surveys
 - Rapid appraisals
 - Participatory research
 - Case studies
 - Action research
 - Experiment

Data can be collected either from secondary sources (collected by other organizations, government offices, private sector organizations etc.) or from statistical studies. Statistical studies are of two major types: experimental studies and observational studies. In experimental studies the variables of interest are first identified. Then one or more factors are controlled so that data can be obtained about how the factors influence the variables. In observational (non-experimental) studies no attempt is made to control or influence the variables of interest. A sample survey is a good example of observational studies. A *population* is the set of all the elements of interest in a study. A *sample* is a subset of the population.

Different methods are used for collection of gender disaggregated data. Sometimes the whole population is of our interest and therefore, the whole population is our data set. For example, we are interested to study the variability in height of girl and boy students of a particular class in a particular school. The number of students (girl and boy) are fixed and it is limited, therefore, one can measure the height for all the students in the class, then the data set of all the students is the entire population of interest. This is feasible preferably when the number of elements (entities/individuals) is less. Instead if we have number of elements too high and it is not possible to collect data on all the elements, in such situation we need to restrict ourselves for a dataset which consist of a sample from the population. In most of the situations, we are interested/ forced to use the sample data set to draw some conclusions about the population under study, therefore, extra care is necessary and compulsory while collecting the sample from the population. Method of drawing conclusion about the population based on information from the sample is known as *statistical inference*.

Numerical characteristics of a sample, such as the sample mean and sample standard deviation, are called **statistic**. Numerical characteristics of a population, such as the mean and standard deviation, are called **parameters**. A statistic such as the sample mean is considered an **estimator** or a population **parameter** - the population mean. A sample mean provides an estimate of a population mean, and a sample proportion

provides an estimate of a population proportion. A primary purpose of statistical inference is to develop estimates and test hypotheses about population parameters using information contained in a sample.

It is important to realize that sample results provide only *estimates* of the values of the population characteristics. The reason is simply that the sample contains only a portion of the population. With proper sampling methods, the sample results will provide 'good' estimates of the population parameters. But how good can we expect the sample results to be? Fortunately, statistical procedures are available for answering this question. Often the cost of collecting information from a sample is substantially less than from a population, especially when personal interviews must be conducted to collect the information. A list of well known sampling techniques are:

Non –probability Sampling

- ✓ Convenience sampling (purposive units)
- ✓ Judgement Sampling (own judgement)

Probability Sampling

- ✓ Simple Random Sampling
- ✓ Cluster Sampling
- ✓ Systematic Sampling
- ✓ Stratified Sampling
- ✓ Multi-Stage Sampling

Obtaining and using GDD – what are the difficulties?

- Observing gender interaction process and the outcome
- Identification of relevant variables to represent the phenomena or outcomes
- Formulating appropriate questions
- Measuring or assessing the variables
- Treating data suitably
- Interpreting
- Communicating and convincing

Gender disaggregated data are pre-requisite for understanding and incorporating gender perspectives in agricultural R & D. But what is required is quality data. Quality of research is as good as the quality of data.

GENDER ANALYSIS TOOLS FOR DEVELOPING SUSTAINABLE GENDER INCLUSIVE GROWTH

B. N. Sadangi

Why Gender Analysis?

Inequalities between men and women are becoming more visible and glaring particularly in the developing countries of the world triggering serious concerns among development experts. UNESCO statistics reveals that women perform 75% of the work, earn 10% of the income and own 1% of property. The 3rd UN Millennium Development Goal (MDG) has called for gender equality and the component of women to combat poverty, hunger and disease and to stimulate development that is truly sustainable. The Beijing Platform for Action (1995) very well supports this fact in the form of twelve objectives and action points viz., women and poverty, education and training of women, women and health, violence against women, women and armed conflict, women and the economy, women in power and decision-making, institutional mechanisms for the advancement of women, human rights of women, women and media, women and environment and the girl child. Prior to the above declaration there were first, second and third world Conference on Women at Mexico (1975), Copenhagen (1980) and Nairobi (1985), respectively. The said global endeavors are also reviewed and appraised at five yearly intervals to overcome the limitations and shortfalls.

India being the largest democratic and welfare state has given attention to the well-being of women. After Independence and the said endeavor got prioritized and institutionalized in line with the declarations and goals of UN bodies/Conferences. Given in Table 1 are the significant steps taken in this directions.

Table 1: National Efforts for the Cause of Women

S. No	Year/Plan	Title	Emphasis
1	1939-40	Sub-committee to advise the National Planning Committee	Welfare of women
2	1976-77	Working group on employment of women for the planning commission	Improvement in the productivity of women in traditional occupations
3	6 th Five Year Plan	Planning Commission	Opportunities for independent employment and income for women
4	7 th Five Year Plan	Planning Commission	Training and education in general and science and technology for women farmers
5	8 th Five Year Plan	Planning Commission	Promoting women as special target groups for employment promotion
6	9 th Five Year Plan	Planning Commission	Empowerment of women
7	10 th Five Year Plan	Planning Commission	Gender equality and gender budgeting

S. No	Year/Plan	Title	Emphasis
8	11 th Five Year Plan	Planning Commission	Engendering the indigenous women
9	12 th Five Year Plan	Planning Commission	Gender Budgeting

Information is essential to gender mainstreaming at various levels. The gender disaggregated information would not only help to identify the gender issues for use in the planning of livelihoods interventions but also to evaluate the impact of government programmes and policies on men and women. Information from a gender analysis will be useful in order to understand the following;

- **Needs:** to identify different needs of men and women that will help them to achieve more sustainable livelihood strategies;
- **Constraints for participation;** to highlight the different responsibilities of men and women that might constrain their participation in a livelihoods project;
- **Ability to participate:** to understand different stakeholders, capacity to participate in any given intervention e.g. given differential levels of education or autonomy;
- **Different benefits from participation:** to determine the different ways in which men and women do or do not benefit from particular livelihoods interventions

What is Gender Analysis?

Gender Analysis is a tool to better understand the realities of the women and men, whose lives are impacted by planned development. These include gender issues with respect of social relations; activities; access and control over resources, services, institutions of decision-making and networks of power and authority; and needs, the distinct needs of men and women, both practical and strategic. Gender analysis is an essential element of socio-economic analysis. A comprehensive socio-economic analysis would take into account gender relations, as gender is a factor in all social' and economic relations. An analysis of gender relations provides information on the different conditions that woman and men face, and the different effects that policies and programmes may have on them because of their situations. Such information can inform and improve policies and programmes, and is essential in ensuring that the different needs of both women and men are met.

Gender Analysis focuses on three sets of questions

1. *Who does what, when and where?* This pertains to farm enterprises and the operations within enterprises, as well as to off-farm, non-farm and household maintenance activities that compete for or complement farm production activities.
2. *Who has access to or control over resources for production?* Access means the resource may be available, but without choice about timing or amount of use. Control means having decision-making authority concerning a resource.
3. *Who benefits from each enterprise?* The question of who benefits is closely related to roles and responsibilities, as well as to control over resources.

Gender Analysis Frameworks

There are a variety of tools that have been developed to assist people in asking these questions. Each tool is different, with some advantages and disadvantages, some account for other social characteristics and factors better, while others are more participatory. Most of the tools have taken from Participatory Rural Appraisal (PRA) methodology. Gender Disaggregated Data (GDD) can also be gathered through socio-economic surveys. A brief description of Standard Gender Analysis Frameworks is given below for helping the readers get fundamental knowledge on each framework.

1. Harvard Analytical Framework: This framework was developed in the 1980s in the Institute for International Relations to facilitate the integration of women into project analysis. It is outlined in *Gender Roles in Development Projects: A Case Book*, edited by Catherine Overholt, Mary B. Anderson, Kathleen Cloud, and James E. Austin. It is a useful tool for gathering data, understanding women's and men's roles in a society and taking account of external forces which affect development planning. It is a flexible instrument which can be used at many different levels of planning and analysis, and can be expanded to disaggregate data according to cultural, ethnic and economic factors as well as gender and age. The framework can also be used as a planning and implementation tool for programmes and projects. There are four inter-related components namely (i) The Activity Profile, (ii) The Access and Control Profile, (iii) Factors. Influencing Activities, Access and Control and (iv) Project Cycle Analysis.

2. Moser Framework: The Moser Framework (gender planning) was developed as a planning tradition in its own right. It takes the view that gender planning, unlike other mainstream planning, is "both technical and political" in nature. It resolves conflicts in the planning process. It involves transformative processes and it characterizes planning as a "debate." There are six tools in the framework that can be used for planning at all levels from project to regional planning. It can also be used for gender training. The following tools were developed under this framework.

- a) Tool 1 : Gender roles identification/ triple role
- b) Tool 2 : Gender Needs Assessment
- c) Tool 3 : Disaggregating control of resources and decision making within a household (intra-household resource allocation and power of decision making within the household)
- d) Tool 4 : Balancing of roles
- e) Tool 5 : WID/ GAD policy matrix
- f) Tool 6 : Involving women, gender aware organizations and planners in planning.

3. Gender Analysis Matrix (GAM) Framework: The framework aims to find out the different impacts of development interventions on women and men by providing a community- based technique for the identification and analysis of gender differences. Secondly, it assists the community to identify and challenge their assumptions about gender roles in a constructive manner. It may be. used for different purposes, for example, transformatory gender training, or as a participatory planning tool.

The analysis is conducted at four levels of society, women, men, household and community. The GAM examines impact On four areas: labour, time, resources and socio-cultural factors. It is simple, systematic and uses familiar concepts. It encourages "bottom-up analysis" through community participation. It is

transformatory and technical in its approach, combining awareness-raising about gender inequalities with development of practical skills. It includes men as a category and therefore can be used in interventions that target men.

4. Women's Equality and Empowerment (Longwe) Framework: The Women's Empowerment Framework aims to assist planner's question what women's equality and empowerment means in practice and to what extent a development intervention is supporting empowerment. Women's empowerment is defined as "enabling women to take an equal place with men and to participate equally with men in the development process in order to achieve control over the factors of production on an equal basis with men".

The Longwe framework introduces the concept of five levels of equality by which to assess the level of women's empowerment in any area of economic and social development. It consists of two tool kits. Under Tool Kit-1 i.e. Women's Empowerment Levels of Equality with respect of Control, Participation, Conscientisation, Access and Welfare are studied. The tool Kit 2, the level of recognition of "women's issues" is analyzed'. A "women's issue" is defined by Longwe as all issues which relate to equality with men, and includes any social or economic roles, and all levels of equality (welfare, access, conscientisation, participation and control).

5. SEAGA Approach: SEAGA stands for socio-economic -and gender analysis. This has been developed by FAO. It is an approach to development based on an analysis of socio-economic patterns and participatory identification of women's and men's priorities. The objectives of the SEAGA approach are to close the gaps between what *people* need and what development delivers. The study of the environmental, economic, social and institutional patterns and their linkages are analyzed to explain the development. This approach has three different categories of tools viz., development context tools, livelihood analysis tools, stakeholders' priorities for development tools.

Categories of Tools:

A. Development context tools

- *Resource Map*
- *Transects*
- *Social map*
- *Trend line*
- *Venn Diagram*
- *Institutional profile*

B. Livelihood analysis tools

- *Farming system*
- *Benefit analysis*
- *Daily Activity Clocks*
- *Seasonal Calendars*
- *Resources Picture Cards*
- *Income & Expenditures Matrices*

C. Stakeholders' priorities for development tools

- *Stakeholders Conflict & Partnership Matrix*
- *Action Plan*

Gender Analysis -Important Practical Uses:

Gender analysis consists of dynamic tools and has scope of analyzing a lot of issues concerning men and women. It is very cumbersome to provide a detail account of all the frameworks and tools under a Chapter. However, it is intended here to motivate and help the readers and beginners to realize and adopt some important components of gender analysis together with the appropriate tools. Examples and illustrations have been provided to add clarity to the process of analysis.

1. **Roles and, responsibilities of men and women:** Under the above enquiry, it is required to identify the roles performed by men and women, the location of engagements and time/season of involvement. Generally, three kinds of roles i.e., productive roles (paid work self-employment and subsistence production), reproductive roles (domestic work, child care and care of the sick and elderly), community participation/self-help (voluntary work for the benefit of the community as a whole) and Community politics (decision-making/ representation on behalf of the community as a whole) are studied. The appropriate tools to analyze the roles and responsibilities of men and women are as under:

2. **Daily activity schedule:** Hour-wise activity of men and women (time clock) exercise should be taken up to identify daily patterns of activity based on gender division of labour and understand how busy men and women are in a day, how long they work and when they have spare time for social and development." activities. Given below brief formats to undertake the exercise.

3. Classifications of Activities

Reproductive Activity	Productive Activity	Community Management Activities	
1. Fetching water	1. Wasteland management	1. Agricultural production	8. Threshing
2. Cooking	2. Community forestry management	2. Land preparation	9. Purchase of inputs
3. Cleaning house		3. Sowing	10. Accessing credit
4. Cleaning utensils		4. Weeding	11. Management of labour
5. Bathing children		5. Transplanting	12. Management of production
6. Excreta disposal		6. Harvesting	13. Marketing
		7. Winnowing	14. Storage and processing

Time	Women	Men	Time	Women	Men
00-01 am			12-01 pm		
01-02 am			01-02 pm		

<i>Time</i>	<i>Women</i>	<i>Men</i>	<i>Time</i>	<i>Women</i>	<i>Men</i>
02-03 am			02-03 pm		
03-04 am			03-04 pm		
04-05 am			04-05 pm		
05-06 am			05-06 pm		
06-07 am			06-07 pm		
07-08 am			07-08 pm		
08-09 am			08-09 pm		
09-10 am			09-10 pm		
10-11 am			10-11 pm		
11-12 am			11-12 pm		

Source: Suzanne Williams, Janet Seed, Ade1ina Mwan (1994) OXFALI1 Gender Training Manual, OXFAM Publications.

Mapping gender differences in roles and relations: The perception of men and women in performing their roles which affects their relationship should also be analyzed in developing suitable interventions for restructuring the gender roles.

1. Seasonal calendar
2. Analysis of Assets: Livelihoods of the households and the various assets associated with the livelihoods should be identified. Further, the access of men and women to the assets viz., human, social, physical, financial is analyzed to compare the opportunities of men and women for development. The constraints of men and women are also studied.
3. Social and resource mapping.
4. Resource Analysis
5. Venn Diagram
6. Income and Expenditure Matrices

1. Seasonal calendar: The PRA exercise on seasonality for work load, cropping pattern, farming systems, food scarcity, climatic conditions, employment, fodder availability and so forth; should be taken up for men and women for developing gender sensitive strategies based on seasonal variations/engagements by both the gender.

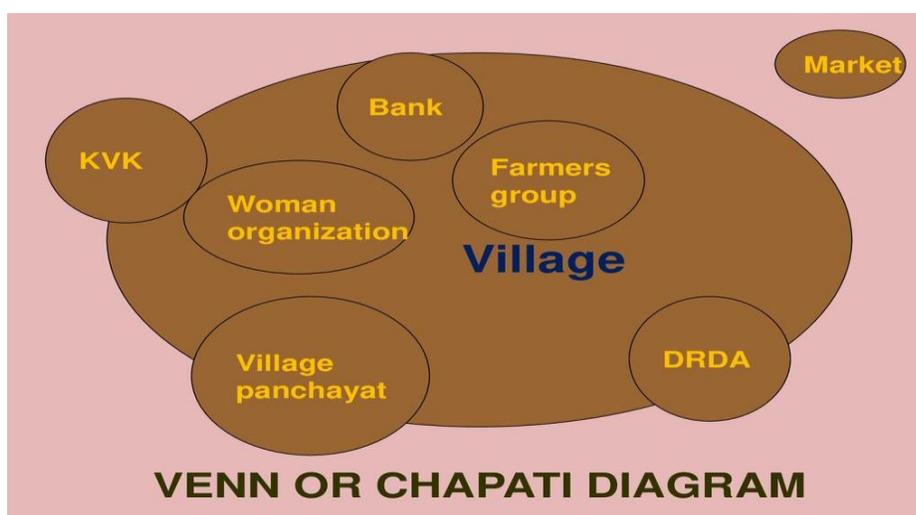
2. Analysis of Assets: It is required that the livelihoods of the households and the various assets associated with the livelihoods should be identified. Further, the access of men and women to the assets viz., human, social, physical, financial is analyzed to compare the opportunities of men and women for development. The constraints of men and women are also in assessing the above resources for sustainable rural livelihoods are also identified by examining their perceptions. The different tools used to understand the differential access and constraints are given below.

3. Social and resource mapping: This is a PRA exercise undertaken to indicate spatial distribution of roads,

forest, water resources and institutions. The maps also identify households, their ethnic composition and other socio economic characteristics/ variables.

4. Resource Analysis: This analysis is undertaken to find out the access of men and women to private, community and public resources. The control of gender over the resources is also studied. Given below a structured format to undertake the study. Access to productive resource refers to right and opportunity of men and women to use the resources as per one's need to carry out his/ her activities. Control over productive resources refers to the rights and power of men and women to decide on the use and destination of the resources.

5. Venn diagram: The Venn diagram is a tool that helps to learn about the importance of local groups and institutions for getting support, training, advisory services for development and livelihoods. This can be useful in identifying potential conflicts between different socio economic groups. The men and women varying by ethnicity, social groups etc. may have different perceptions and constraints in availing the support and resources of the institutions. The result of the exercise would identify the gender issues in the management of local institutions for gender mainstreaming. The women can also mention their constraints in getting the services of the local institutions.



Income and Expenditure Matrices: Economic well being of men and women is analyzed in order to understand their financial condition for sustaining their livelihoods. The perception of men and women on criteria of wealth need to be identified and their relative position in the socio-economic status across caste, class and farming groups should be worked out. Income and expenditure matrices are produced to help us understand a very important aspect of people's livelihoods -sources of income and sources of expenditures. This tool can also reveal changes in expenditures in times of crisis. By quantifying the relative importance of different sources of income for different people, including both women and men from each social group, we can understand the security and vulnerability of different people's livelihoods. By quantifying the relative importance of different sources of expenditures for different people, we can understand their priorities and limitations. In the Expenditures Matrix it is important to see if all, most or only some of their total income is spent to meet basic needs -food, water, clothing, shelter, health care and education. After meeting their basic needs, do people have any money left for savings or to invest in their livelihoods, such as animal vaccines or fertilizer?

Mapping gender differences in roles and relations:

Resources	Access (M/F)	Control (M/F)	Benefits	Access (M/F)	Control (M/F)
1. Land			1. Outside Income		
2. Equipment			2. Assets Ownership In-Kind goods (Food, clothing, shelter etc)		
3. Labour <ul style="list-style-type: none"> • Production • Reproduction 			3. Education		
4. Capital			4. Political Power/ Prestige Other		
5. Education/training					

Power and Decision-making: Decision-making in the household tells to a great extent the empowerment status in the family. Who takes decision in the social, economic and religious matters should be known in developing appropriate course of action for gender mainstreaming. Decisions may pertain to household expenditure, input use, technology application, marketing, energy use, mobility and so on. There are also community level decisions for example management of community water supplies. How women get opportunities to take part in community decisions needs careful examinations. Structured questions or field exercises as per PRA methodology maybe developed to understand the decision making behavior of men and women in the society. Either man or woman maybe fully empowered to take decision in matters of investigation or partially involved. In many cases men and women may take 'joint decision in 1:1 ratio. However, it is observed that decision making behavior of men and women is affected by field of work, age, caste, class, ethnicity etc.

It is also required to analyze the constraints faced by men and women separately in making decisions related to household management, livelihoods, socio-cultural and religious spheres. Analysis of constraints would help the development experts to propose suitable interventions so that women can make decisions related to their socio-economic lives.

Needs, Priorities and Perspectives:

As there are differences between men and women with respect to their roles played in the society, it is quite evident that there would be difference in their needs, problems, priorities and perspectives. Any development programme aimed at gender equality and equity must take into account the above dimensions. Need is the fundamental psychological object that motivates the individual to move and participate. It is in the said perspective' needs of women should be precisely understood before implementation of any development programme. Given below the description of two important categories of gender needs and examples under each.

Pair-wise ranking: Pair-wise ranking is a tool that helps to learn about the most important problems of different community members. It also allows for easy comparison of different people's priorities. Many

people's priority problems are those related to the day-to-day struggle to meet basic needs, while others stem from hopes for the future. Some problems are related specifically to gender issues, such as women's lack of control over key resources or the gender-based division of labour. Pair-wise Ranking highlights how the priority problems of women and men differ and where they overlap. Similarly, the priority needs of members of different socio-economic groups are revealed.

Example: The pair-wise ranking Matrix from Kenya shows that the participants selected “lack of inputs”, “climate” and “lack of land” as their priority problems.

Pair-wise Ranking Matrix (Study in Kenya)

<i>Problems</i>	<i>Climate</i>	<i>Pests</i>	<i>Weeds</i>	<i>Costs of inputs</i>	<i>Lack of Land</i>	<i>Lack of Irrigation</i>	<i>Lack of Tech. K</i>
Climate		Climate	Climate	Costs of inputs	Climate	Climate	Climate
Pests			Pests	Costs of inputs	Lack of Land	Lack of Irrigation	Pests
Weeds				Costs of inputs	Lack of Land	Lack of Irrigation	Weeds
Costs of inputs					Costs of inputs	Costs of inputs	Costs of inputs
Lack of Land						Lack of Land	Lack of Land
Lack of Irrigation							Lack of Irrigation
Lack of Tech. Know							

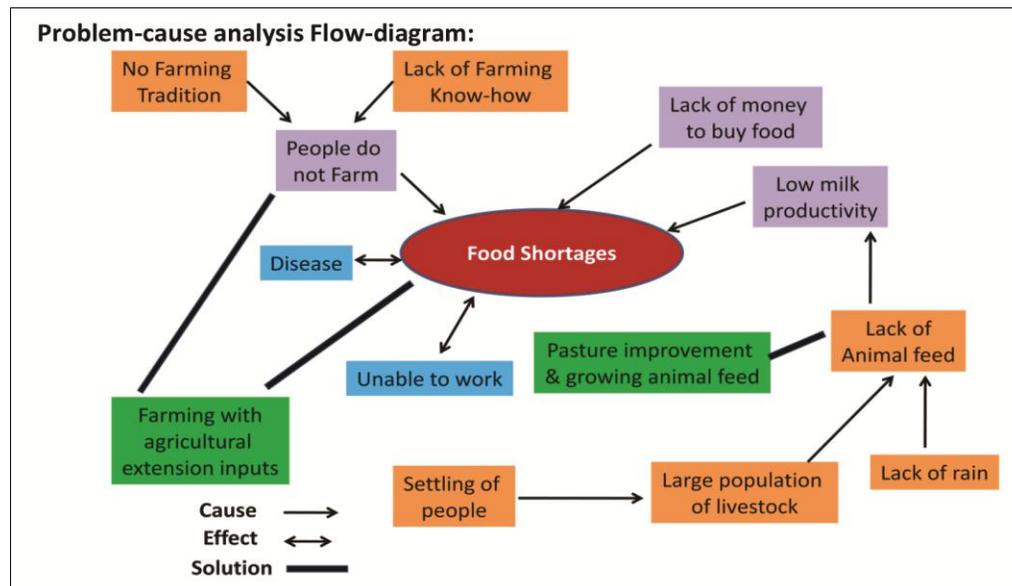
Problems	Number of Times Preferred	Rank
Climate	5	2
Pests	2	5
Weeds	1	6
Costs of Inputs	6	1
Lack of Land	4	3
Lack of Irrigation	3	4
Lack of Technical Knowledge	0	7

Source: National. Environmental Secretariat, Government of Kenya; Clerk University, Egerton University and the Centre for International Development and Environment of the World. Resources Institute, (February, 1990) Participatory Rural Appraisal Handbook.

Practical and Strategic Gender Needs:

Practical Gender Needs	Strategic Gender Needs
Examples: ✓ Access to water ✓ Access to fuel ✓ Access to fodder ✓ Access to sanitation facilities ✓ Access to child care facilities	Examples: ✓ Sharing of housework ✓ Women in non-traditional tasks ✓ Equal wages for work of equal value ✓ Equal rights to private property and common property resources ✓ Equal representation and participation of poor women in decision-making forums

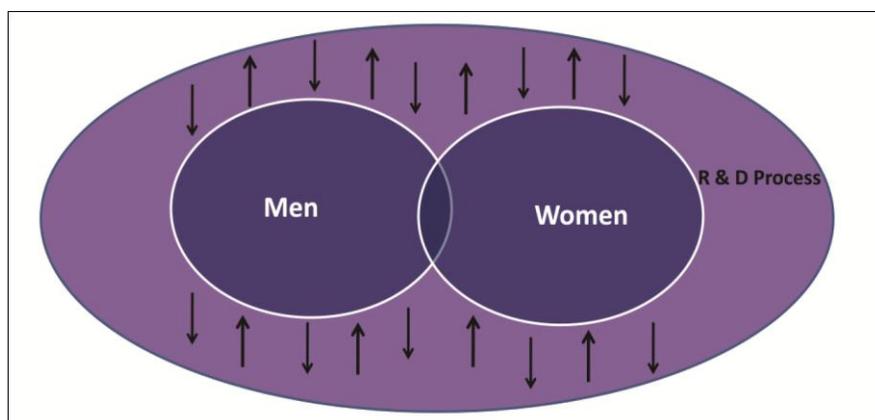
Problem-cause analysis: Once the priority problems of all the different groups in a community are identified, it is time to bring everyone together for further analysis. This is the purpose of the Problem Analysis Chart. With this tool all the different problems are presented and discussed with the community as a whole, showing where different people's priorities overlap and where they differ. It also allows for expanded discussion of the causes of the problems, as well as current coping strategies. Coping strategies are important to learn about because they may be strategies that can be built upon for development. We can also learn if efforts to address a particular problem have already been made, and have failed or have not addressed the problem completely. The Problem Analysis Chart also looks at opportunities for development. For this reason it is important that technical "experts" from outside agencies and organizations, such as extension officers and NGO workers, be invited to participate as well. While local people may have very good ideas about what they need, they may lack information about the options that development programmes can offer. It is very important at this stage in the analysis that the local people get appropriate information so that they can make informed decisions about their development.



Community Action Plan: The access of men and women in developing community action plan should be analyzed. Special attention should be paid to know exactly the women voice in developing the plan. The solutions for the problems prioritized by the women must be as per their consent and preferences. The alternatives and options in development should be understandable and meaningful to the women

participating in the programme. Opportunities for development to men and women and to learn from each other experience and knowledge should be explored and issues and problems pertaining to that should be identified.

Gender Impact of Technologies/ Programmes: Technologies are *not* gender neutral and may impact men and women differently. There are *two* ways that we can look at gender in the context of agriculture R&D as depicted in the schematic diagram (fig.1). ,here R&D refers to Research and Development ,First, effects of R &D process on gender as indicated by inward arrows and second, gender role in R&D Process or, how gender influences R&D processes as indicated by outward arrows. How R&D process affects men and women? This is an important approach to study relationship between gender and, R&D processes. A very common area of research in this context is gender impact analysis of agricultural research and development. For example, as to how the structural, technological and .institutional changes have affected men and women from different background in different situations in matters like sharing of benefits, work burden, changes in gender role, access to resources etc. and reasons thereof. How the much talked triple role of women i.e. reproductive, productive and community roles, are affected by the developments in nature and technological and policy changes in agriculture and allied sectors. Such studies are quite useful as the findings can be used in revision of the programmes and policies to create wider and equitable gender impact.



The Gender Impact Analysis Matrix may be used to assess the effects of the projects on men and women.

Potential Impact

	<i>Labour</i>	<i>Time</i>	<i>Resources</i>	<i>Culture</i>
Women				
Men				
Household				
Community				

Women: Refers to women of all ages who are in the target group if the target group includes women, of all women in the community.

Men: Refers to men of all ages who are in the target group if the target group includes men, or to all men in the community.

Household: Refers to all women, men and children residing together even if they are not part of one nuclear family.

Community: Refers to everyone within the project areas as a whole.

Labour: Refers to changes in tasks (fetching water from the river), level of skill required (skilled versus unskilled, formal education, training), and labour capacity (how many people and how much they can do; do people need to be hired or can members of the household do it?) etc.

Time: Refers to changes in the amount of time (3 hours, 4 days, etc.) it takes to carry out the labour associated with the project or activity.

Physical Resources: Refers to the changes in capital (income, land, access to credit, health etc.) as a consequence of the project and the extent of control over changes in resources (more or less) for each level of analysis.

Socio-cultural factors: Refers to changes in social aspects of participants' lives (changes in gender roles or status) as a result of the project.

Conclusion

Gender analysis provides valuable output in terms of gender disaggregated data and gender issues in social, economic, cultural and development aspects. It has wider application ranging from a smallest unit i.e. household to a larger body i.e. region. As gender roles are dynamic, the analytical tools should be selected and used as per the varying situations. The framework and tools described in this chapter is not exhaustive but provide the readers sufficient clues to select the desired enquiry and its corresponding tools. The knowledge and expertise on the process work of PRA tools are prerequisite to get desired outputs. Scholars of gender studies may find the information very useful in planning gender development projects and seeking additional information.

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ROLE OF MICROFINANCE INSTITUTIONS IN ECONOMIC EMPOWERMENT OF WOMEN

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Introduction

Microfinance concept of financing small credit requirements in rural areas started in seventies and gained momentum in nineties and twenties in India. The Gramin Bank concept of financing rural small credit needs in Bangladesh spreaded to other Asian countries and in India it was seen as most effective way of financing rural credit needs. Taking into account the rural credit need, the Govt. of India established NABARD in early eighties. The emphasis on rural credit needs through small non-financial institutions resulted in emergences of a number of micro finance institutions in the country.

Definition of Microfinance Institutions

Reserve bank of India defines NBFC-MFI as a non-deposit taking NBFC (other than a company licensed under Section 25 of the Indian Companies Act, 1956) with Minimum Net Owned Funds of Rs.5 crore (for NBFC-MFIs registered in the North Eastern Region of the country, it will be Rs. 2 crore) and having not less than 85% of its net assets as “qualifying assets”. Ultimate goal of microfinance is to give low income people an opportunity to become self-sufficient by providing a means of saving money, borrowing money and insurance. The micro finance bill defines Micro Finance Institution as “an organization or association of individuals including the following (i) if it is established for the purpose of carrying on the business of extending microfinance services: i. a society registered under the Societies Registration Act, 1860, 100 (ii) a trust created under the Indian Trust Act,1880 or public trust registered under any State enactment governing trust or public, religious or charitable purposes, (iii) a cooperative society / mutual benefit society / mutually aided society registered under any State enactment relating to such societies or any multistate cooperative society registered under the Multi State Cooperative Societies Act, 2002.

Microfinance and Women Empowerment

The major focus of **microfinance** programs is to **empower women** as they are the most vulnerable and investing in **women** helps **empowering** them and contributes to greater economic growth and development. Moreover, participation in **microcredit** programs helps to increase **women's** welfare and reduce male bias. Microfinance has emerged as a powerful tool for women empowerment in the new economy. In India, microfinance distribution is mainly dominated by Self Help Groups (SHGs) -Bank Linkage Programme. It aims at providing a cost effective mechanism for providing financial services to the poor section of the society. Self-help groups intermediated by microcredit have been shown to have positive effects on women, with some of these impacts being ripple effects. They have played valuable roles in reducing the vulnerability of the poor, through asset creation, income and consumption smoothing, provision of emergency assistance, and empowering and emboldening women by giving them control over assets and increased self-esteem and knowledge. There are many studies around the world which suggest that women empowerment is closely linked to financial inclusion and that no amount of awareness programmes could motivate women to step out of their homes if they are not financially independent. In the absence of formal banking services and credit facilities in the remotest parts of the country, Micro-finance Institutions have played a commendable role in empowering women and providing them with easy credit access, in the form of loans, thus giving wings to their dreams. Because an empowered and financially independent woman can significantly

contribute to the health and productivity of her family and community. According to the Sixth Economic Census by the Ministry of Statistics and Programme Implementation, women constitute around 14 per cent of the total entrepreneurship in India. 98 per cent of them work in the informal sector. The Global Findex Survey suggests that only 5 per cent Indian women with bank accounts receive bank loans compared to 11 per cent in China. Hence, they often end up limiting their business within the boundaries of their locality or borrow from informal sources, at a much higher rate of interest, thus making their products or services uncompetitive. The significance of microfinance institutions (MFIs) in the country can be understood from the recent rise in borrowings by women. According to Micro Finance Institutions Network, there were more than 2.65 Crore borrowers associated with these institutions with the outstanding Gross Lending Portfolio of Rs. 1,48,097 Crores as of June 2018. Majority of them are women, who do not have access to formal credit. The launch of MUDRA scheme and institutional provisions like revised RBI guidelines for NBFC-MFIs have provided the necessary boost to the industry. Micro-finance institutions connect women entrepreneurs through small joint liability groups. Each member of the group receives a certain amount of loan without any collateral or cumbersome documentation process, which can be used for income generation purposes like animal husbandry, agriculture, handicraft, trading and other forms of business. More importantly, the presence of branches even in the remotest parts of the country implies that easy access to loans and streamlined disbursement processes. Experience suggests that women are more financially disciplined as compared to men. Thus, there is a far more social value generated when women access formal credit. Thus, each micro-loan that is disbursed to women entrepreneurs goes a long way towards multiplying jobs, poverty alleviation and creation of a prosperous society

Objectives of microfinance

The organizations working to promote microfinance institutions in different parts of the world determine various objectives to microfinance. The important among them are listed as follows. 1. Promote socio-economic development at the grass root level through community-based approach 2. Develop and strengthen people's groups called Self-Help Groups and facilitate sustainable development through them 3. Provide livelihood training to disadvantaged population. 4. Promote activities which have community participation and sharing of responsibilities 5. Promote programs for the disabled 6. Empower and mainstream women 7. Promote sustainable agriculture and ecologically sound management of natural resources 8. Organize and coordinate networking of grass root level organization 9. Get benefits by reducing expenditure and making use of local resources as inputs for livelihood activities 10. Increase the number of wage days and income at household level.

Microfinance Models in India

A wide range of microfinance models are working in India. Experts opinion is that India host the maximum number of microfinance models. Each model has succeeded in their respective fields. The main reason behind the existence of these models in India may be due to geographical size of the country, a wide range of social and cultural groups, the existence of different economic classes and a strong NGO movement. Micro Finance Institutions in India have adopted various traditional as well as innovative approaches for increasing the credit flow to the organized sector. They can be categorized into six broad types. 1) Grameen model 2) SHG model 3) Federated SHG model 4) Cooperative Model 5) Micro-finance companies (MFCs)

The Grameen Model

The Grameen model has been a case of exceptional success in Bangladesh. It turns out that many organizations in India have adopted the Grameen Bank model with little variations. Some of the notable examples are SHARE Microfinance 107 Limited, Activists for Social Alternatives (ASA) and CASHPOR Financial and Technical Services Limited. Some of the significant features of Grameen bank model are low transaction costs, no collateral (peer pressure is sufficient), repayment of loans in small and short interval and quick loan sanctions with little or no paper works and no formalities. Repayment of loans in small chunk is one of the major reasons of high loan recovery rate of a Grameen Bank. Furthermore, loans are provided for all purposes like housing loans, sanitation loans, supplementary loans etc. Also the interest rates are nominal making it easy for the poor people to repay their loans timely. Some of the salient features of Grameen model are mentioned below: a) Homogenous groups of five members are formed at local level. b) All the group members got a 7-day compulsory training c) Some groups undergo the Group Recognition Test for screening serious and non-serious groups. d) Those who passed the GRT she should become members of bank by paying a one-time membership fees. e) Eight Groups affiliate together to form a centre. f) Centre meets every week, at a defined time. A staff of the bank attends the meeting. g) Group discipline is enforced through peer pressure h) The savings are compulsory for the members. Every member saves Rs. 10 every week. i) The size of the loan generally ranges from Rs 4000 to Rs 10000 for general yearly loans. The first year size is Rs 4000 and there is an annual increase of Rs. 1000 in loan size, for every year thereafter. 108 a) All loans including agriculture loans are repayable within a year, equal installments spread over 52 weeks. b) The provision of 5% tax of all productive loans disbursed to a member is one of the most important strategies to increase group fund. This fund remains with the group. c) The group leader collects the loan repayments and savings prior to the meeting and hands it over to the centre leader who in turn during the meeting gives it to the field worker. d) The interest rates varies from 15- 24%. e) Collateral is replaced by peer pressure. The incentive to timely repayment is repeat loans and continues access to increasing credit from Bank. The most remarkable aspect of the Grameen model is very low default, repayment rate is in the range of 98% and above. It has led to low cost of credit and attracted low cost funds from the government and international donors. While the Grameen model is limited to less than a dozen major NGO-MFIs or NBFs, it is an important alternative credit delivery system to mainstream finance.

Self Help Groups (SHGs)

An SHG is a group of five to 20 people from same income category formed on principle of lending their own savings. They also seek external funding to augment these resources. This group is a voluntary one, formed on the areas of common interest so that they can think, organize and operate for their own development. The SHGs function on the basis of co-operative principles and provide a forum for members to extent support to each other. SHGs play a crucial role in improving the savings and credit and also in reducing poverty and social inequalities. Almost 90% of the SHGs in India are female only due to the known fact that world's poorest households tend to rely more heavily on income generated 109 by women of the house. In India, SHGs have been the most popular way to help the poor and make them bankable. They can play important role in: (1) Preventing exploitation of the poorer sections by creating self-reliance (2) Building leadership qualities among group members (3) Helping group members in documentation for obtaining credit (4) Motivating members for prompt repayment of credit (5) Providing training to its members. In the country this model was popularized by NABARD's SHG-Bank linkage programme. A number of nongovernment organizations (NGOs) are specializing in promoting and motivating SHGs. Once the basic group is identified the NGO

facilitator builds in processes and systems that make the SHG a viable, sustainable institution. The group meets regularly, mostly weekly, at a determined time and place and carries out its financial transactions of savings and credit. The group mobilizes savings from its members and makes need based loans to them out of the pool of funds created. The rules and the norms of the group are determined by the group members themselves and the NGO facilitator does not impose any thing.

Features of SHG Model

The SHG model has mainly evolved in the NGO Sector. 1) NGOs primarily have the missionary for enabling; educating and networking 2) Strengths of members are 10 to 20. Group members are socially and economically homogenous. 3) Groups are composed either by male only or by female only. In India 90 percent of the SHGs are composed of female only. 110 4) Members are selecting groups as their choice. NGO acts as a facilitating agency to build in processes and systems that make the SHGs viable and sustainable institutions. 5) The SHG members meet regularly at a fixed time and place for carrying out their savings and credit activities and other issues of development. 6) The group mobilizes thrifts among the members and issues loans to the members 7) The rules and norms for the group are decided by members themselves. 8) The main motive of the SHG is to empower poor socio-economically and improve their living standard.

Features and functions of federations

Being small in size, Self-help Groups (SHGs) are somewhat limited in the financial services that they can provide. 1) Federations of self-help groups, which bring together several SHGs. Have the ability to overcome the limitations of individual SHGs. 2) Federations are registered, usually under the Societies Registration Act. They have between 1000 to 3000 members. 112 3) There are three tier structures for federations. The SHG is the basic unit, the cluster is the intermediate unit and an apex body, a federation, represents the entire membership. 4) At the cluster level, each SHG participates directly in the representative body, with two members from each SHG attending the monthly cluster meetings. Information from the groups to the federations and vice versa is channeled through the cluster level representative body. 5) The leaders of the cluster, who are in closer contact with the groups, are thus a highly effective tier for group monitoring and strengthening. By creating clusters, the operations of the apex body are decentralized. 6) The executive body at the apex level is the executive committee, which is typically made up of 9 to 15 members. 7) Federations also have paid staff members working for them. The staff manages the day-to-day operations, with guidance from the supporting NGO. 8) As apex institutions representing several SHGs, the federations are fairly competent in helping groups with loan recovery and in strengthening weak groups. 9) Paucity of funds and idle money both been problems in SHGs models, have been solved by federations, which helped to a) Productively channelize the idle money of SHGs, where the demand for loans is much lower than their available money supply b) Enable SHGs, where natural demand for loans greater than the available credit, to access more funds c) In a way, this is a crucial role played by federations, whereby the utilization of scarce local capital is optimized and the returns on this capital are maximized. 113 d) Compared to SHGs, federations provide members with more opportunities to save and also make larger loans available. They are also able to provide specialized financial services (like insurance) to the members because of the (larger) scale of their operations.

Co Operative credit Unions

Cooperative credit unions are another important microfinance model developed in the country. The leading organization that has been successful in using the cooperative form in rural microfinance in India has been the Cooperative Development Forum (CDF), Hyderabad. CDF's approach has relied on a credit union model involving a savings first strategy. It has built up a network of financial cooperatives based upon women's and men's thrift groups. After the implementation of Andhra Pradesh Mutually-Aided Societies Act for flexible functioning of cooperatives, it has registered the associations of thrift groups promoted by it under this Act. The MACS Act has become landmark legislation, which has been used by other organization as well to register associations based on other approaches such as SHGs and Grameen joint liability groups as MACS.

Why Microfinance Model is not very vibrant

The primary reason for the lackadaisical effects of microcredit is the stringent repayment schedule offered by most microcredit institutions. Since most borrowers to whom microcredit is given have little to no credit history as a result of their exclusion from traditional systems of credit, institutions offering microcredit are unable to judge the risk associated with lending to certain borrowers, and cannot be sure what the risk of them defaulting will be. To lower the risk of defaulting, microcredit lenders therefore resort to repayment schedules that demand an initial repayment that is almost immediate, after which borrowers must adhere to an inflexible weekly schedule for repayments. The effect of this is that borrowers are unable to use the loans on investments that will take some time to be fully realized, and instead are forced to use the loans they receive on short term investments that only boost production to an extent, and the overall growth of their incomes remains meager.

Conclusion

Financial inclusion plays a key role in empowering women and preparing them for greater roles as contributors to national growth. However, this is a collective responsibility that should be shared by the banking communities, Microfinance institutions and the Government alike. It's no easy task to build a financially inclusive and empowered society, taking into account India's geographic and demographic diversity with protruding educational backwardness. Therefore, a comprehensive action plan needs to be put in place that not only aims at a financially inclusive society but also empowering and equipping the women with the basic skills of self-employment. This will undoubtedly lay the foundation for a new and progressive India, rooted in self-reliance and economic resilience.

BIO-FORTIFICATION OF CROPS FOR NUTRITIONAL IMPROVEMENT AMONG FARM WOMEN

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Introduction

Malnutrition is one of the biggest challenges all over the world. So it is taken as one of the Millennium Development Goal. Globally around two billion people suffer from malnutrition, while 815 million people are undernourished. It is also one of the biggest challenges in India. According to the Global Nutrition Report India is facing a major malnutrition crisis as it holds almost a third of the world's burden for stunting. The Global Nutrition report highlighted that 46.6 million children in India are stunted and India tops the list, followed by Nigeria (13.9 million) and Pakistan (10.7 million). The Global Nutrition report also noted that India also accounted for 25.5 million children who are wasted, followed by Nigeria (3.4 million) and Indonesia (3.3 million). UNICEF report notes that nearly one in three people in India have at least one form of malnutrition and this will increase to one in two by 2025 going by current trends. According to National Family Health Survey (NFHS)-4, 2015-16, one in every five Indians (both genders) is too thin with a BMI of less than 18.5, while every fourth male and second female is anaemic. The NFHS-4 highlighted that one in three women consume dark green leafy vegetables, chicken/meat/fish/eggs only once a week while one in two women do not consume fruits even once a week. The NFHS report also noted that one in five women however, consume aerated drinks weekly, one in 10 women consume fried food daily. Only one in 10 children aged 6-23 months receives an adequate diet.

Farm women play a significant crucial role in the development of agriculture and allied fields. Although farm women contribute a lot in the all-round development of the society they are still ignored. The farm women have to perform many fold tasks in the field as well as in the home. It increases the food demand of farmwomen more where as it is not fulfilled. The poor economic condition and family burden makes a poor feeding habit of farm women which is deficient in required quantity and nutritious as per the demand. This nutritional deficiency reduced the work efficiency and health condition of the farm women. This condition not only gives a social consequence but also affect the economics of the country in the terms of GDP and health expenditure.

The inadequacy of food and nutrition leads to develop a hidden hunger in the body and lead to physiological as well as pathological consequences. The under nutrition and feeding of more cereal based food among the farm women leads a deficiency in the different micronutrient in their body.

To address this issue food fortification and medication by providing tablets is not a sustainable way due to the poor economic condition and low purchasing power of the farm women. Increasing nutrition of the food in their grain will give a sustainable way to reduce the malnutrition among the farm women. So bio-fortification of food crops is the economical and sustainable solution to solve the nutritional problem of farm women as well as the nutritional security of the world.

Bio-fortification

Bio-fortification is a process where the nutritional quality of crop is enhanced through genetic manipulation that includes both breeding and transgenic approaches. The advantages of bio fortification approach for nutrient improvement to address malnutrition are:

- (i) Bio-fortification is sustainable: Sustainable as it deliver the micronutrients by staple food already consumed by the poor people.
- (ii) Bio-fortification is targeted: It is an effective means for reducing malnutrition of poor people with limited access to supplements, commercially marketed fortified foods, or other urban based interventions.
- (iii) Bio-fortification is Cost effective: Single investment in a bio-fortified crop can generate new varieties for farmers to grow for years to come.

Among the various nutrients protein, lysine, tryptophan, iron, zinc, vitamin A and vitamin C are essential for human nutrition and their deficiency leads to various symptoms and health disorders which are to be increased in crop plant through bio-fortification.

There are some anti-nutritional factors associated with the crop plants like Euricic acid, Glucosinolates and Kunitz trypsin inhibitor (KTI) which are to be lowered through bio-fortification.

Effect and consumption requirement of the nutritional and anti-nutritional factors

The nutritional factors to be bio-fortified proper growth and development of human and their deficiency symptoms are as below.

Nutritional factors

Protein: It provides essential amino acids for growth and tissue repair. Humans require 0.66 g protein/kg body weight/day to meet the requirement for proper growth and development. Deficiency in protein leads to poor intellectual development, disorderly physical functioning and even mortality. Diet deficient in protein leads to kwashiorkor and marasmus among humans.

Lysine: It is a building block in protein synthesis besides serving as precursor for several neurotransmitters and metabolic regulators. The daily lysine requirement is 30 mg / kg body weight / day for adults, while it is 35 mg/kg body weight/day for children of 3-10 year of age Deficiency leads to fatigue, dizziness, nausea, anaemia, delayed growth, loss of appetite and reproductive tissue.

Tryptophan: It is also a building block of proteins, and functions as precursors for several neurotransmitters and regulators of metabolic pathways. Tryptophan is required at the rate of 4 mg/kg body weight/day in adults and 4.8 mg/kg body weight/day in children 3-10 year. Its deficiency leads to depression, anxiety and impatience. Weight loss and slow growth in children are the major symptoms of tryptophan deficiency.

Iron: It is a mineral element which humans require for the proper functioning of muscle and brain tissues. It serves as the transport medium for electrons within cells and also carries oxygen from the lungs to various tissues by red blood cell haemoglobin. It is an integral part of important enzyme systems in various tissues. Estimated average requirement (EAR) of iron for non-pregnant and non-lactating women is 1460 µg/g, while it is 500 µg /g per day for children of 4-6 year. The occurrence of anaemia is the most common characteristics

of iron deficiency in human. It affects overall growth and development, besides causing mild mental retardation and goitre thereby severely affecting the work productivity.

Zinc: It is a mineral element which serves as cofactor in as many as 300 enzymes required for human metabolism. It is required for the regulation of synthesis and degradation of nucleic acids, proteins, lipids and carbohydrates. Zinc also plays vital role in maintaining cellular integrity and immune system. The EAR of zinc for non-pregnant and non-lactating women is 2960 µg/g, while it is 1390 µg/g per day in case of children of 4-6 yr. The clinical symptoms of severe zinc deficiency are retardation in growth associated with delayed sexual and bone maturation. Loss of appetite, impaired immune function, and increased susceptibility to infections such as diarrhoea besides skin lesion also occurs as a result of zinc deficiency.

Vitamin A: Also called as retinol, vitamin A is essentially required for the normal functioning of the visual system, growth and development, maintenance of epithelial cell integrity, immune system and reproduction. The requirement of vitamin A in non-pregnant and non-lactating women is 500 µg /g, while it is 275 µg /g per day in case of children of 4-6 year. Night blindness is the hallmark of an early symptom of vitamin A deficiency. Xerophthalmia and keratomalacia caused due to structural alterations of the conjunctiva and cornea may also follow. In severe deficiency, it may lead to irreversible blindness. Further, chances of anaemia, diarrhoea, measles, malaria and respiratory infections are also enhanced.

Vitamin C: It is also called ascorbic acid and required for metabolism and repair of various tissues such as skin, bone, teeth and cartilage. Vitamin C is also used to increase iron absorption from the gastrointestinal tract. The recommended dietary allowance for vitamin C in adult women is 60 mg per day, while it is 90 mg/day in adult men¹⁹. Deficiency leads to scurvy which is characterized by bleeding gums, bruising and poor wound healing in the teeth and is also associated with joint and muscle pains.

Anti-nutritional factors

Erucic acid: It is a monounsaturated fatty acid found especially in mustard and rapeseed oil. High concentration of erucic acid in edible oils impairs myocardial conductance, causes lipidosis in children and increases blood cholesterol, <2.0 per cent of erucic acid in oil is desirable for health.

Glucosinolates: It is a group of thioglucosides mainly found in *Brassicaceae* family. Glucosinolates produce glucose, sulphate and other aglucon products when broken down by myrosinase. Higher consumption is detrimental to animal health as these reduce the feed palatability and affect the iodine uptake by the thyroid glands, which in turn lowers feed efficiency and weight gains particularly in non-ruminants such as pigs and poultry; <30 ppm of glucosinolates in seed meal is desirable.

Kunitz trypsin inhibitor (KTI): It is a non-glycosylated protein that possesses adverse effects on growth of humans primarily through inhibition of trypsin in the digestive tract leading to indigestion. KTI constituting the major portion of total trypsin inhibitors in soybean, is considered detrimental to human health. Although heat treatment is used to get rid of this heat labile protein, the entire amount is not removed.

Bio-fortification in crops

As per the food habit in Indian diet is concerned the bio-fortification is targeted for different crops for developing different bio-fortified crops. Rice, wheat, maize, pearl millet, sorghum and millets are targeted and some vegetable and fruits are targeted for bio-fortification. Rice and maize is targeted for iron, zinc, vitamin A and protein while wheat, pearl millet, sorghum and millets are targeted for iron and zinc.

The base line of existing traditional cultivar and higher level achieved in some of the recently developed bio-fortified crops in the country as given below.

Table 1. Details of baseline level of nutrients in targeted crops and levels achieved through bio-fortification

Crop	Nutrient	Baseline levels	Level achieved
Nutritional factors			
Rice	Zinc	12-16 ppm	>20.0 ppm
	Protein	7-8 %	>10 %
Wheat	Iron	28-32 ppm	>38ppm
	Zinc	30-32 ppm	>40 ppm
	Protein	8-10%	>12%
Maize	Lysine	1.5-2%	>2.5%
	Tryptophan	0.3-0.4%	>0.6%
	Pro-vitamin A	1-2 ppm	>8 ppm
Pearl millet	Zinc	30-35 ppm	>40 ppm
	Iron	45-50 ppm	>70 ppm
Lentil	Zinc	35-40 ppm	>50 ppm
	Iron	45-50 ppm	>62 ppm
Cauliflower	β – carotene	Negligible	>8 ppm
Sweet potato	Anthocyanin	Negligible	>80.0 mg/100g
	β – carotene	2.0-3.0mg/100g	>13.0mg/100g
Pomegranate	Vitamin C	14.2-14.6 mg / 100g	>19 mg/100g
	Iron	2.7-3.2 mg/100g	>5.0mg/100g
	Zinc	0.5-0.54mg/100g	>0.6mg/100g
Anti-nutritional factor			
Mustard	Glucosinolates	>120 ppm	<30 ppm
	Erucic acid	>40%	<2%
Soybean	Kunitz tripsin inhibitor	30-45 mg/g of seed meal	Negligible

Bio-fortification in rice:

Golden Rice

In 1990, Peter Bayer of the University of Freiburg in Germany and Ingo Potrykus of the Institute of Plant Sciences at the Swiss Federal Institute of Technology (ETH) jointly conceived the idea of genetically engineering beta-carotene into rice grain. The rice variety that the Swiss group worked on was the japonica TP 309, which grows in moderate climates. Working together over a ten year period, they and their team at ETH succeeded in 2000 in developing a beta-carotene enriched GM-rice variety, which has since been dubbed "Golden Rice". The biofortified rice was called Golden rice because of their golden grain colour. Golden rice

was created by transforming rice with three beta-carotene biosynthesis genes including psy (phytoene synthase) and lyc (lycopene cyclase) both from daffodil (*Narcissus pseudonarcissus*) and crtI (carotene desaturase) from the soil bacterium *Erwinia uredovora*. Golden Rice 1 contains the PSY gene from daffodil and the CRTI gene from the bacterium *Erwinia uredovora*, both expressed only in the rice seed. Replacing PSY with genes from maize and rice increased the level of β -carotene by 23 times in Golden Rice 2. Golden rice 2 was developed in the background of the Kaybonnet, an American variety. Half the daily recommended allowance of vitamin A for a 1-3 year old child would be provided by 72g of Golden Rice 2.



In India the golden rice2 is back crossed with swarna and golden swarna was developed.



Golden rice is now approved for cultivation as it is proved safe for human consumption and farmers earning below 10000 dollar are allowed to cultivate and sell the seed. Golden rice project wins the patent for humanity award 2015.

Iron and zinc fortified rice:

Iron and zinc availability is more in indigenous rice genotypes. So screening programs and identification of donor parent and hybridization or pure line selection and multi locations testing of these genotypes were conducted and different genotypes to find bio-fortified rice genotypes.

Based on the criteria set during 48th Annual Rice Group Meeting entries possessing ≥ 20 mg/ Kg zinc and or ≥ 10 mg/ Kg iron in polished rice are eligible for promotion.

Machineries used for processing and estimation of iron and zinc in rice



Non - ferrous dehusker



Non - ferrous Polisher



Atomic Absorption Spectrophotometer (AAS)



X-ray Florescence Spectrophotometer (XRF)

IR68144-3B-2-2-3 : IRRI screening programme, an aromatic variety (IR68144-3B-2-2-3) was identified with high grain iron (21mg/Kg) in brown rice.

DRR Dhan 45 : It is a pure line variety and possessed high zinc (22.6 ppm) in polished grain. Semi dwarf medium duration (125-130 days) with a yield potential of 5.2 tonnes /ha. Notified in Karnatak, Andhra pradesh and Telengana. Released in 2016. This biofortified variety has been developed by ICAR-Indian Institute of Rice Research, Hyderabad, Telengana.

DRR Dhan 49: It is a pure line variety with high zinc (25.2 ppm) in polished grain. It has been released and notified in 2018 for Gujarat, Maharashtra and Kerala. Its average grain yield is 50.0 q/ha. It matures in 125-130 days. This biofortified variety has been developed by ICAR-Indian Institute of Rice Research, Hyderabad, Telengana.

Chhatisgarh Zinc Rice -1 : It is having 22 ppm zinc. Semi dwarf and early maturing with long bold grain.

Protezin : 9.02 % protein and 20.9 ppm zinc with grain yield of 5.3 tonnes/ha

IET 24557: 26 ppm zinc, medium slender grains with BLB resistance gene.

IET 24760: (Nuziveedu Seeds Ltd) 21 ppm zinc with 107 days to flowering.

High protein rice

CR Dhan 310: It is a pure line variety and contains high protein (10.3%) in polished grain. It has been released and notified in 2016 for Odisha, Madhya Pradesh and Uttar Pradesh. Its average grain yield is 45.0 q/ha

(quintal/hectare). It matures in 125 days. This biofortified variety has been developed by ICAR-National Rice Research Institute, Cuttack, Odisha.

Bio- fortification in wheat

WB 02: It is a pure line variety and rich in zinc (42.0 ppm) and iron (40.0 ppm). It has been released and notified in 2017 for Punjab, Haryana, Delhi, Rajasthan (excluding Kota and Udaipur division), western Uttar Pradesh (except Jhansi division), Jammu and Kathua district of Jammu and Kashmir, Paonta Valley and Una district of Himachal Pradesh and Tarai region of Uttarakhand. Its average grain yield is 51.6 q/ha. It matures in 142 days and is suitable for irrigated timely sown conditions. This biofortified variety has been developed by ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana.

HPBW 01: It is a pure line variety and contains high iron (40.0 ppm) and zinc (40.6 ppm). It has been released and notified in 2017 for Punjab, Haryana, Delhi, Rajasthan (excluding Kota and Udaipur division), western Uttar Pradesh (except Jhansi division), Jammu and Kathua

district of Jammu and Kashmir, Paonta Valley and Una district of Himachal Pradesh and Tarai region of Uttarakhand. Its average grain yield is 51.7 q/ha. It matures in 141 days and is suitable for irrigated timely sown conditions. This biofortified variety has been developed by Punjab Agricultural University, Ludhiana, Punjab, under ICAR-All India Coordinated Research Project on Wheat and Barley.

Pusa Tejas (HI 8759): It is a pure line variety with high protein (12%), iron (42.1 ppm) and zinc (42.8 ppm). It is a durum wheat variety suitable for making *chapatti* (Indian bread), pasta and other traditional food products. It has been released and notified in 2017 for Madhya Pradesh, Chhattisgarh, Gujarat, Rajasthan and Uttar Pradesh. The average yield of this variety is 50.0 q/ha under timely sown irrigated conditions. This biofortified variety has been developed by ICAR-Indian Agricultural Research Institute (IARI), Regional Station, Indore, Madhya Pradesh.

Pusa Ujala (HI 1605): It is a pure line variety with high protein (13%), iron (43 ppm) and zinc (35 ppm) and having excellent *chapatti* making quality. It has been released and notified in 2017 for Maharashtra, Karnataka and Tamil Nadu. Its average yield is 30.0 q/ha under timely sown, restricted irrigation conditions. This biofortified variety has been developed by ICAR-IARI, Regional Station, Indore, Madhya Pradesh.

MACS 4028 (d): It is a pure line durum wheat variety with high protein (14.7%), iron (46.1 ppm) and zinc (40.3 ppm). It has been released and notified in 2018 for Maharashtra and Karnataka. Its average grain yield is 19.3 q/ha under rainfed low fertility, timely sown conditions in Peninsular Zone. It matures in 102 days. This biofortified variety has been developed by Agharkar Research Institute, Pune, Maharashtra, under ICAR-All India Coordinated Research Project on Wheat and Barley.

Biofortification in Maize

Pusa Vivek QPM9 improved: It is an early maturing hybrid and possesses high provitamin-A (8.15 ppm). It also contains high tryptophan (0.74%) and lysine (2.67%) in endosperm protein and known as 'quality protein maize' (QPM). It is also a multi-nutrient maize hybrid. It has been released and notified in 2017 for Jammu and Kashmir, Himachal Pradesh, Uttarakhand (Hills), North Eastern States, Maharashtra, Karnataka, Andhra Pradesh, Telangana and Tamil Nadu. Its average grain yield is 55.9 and 59.2 q/ha, with maturity of 93 and 83 days in the two different agro-climatic zones, respectively. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Pusa HM4 improved: It is a medium maturing QPM hybrid that possesses high tryptophan (0.91%) and lysine (3.62%) in endosperm protein. It has been released and notified in 2017 for Punjab, Haryana, Delhi, Uttarakhand (plains) and western Uttar Pradesh. Its average grain yield is 64.2 q/ha. It matures in 87 days. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Pusa HM8 improved: It is a medium maturing QPM hybrid that possesses high tryptophan (1.06%) and lysine (4.18%) in endosperm protein. It has been released and notified in 2017 for Maharashtra, Karnataka, Andhra Pradesh, Telangana and Tamil Nadu. Its average grain

yield is 62.6 q/ha. It matures in 95 days. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Pusa HM9 improved: It is a medium maturing QPM hybrid that possesses high tryptophan (0.68%) and lysine (2.97%) in endosperm protein. It has been released and notified in 2017 for Bihar, Jharkhand, Odisha, West Bengal and eastern Uttar Pradesh. Its average grain yield is 52.0 q/ha. It matures in 89 days. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Besides, Shakti-1 (composite) and hybrids, namely Shaktiman-1, Shaktiman-2, HQPM-1, Shaktiman-3, Shaktiman-4, HQPM-5, HQPM-7, Vivek QPM-9, HQPM-4, Pratap QPM Hybrid-1 and Shaktiman-5, have also been released for various agro-ecologies of the country under the AICRP system. These cultivars possess high protein quality due to a higher concentration of lysine and tryptophan.

Bio-fortification in Pearl millet

HHB 299: It is a hybrid and possesses high iron (73.0 ppm) and zinc (41.0 ppm) content. It has been released and notified in 2017 for Haryana, Rajasthan, Gujarat, Punjab, Delhi, Maharashtra and Tamil Nadu. Its average grain yield is 32.7 q/ha, and dry fodder yield is 73.0 q/ha. It matures in 81 days. This biofortified variety has been developed by Chaudhary Charan Singh-Haryana Agricultural University, Hisar in collaboration with International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad, Telangana, under ICAR-All India Coordinated Research Project on Pearl millet.

AHB 1200: It is a hybrid and rich in iron (73.0 ppm). It has been released and notified in 2017 for Haryana, Rajasthan, Gujarat, Punjab, Delhi, Maharashtra and Tamil Nadu. Its average grain yield is 32.0 q/ha; dry fodder yield is 70.0 q/ha. It matures in 78 days. This biofortified variety has been developed by Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, in collaboration with ICRISAT, Patancheru, Hyderabad, Telangana, under ICAR-All India Coordinated Research Project on Pearl millet.

Bio fortification in Lentil

Pusa Ageti Masoor: It is a pure line variety and contains 65.0 ppm iron. It has been released and notified in 2017 for Uttar Pradesh, Madhya Pradesh and Chhattisgarh. Its average grain yield is 13.0 q/ha. It matures in 100 days and is suitable for the rainfed condition. This biofortified variety has been developed by ICAR-IARI, New Delhi.

IPL 220: It is a pure line variety with high iron (73 ppm) and zinc (51 ppm). It has been released and notified during 2018 for eastern Uttar Pradesh, Bihar, Assam and West Bengal. The average yield of IPL- 220 is 13.8 q/ha. It matures in 121 days and is suitable for the rainfed situation during rabi season. This biofortified variety has been developed by ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh.

Bio fortification in Mustard

Pusa Mustard 30: It is a pure line variety and contains low erucic acid (<2.0%) in oil. It has been released and notified in 2013 for Uttar Pradesh, Uttarakhand, Madhya Pradesh and Rajasthan. Its average oil content is 37.7 per cent, with a seed yield of 18.2 q/ha. It matures in 137 days and is suitable for timely sown irrigated conditions. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Pusa Double Zero Mustard 31: It is a pure line variety and contains low erucic acid (<2.0%) in oil and glucosinolates (<30.0 ppm) in seed meal. It has been released and notified in 2016 for Rajasthan (north and western parts), Punjab, Haryana, Delhi, western Uttar Pradesh, plains of Jammu and Kashmir and Himachal Pradesh. Its average oil content is 41.0 per cent, with a seed yield of 23.0 q/ha. It matures in 142 days and is suitable for timely sown irrigated conditions. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Bio-fortificatiion in Soybean

NRC-127: It is a KTI-free pure line soybean variety. It has been released in 2018 for Madhya Pradesh, Bundelkhand region of Uttar Pradesh, Rajasthan, Gujarat and Marathwada and Vidarbha region of Maharashtra. The average yield of NRC-127 is 18.0 q/ha, and it matures in 104 days. It has 18.5-20.0 per cent oil and 38.0-40.0 per cent protein content. This biofortified variety has been developed by ICAR-Indian Institute of Soybean Research, Indore, Madhya Pradesh.

Bio fortification in Cauliflower

Pusa Beta Kesari 1: It is a pure line variety and contains high β -carotene (8.0-10.0 ppm). It has been released and notified in 2015 for the Nation Capital Region of Delhi. Its average curd yield is 40.0-50.0 t/ha^{21,25}. This biofortified variety has been developed by ICAR-IARI, New Delhi.

Bio-fortification in Sweet potato

Bhu Sona: It is a pure line variety and contains high β -carotene (14.0 mg/100 g). It has been released and notified in 2017 for Odisha. Its average tuber yield is 19.8 t/ha with dry matter of 27.0-29.0 per cent, starch of 20.0 per cent and total sugar of 2.0-2.4 per cent. This biofortified variety has been developed by ICAR Central Tuber Crops Research Institute (CTCRI), Thiruvananthapuram, Kerala.

Bhu Krishna: It is a pure line variety and contains high anthocyanin (90.0 mg/100 g). It has been released and notified in 2017 for Odisha. Its average tuber yield is 18.0 t/ha, with dry matter of 24.0-25.5 per cent, starch of 19.5 per cent and total sugar of 1.9-2.2 per cent. This biofortified variety has been developed by ICAR-CTCRI, Thiruvananthapuram, Kerala.

Bio fortification in Pomegranate

Solapur Lal: It is a hybrid variety and contains high iron (5.6-6.1 mg/100 g), zinc (0.64-0.69 mg/100 g) and vitamin C (19.4-19.8 mg/100 g) in fresh arils. It has been released and notified in 2017 for semi-arid regions of the country. Its average fruit yield is 23.0-27.0 t/ha. This biofortified variety has been developed by ICAR-National Research Centre on Pomegranate, Pune, Maharashtra.

Feeding of bio-fortified crops

Different studies conducted for feeding effect of the bio-fortified crops in different countries showed a significant improvement in the nutritional status. Study conducted among in the school children of Maharashtra by taking 246 children in the age group of 12-16 feeding with iron rich pearl millet indicated that it was an efficient approach to improve iron status in school age children. Study conducted in Zambia by feeding provitamin A maize grain to the school children with pro-vitamin-A rich maize improve their serum xanthophylls and retinol. Feeding trail conducted at local Ashram at Dharampur near Chinsurah, Hooghly, West Bengal for five months (October 2010-February2011) with Jayasilet, Chapakhusi and Seetabhog with 400g rice daily consumption (200g/meal) indicate the increase in iron content of blood Hb content.

Conclusion

Feeding experiments with bio-fortified crops indicated that the levels of these nutrients are increasing in the blood of the consuming children or women. So bio-fortification by increasing the enrichment of these nutrients content in crop plant and intake of these in the feeding practice of the poor farmwomen and children help in reducing the malnutrition problem. So bio-fortification is the feature solution for nutrition of farm women. The crop will be grown by the farm women, consumed by the farm women and the quality produce sell in the market fetching higher price thereby increasing the economic condition of the farm women.

**PARTICIPATORY MONITORING, EVALUATION AND IMPACT ASSESSMENT TOOLS FOR AGRICULTURE
RESEARCH AND EXTENSION**

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Participatory Monitoring and Evaluation (PME)

There are many definitions of participatory monitoring and evaluation, but perhaps the simplest is keeping track of changes with the community stakeholders. This article adapted from Estrella et al (2000), and incorporating ideas volunteered by participants at a programme partner workshop in January 2005 – provides some further insight.

Features implied within Participatory Monitoring and Evaluation

Participatory

- Shared learning
- (in this context) Joint decision-making Co-ownership
- Democratic process-involving everyone in the community, not just the most vocal members
- Mutual respect
- Empowerment
- Enhanced mutual understanding

Monitoring

- Knowing where we are
- Observing, recording change
- Regular, timely assessment
- Increased, jointly shared accountability
- Routine reflection
- Feedback

Evaluation

- Reflection process on what has occurred
- Assessment of achievements/impacts over a longer period
- Learning from experience
- Valuing change

Overall, PME should serve to increase the analytical capacities of community members, and empower them to question, and become pro-active in development initiatives. From this it may be seen that monitoring is a periodic but regular activity for ‘keeping track’ of what is happening in any project intervention. In this way, changes over time can be recorded effectively. Furthermore, any unexpected or new circumstances can be

taken into account, and incorporated in further activities. Evaluation, by contrast, happens at a pre-defined point within a long period of project interventions and entails a reflection and assessment of what has been achieved and learned.

Ideally, the system of monitoring and evaluation should be planned as an integrated part of project design. It should start before the commencement of project activities, with decisions on what should be monitored, and eventually evaluated. These criteria are often defined as indicators. Furthermore, if the system of monitoring and evaluation is to be truly participatory, the indicators and the means of determining them should be discussed, identified and agreed by the community stakeholders at the beginning. Indeed, it should then be these same stakeholders who decide how often progress should be reviewed, who should do it, using what method, etc.

Who wants to know what has changed?

Although the PME should be based on the ideas and wishes of the community stakeholders, it is a fact that local people rarely demand information in such a structured manner. They form their own opinions. It is usually NGO staff, donor agencies or other interested persons (Government agencies, researchers, journalists) who wish to have changes captured and, if possible, quantified. Consulting local people in a monitoring and evaluation exercise does not automatically make the process participatory. If based on a one-way process of information collection, it can be purely extractive. PME, by contrast, should entail a two-way exchange of information. Most of all, it should be an enjoyable process in which everyone feels that they have learned something. Most of all, PME should be enjoyable Participatory Monitoring and Evaluation.

Participatory Impact Monitoring and Assessment

In support of Impact Monitoring/Impact Assessment

- Despite the increasing number and sophistication of management tools and methodologies, monitoring the impacts of development efforts continues to be a complex and neglected task.
- Management focus is generally concentrated more on planning than on other aspects of project administration
- Results are usually measured in terms of outputs....
..... and sometimes in terms of outcomes.
- But almost never in terms of impacts

Impacts are often difficult to measure for several reasons.....

- They do not always happen as per plans and schedules
- Impacts that are intangible or qualitative are difficult to measure and document credibly and comprehensively
- Unintended, unplanned, unexpected impacts get overlooked unless they are somehow discovered and captured
- The extent to which project activities alone are responsible for impacts is not always clear since there may also be other external factors influencing impacts
- Practical methodologies to assess and document impacts are inadequate

On the other than, development agencies are increasingly exposed to public pressure and are expected to justify how and to what extent expenditures have benefited the intended populations. They are called upon to demonstrate that their projects are creating the expected benefits for their target groups.

Participatory Impact Monitoring/Assessment refers to

A process in which development interveners and local communities jointly observe, document and critically reflect on the effects and changes caused by project interventions

The objectives of PIM/A are threefold

- Participatory Impact Monitoring/Assessment
- Promoting Learning Process
- Improving Communication between stakeholders
- Improving Project Steering

PIM/A is not simply a methodology but even more, it represents a philosophy. It is not a one-time event, it has to be periodically undertaken so that programmes and intervention strategies are constantly reviewed and improved.

Indicators for Impact Monitoring and Assessment

Indicators are quantitative or qualitative variables that can be measured or described and, when observed periodically, demonstrate trends; they help to communicate complex phenomena. They represent the abstraction of a phenomenon or a variable. In other words, an indicator is just an indicator. It is not the same as the phenomenon of interest, but only an indicator of that phenomenon (Patton, 1999).

Classification of Indicators

Scientific indicators tend to be measurable in quantitative terms; they are global within a given discipline and are meant to be comparable across space and time.

Grassroots (indigenous/local) indicators are signals used by local people (individuals, groups, communities) based on their own observations, perceptions and local knowledge, applied within specific cultural, ecological and spiritual contexts; they tend to be more descriptive.

Another, classification of indicators says that, they can be broadly classified into two categories, namely; **final and intermediate**.

Final indicator: when an indicator measures the effect of an intervention on individuals' say 'well-being', we call it a "final" indicator.

For example, literacy may be considered one of the dimensions of 'wellbeing', so an indicator measuring it—say, the proportion of people of a certain age who can read a simple text and write their name—would be a final indicator. Sometimes final indicators are divided into **“outcome”** and **“impact”** indicators.

Impact indicators measure key dimensions of 'well-being' such as freedom from hunger, literacy, good health, empowerment, and security.

Outcome indicators capture access to, use of, and satisfaction with public services, such as use of health clinics and satisfaction with the services received; access to credit; representation in political institutions and so on. These are not dimensions of

well-being in themselves, but are closely related. They may be contextual.

Thus, both the **impact** and **outcome** indicators should constitute the final indicators of impact assessment and monitoring impact.

Intermediate indicator: when an indicator measures a factor that determines an outcome or contributes to the process of achieving an outcome, we call it an **“input”** or **“output”** indicator, depending on the stage of the process—in other words, an "intermediate" indicator.

For example, many things may be needed to raise literacy levels: more schools and teachers, better textbooks, and so on. A measure of public expenditures on classrooms and teachers would be “input” indicators, while measures of classrooms built and teachers trained would be “output” indicators. What is important is that inputs and outputs are not goals in themselves; rather, they help to achieve the chosen goals.

Features of Good Indicators

A good indicator:

- Is a direct and unambiguous measure of progress/change—more (or less) it is unmistakably better.
 - Is relevant— it measures factors that reflect the objectives.
 - Varies across areas, groups, over time, and is sensitive to changes in policies, programs, institutions.
 - Is not easily blown off course by unrelated developments and cannot be easily manipulated to show achievement where none exists.
 - Can be tracked (better if already available), is available frequently, and is not too costly to track.
-

Identification and Selection of Indicators for Impact Monitoring and Assessment

Once a set of goals/objectives of the project have been agreed upon through a participatory analysis processes, the next step is to identify indicators—also in a participatory way—to measure progress toward those goals as a result of an intervention or a development project. The impact monitoring and assessment depend critically on the choice of appropriate indicators. Preferably, they should be derived from the identification and descriptions of relevant variables being given by the clients, with appropriate indicators of them being based on discussion of all the stakeholders.

Basis for Indicators of Impact Assessment

Indicators should comprise comprehensive information about the program outcomes:

- Indicators of the program impact based on the program objectives are needed to guide policies and decisions at all levels of society- village, town, city, district, state, region, nation, continent and world.

- These indicators must represent all important concerns of all the stakeholders in the program: An ad-hoc collection of indicators that just seem relevant is not adequate. A more systematic approach must look at the interaction of the program components with the environment.
- The number of indicators should be as small as possible, but not smaller than necessary. That is, the indicator set must be comprehensive and compact, covering all relevant aspects.
- The process of finding an indicator set must be participatory to ensure that the set encompasses the visions and values of the community or region for which it is developed.
- Indicators must be clearly defined, reproducible, unambiguous, understandable and practical. They must reflect the interests and views of different stakeholders.
- From a look at these indicators, it must be possible to deduce the viability and sustainability of change due to a project program and current developments, and to compare with alternative change/development paths.
- A framework, a process and criteria for finding an adequate set of indicators to assess all aspects of the impact of the program are needed.

These facts must be borne in mind when defining indicator sets.

Appropriate Tools

Participatory Rural Appraisal (PRA) tools are often only seen as appropriate for gathering information at the beginning of an intervention, as part of a process of appraisal and planning. Development workers may talk about having 'done' a PRA, sometimes seeing it as just a step towards getting funding. However, PRA tools have a much wider range of potential uses, and can often be readily adapted and used for participatory monitoring, and for participatory evaluation.

PME methods and examples

The examples documented here are not selected as models to be followed, but as cases of real situations, described by participants as learning experiences worth sharing. To stimulate further thought, particular points of note are given in comment boxes. For each case example, a small information box provides an introduction to the NGO concerned, and indicates the communities with whom they are working.

The examples described are as follows:

Transect walk: is a means of involving the community in both monitoring and evaluating soil conservation changes that have taken place over the period of programme intervention. This method entails direct observation whilst incorporating the views of community members. The case example comes from the Nilgiri hills of Tamil Nadu, where the Keystone NGO is working with tribal communities.

Spider web diagram: in this case is used as a means for participants to monitor and evaluate key areas of a programme. The spider web is a simple diagrammatic tool for use in discussions; it does not entail any direct field observations. The case example comes from the Jawadhu hills of Tamil Nadu, where the SCOPE NGO is working with tribal communities.

Participatory mapping: is perhaps the most easy and popular of participatory tools, used here to evaluate project interventions. The example is taken from Chikmagalur district, Karnataka, where the Vikasana NGO is working with generally poor and marginalised communities.

Photographic comparisons: is another easy visual tool, here used to stimulate community discussions in evaluating programme interventions. In this case, the RWT NGO is working with marginalised communities in Belgaum district, Karnataka.

Matrix ranking: in this case used to evaluate the impact of skills training to women belonging to a shepherd community. The example is taken from Belgaum district, Karnataka, where the RES NGO is working with the shepherd community.

Time line: a tool used to elaborate historical change. In this example, only a simple time line is given, comparing two points in time (usually there would be more). The case is a second one from the Keystone NGO, working in the Nilgiri hills of Tamil Nadu.

Well-being ranking: is described in the final example, being used to differentiate the benefits that different community members have gained from the renovation of a community pond. This example comes from the Prakruthi NGO in Kolar district of Karnataka.

H-form: a simple monitoring and evaluation tool, used in this case to evaluate tank silt application to farm land. The Grama Vikas NGO is working with marginalised farming communities in Kolar district, Karnataka.

The H-form: the method

This method is particularly designed for monitoring and evaluation of programmes. It was developed in Somalia for assisting local people to monitor and evaluate local environmental management. The method can be used for developing indicators, evaluating activities, and to facilitate and record interviews with individuals tank silt application.

PME as an integral part of all community-based interventions

However interesting a participatory evaluation at the end of a programme might be, without it having been based on a sound system of participatory monitoring throughout the project intervention, the evaluation in itself is limited. Thus, the first conclusion to draw is that monitoring and evaluation should be made a systematic feature of all interventions, seeking community participation from the outset in defining what should be monitored (indicators); how often and by whom the monitoring should be conducted; how this information will be used, etc.

Document unexpected or negative outcomes carefully

In a number of the examples documented, participants voiced only positive outcomes of the intervention. This may be partly due to a wish not to cause offence, but it may also be a genuine inability at the end of an intervention to identify more negative aspects, given a general feeling that the activities were successful. Yet, often the greatest opportunities to learn arise from unexpected findings. Thus, for example, whilst Keystone was surprised to find that dietary habits had changed less than they expected over the course of project interventions, they could use this finding to stimulate further community discussions and learning.

Be flexible in the use of participatory tools

In a number of the examples given, the partner staff had a certain idea on how to approach an exercise, and when they came to the field, they found that they had to adjust their plans because more people had come than expected, or for other reasons. It is best to conduct participatory exercises in a spirit of flexibility, whilst keeping sight of the information that is required for effective monitoring and/or evaluation.

Gender

In most of the exercises documented, a deliberate effort was made to seek out the views of women and men separately. Generally, however, the outcomes were quite similar, so the overall findings were pooled as one. Sometimes differences of perspective can appear relatively minor, but it is nevertheless important that they are discussed to ensure that any underlying differences are fully explored.

Capacity building

A participatory approach to monitoring and evaluation requires not only knowledge of tools, but an overall understanding of community dynamics, and aspects such as facilitating the representation of all groups in discussions and decision-making. It also requires, of course, a clear conceptual understanding of what monitoring and evaluation entail. For both NGO staff and community members alike, regular capacity building through trainings, field exposures and learning 'on the job' are thus an essential aspect of promoting PME in particular interventions, and as a part of organisational culture.

A technology is said to be successful, only when majority of the clientele groups implements it without any inhibition and gets satisfied with the result. Of course, all research innovations cannot be adopted in the field, as they have varied attributes. Hence, location-specific technology generation and target-based technology transfer efforts have to be followed for wider adoption and popularization. There should be sufficient pre-project diagnosis or situational analysis to better characterize research problems. Paradigm shifts in technology development process such as the shift from mono-disciplinary to multi-disciplinary, supply-driven to demand-driven, general to location-specific etc. are the need of the hour.

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IDENTIFICATION OF DRUDGERY FOR FARM WOMEN AND THEIR SUITABLE MEASURES

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More than 300 million women reside in rural India playing a key role in agriculture and rural development. The most of the farmer in India are women. It is understood that women responsibility in agriculture is far more than male because of their involvement in multifarious activities. The women are the backbone of agricultural workforce but worldwide her hard work has mostly been unpaid. They do the most tedious and back-breaking tasks in agriculture, animal husbandry and homes. They have to perform different activities in the home as well in the field throughout the day without any rest. Still women are considered as secondary workers in the economic scenario. The farmwomen perform almost each and every agricultural activity right from land preparation, weeding, sowing, transplanting to the harvesting and storage of the agricultural produce. In villages farm women are fully occupied and over burdened with three fold responsibility of home, agriculture and livestock management. Many agricultural operations and household activities performed by women involve a lot of physical strain, which create serious health problems in the long run. The majority of these activities, which are full of drudgery, have not been supported by the mechanical advantages of tool and appliances. Besides women an average have smaller stature and have less physical strength, their vital capacity is 11 per cent lesser, haemoglobin is app.20 per cent less. Their skin area is larger compared to body fat content. They have lower heat tolerance & greater cold tolerance. They have reproductive function. So as compare to man they are more prone to drudgery and occupational health hazards.

What is Drudgery

Tedious, menial, or unpleasant work can be termed as drudgery. Drudgery is generally conceived as physical and mental strain, agony, fatigue, monotony and hardship experienced by human being, while all these result in decline in performance of men and women alike. The plight of women in this regard is alarming as they are constrained by illiteracy, poor health, unemployment, low technical know-how and skills. The farm women put in hard physical labour beyond their capacity. A continuous work affects adversely their mental and physical well-being. In relation to drudgery faced by farm women in different farm activities, based on opinion of farm women it has been reported that maximum degrees of drudgery perceived by the respondent were in rice transplanting and harvesting followed by manure application, preparatory work during seedbed, weeding, sowing, irrigation, fertilizer application, pesticide dusting, carrying crops to threshing, threshing, and grain carrying operations (Sirohi, 1996, and Singh et al, 2006 a). In post harvest operations, Dubey, et al. (1996) revealed that maximum drudgery oriented task as perceived by rural women was winnowing followed by crop bundles of harvested produce in the thresher, carrying bundles on head to threshing place, collecting harvested produce and making bundles, transporting produce from farm to home, filling grains in gunny bags and loading gunny bags in carts/ tractor. Least drudgery-oriented tasks considered were storing grains and protecting harvested produce from birds. The main reasons for drudgery perception were monotone, tiring, laborious, repetitive and time-consuming tasks. In animal husbandry activities, Lakhotia (1996) revealed that rural women perceived maximum amount of drudgery in collection and disposal of dung, collecting and bringing of fodder, cleaning cattle-shed, taking animals to pasture and milking. Moderate amount of drudgery was perceived in preparing dung cakes and their storage, taking care of sick animals and making butter from milk while preparing feed and bathing/cleaning of animals were the least drudgery-oriented tasks.

Drudgery and Occupational Health Hazards of farm women in various activities

Drudgery is associated with a worker when he/she is doing a difficult task or a something he/she does not looking forward to doing due to tedious, menial, or unpleasant work. This affects the worker's physical and mental health and decrease the working efficiency or capacity. The worker remains disturbed and doesn't concentrate upon his/her assigned tasks. There are more chances of increasing rate of accidents at work places and absence of workers due to sickness. Women are more vulnerable in all cases because of their poor health condition, nutritional status, poor level of knowledge and skills, lower education, less awareness and exposure to different technologies and working for long duration at unsuitable workplace or working environment with awkward posture and repetitive motion of body parts. These are the factors which are directly or indirectly responsible for leading drudgery in various activities among rural women. In rural India women perform various activities such as household, farming and animal rearing along with rearing of children and caring of old family members. They devote their time according to their priority of the work. Fetching water, collecting fuel and fodder from distance places are very difficult for them. They cook for entire family with earthen chulha in traditional manner at less illumination and poor ventilation of cooking place. In the long run in such type working condition there are chances of health hazards among the rural housewives and accidents at the work place. These can be lead to severe drudgery, musculoskeletal disorders and other health related problems. Cleaning animal shed, fodder chaffing, milking and disposal of animal dung are also very tedious activities in case of animal rearing for rural women. A part from these, they perform almost all kind of farming activities except plough, pesticide application and irrigation activities in the farm. Farming operation is a very tough job where they do their work hard under the adverse environmental condition of light, dust, noise and vibrations. In all the cases drudgery is very common and associated with the rural women in our country

Occupational Health Hazards have been a widespread problem in agriculture in more than a decade. Occupational risk factors include static position, forward bending, heavy lifting and carrying, kneeling and vibration in agriculture. The identification of occupational health hazards and development of systems to evaluate intervene and decrease musculoskeletal risk factors and resulting disorders is quite crucial for safety of farm women. Role of women in agriculture is increasingly understood and recognized in agriculture. Women play a substantial role in decision making in farm related tasks. There is need to initiate women oriented researches in agriculture. As woman has different ergonomical characteristics than man, design of women friendly tools and equipment is required. Work station should be adjustable to make it comfortable for women during performing agricultural activities.

Need for drudgery reduction

The quality of work life of women in agriculture is characterized by long hours of work, awkward postures and drudgery experiences at work due to work load and unsuitable farming equipments. The education level was very poor and there was less awareness about using different agricultural implements. There were more drudgery and stress among the farm women found in the field. They adopt very awkward static posture squatting, bending, sitting and performed task repetitively which was responsible for musculoskeletal disorders and leads to occupational health hazards. They need more attention for better health and productivity. Above all women friendly ergonomically designed farm tools or implements should be designed to reduce drudgery and health hazards. This also leads in the direction of women empowerment.

Human power plays a great importance in agriculture system since agrarian and they are involved in various farm operations. Hence in the design of farm tools and equipment, everything known about operator is very important, as they have to work with the designed/developed equipment. It is reported that many agricultural projects aimed at men with the assumption that they will somehow automatically benefit women though the ergonomical characteristics of women are different than men workers. The contribution of women is very high in the farm sector as they are involved in majority of farm operations and are therefore subjected to extra harsh conditions of work that leads to drudgery. Introducing women friendly improved farm tools and equipment can reduce drudgery in farm operations.

Risk Factors at the workplace

- Performing the same task over and over
- Working in the same position for long periods
- Bending or twisting back in an awkward way
- Lifting or transferring dependent loads
- Continuing to work when injured or hurt
- Inadequate training in injury prevention

Signs and Symptoms

- Some people recognize symptoms in specific areas, while others feel weakness or tenderness over a large area, such as the shoulder.
- Signs and symptoms of injury may appear suddenly or gradually over a period of weeks, months or years.
- Discomfort, Pain, Numbness, Tingling, Burning, Swelling, Change in color, Tightness, loss of flexibility

DRUDGERY ASSESSMENT

Drudgery can be assessed by measuring physiological cost of activities/ task either by traditional/ improved methods performed by farm women/ workers. The common parameters related to physical strain experienced by the worker while carrying agricultural activities, can be used which are given below,

- Working heart rate
- Increase in working heart rate over rest
- Oxygen consumption rate while working
- Increase in oxygen consumption while working over rest
- Energy expenditure rate
- Increase in energy expenditure rate over rest
- Overall discomfort rating
- Body parts discomfort score

Role of Ergonomics in Drudgery Reduction

Ergonomics is the scientific study of relationship between human and his/her working environment. The term environment includes his/her tools and materials, his/her method of work, ambient conditions and physical environment of work, and also the organization of the work. The scope of ergonomics application includes the following:

- i) Fitting the demands of work to the efficiency of human in order to reduce stress.
- ii) Designing machines, equipment and installations so that they can be operated with great efficiency, accuracy and safety.
- iii) Working out proportions and conditions of work place to ensure correct body posture.
- iv) Adopting visual and thermal and acoustic environment to suit human's physical requirements.

Importance of ergonomics has been well-established and recognized in industry and military applications. However ergonomics is equally important and relevant in agriculture and related activities also. In most of the developing countries human work constitute as one of the important sources of farm power. In developed countries also human workers operate various tractor operated/self propelled/power operated machines. Therefore in agriculture also, the application of ergonomics can help in increasing the efficiency and thereby productivity of the worker without jeopardizing his/her health.

The ergonomical issues that affect farm women in using the already existing farm tools and equipment are grouped under the following sub-headings:

1. Anthropometry
2. Muscular strength
3. Aerobic capacity
4. Physiological cost of operation
5. Posture
6. Load carrying capabilities

1. Anthropometry

Anthropometry is the technology of measuring various human physical traits as size, mobility and strength.

Engineering anthropometry is an attempt to apply such data in designing farm equipment, workplace and clothing to enhance efficiency, safety and comfort of the worker as human-machine interface decides the ultimate performance of the equipment/work system. Anthropometric measures vary considerably with factors such as gender, race and age that play dominant role in this variability. Due to variability, generally equipment is designed in such a way that it will satisfy 90 per cent of the users which can be achieved by using 5th and 95th percentile values/ limits. The anthropometric criteria deal with issues of clearance (95th percentile limit), reach (5th percentile limit), posture (as per job requirement) and strength (5th percentile limit). Based on 5th percentile selected body dimensions of Indian farm workers, it is observed that the dimensions of women farm workers were about 6 to 21 per cent lower as compared to men workers. Hence, farm equipment developed for men workers may not be suitable for operating by women workers.

2. Muscular strength

In the agricultural activities, human beings are used as a source of power or a controller and data on muscular strength of various parameters are necessary for optimal design of equipment as muscular strength is the maximal force which muscles can exert isometrically in a single voluntary effort. It is generally considered that the strength is positively correlated to body weight. Strength also varies with age, its maximum value being in the age group of 25-35 years. Older workers aged between 50 and 60 years can produce muscular power of only about 75-85% of that of the younger group. Astrand & Rodahl (1986) reported that women's maximal strength of leg muscles is roughly 65-75% of that of men. In case of trunk muscles, the figure is slightly lower (60-70%), while in elbow flexion and extension the strength of women is only some 50 % of that of males. Singh et al. (2010) reported that the maximum force was exerted by the worker on upper leg from trunk and on trunk from upper leg during hand cranking operation. Worker experienced maximum force during movement of handle from back side to the top position amongst the force observed at remaining positions. From bio-mechanical parameters point of view, trunk portion seems to be responsible during hand cranking operation.

3. Aerobic capacity

VO₂ max (also maximal oxygen consumption, maximal oxygen uptake, peak oxygen uptake or aerobic capacity) is the maximum capacity of an individual's body to transport and use oxygen during incremental exercise, which reflects the physical fitness of the individual. It is considered as an International Reference Standard of cardio-respiratory fitness and depends on age, race, sex, body built-up, training etc. Astrand et al. (1973) reported that the women's power is on an average, 65 to 75% of that of man. Gite and Singh (1997) reported that the aerobic capacity of Indian men workers are about 2.0 l/min while for western workers value comes out to be about 3.0 l/min.

4. Physiological cost of operation

Physiological cost of any operation is expressed in terms of heart rate and oxygen consumption rate. For an 8 hour work period for male workers a work load requiring oxygen at a rate of 0.7 l/min is considered as the maximum limit for acceptable work load. The heart rate for such a workload will be about 110 beats/min. For female workers the corresponding values will be 0.6 l/min and 105 beats/min.

The heart rate levels of 120 beats per min or work pulse of 40 beats per min may also be considered as optimal criteria, for the quick appraisal of the state of activity that may be continued for longer period with proper rest pauses.

5. Posture

A good working posture is one which can sustain a minimum of static muscular effort and in which it is possible to perform the given task more effectively and with least muscular discomfort. Any operation in squatting or bending posture involves drudgery and it is reflected in terms of discomfort experienced by the workers. Therefore, as far as possible, such postures should be avoided and only sitting or standing posture should be used during work. Also for long duration work, a sitting posture may be better than the standing posture. In many cases, though the work may be well within the physiological limits, the body discomfort may restrict the duration of work depending upon the static load component involved in it and this is the case for most of the agricultural activities.

Farm women prefer to work in sitting than in standing positions. Based on their preference, a sitting type groundnut decorticator was modified. A stool was provided for comfortable seating of farm women during operation of this equipment (Anonymous, 2003). While studying CIAE hanging type grain cleaner, the handle height of equipment should be at waist height of workers for its easy oscillation and operation. A rubber grip was also provided on its handle to give comfort to workers in its operation (Singh, 2005). Farm women also prefer work with hand or leg/foot in treading mode rather than cycling. This factor was considered while developing gender-friendly hand operated maize dehusker-sheller (Singh et al, 2012).

6. Load carrying capabilities

Load carrying and transportation is one of the important activities in agriculture for example carrying tools & equipment, manure, FYM, seeds, fertilizer, lifting & transportation of harvested produce and grain etc. It is generally considered that the load to be carried by a worker should not exceed 40 per cent of their body weight. As per the anthropometric data of Indian farm workers, the body weight of women was about 21 per cent less as compared to men worker. Therefore, the equipment/ material designed for men workers would again not be suitable for women workers. During modification of commercial fertilizer broadcaster unit, reduction of total weight of equipment including weight of fertilizer filled in was also one of the factors that were reduced. Further, the static loading of hands and arms may be avoided while carrying/ transportation.

Safety Issues

Safety is the state of being safe, the condition of being protected against physical, social, spiritual, financial, political, emotional, occupational, psychological, educational or other types or consequences of failure, damage, error, accidents, harm or any other event which could be considered non-desirable. Safety can also be defined to be the control of recognized hazards to achieve an acceptable level of risk (Anonymous, 2012b). This can take the form of being protected or from exposure to situation that causes health or economical loss.

During study on above-mentioned 39 farm equipment at DRWA following factors were observed prone to risk while farm women at work:

- Wearing loose clothes (saree)
- Long hair
- Dupatta
- Social taboos (Purda system)
- Casual approach
- Lack of cautionary tips

OUAT modified pedal thresher had provision of a safety guard so that during threshing grain could not hit the face of worker. CRRI hand winnower had provided safety cover with rectangular slot on the shaft but it trapped the saree of the worker and hence a cover with perforated m. s. sheet having hole may be provided. The moving parts and chain drive system must be covered to avoid any miss-happening.

Need of work place assessment for the farmwomen

In rural India, men and women, both are engaged in farm activities. Of both, women do the household work in addition to child bearing and nursing to old parents. Thus their job in rural surrounding is more challenging than counter parts. This also reflects that they may be more prone to health hazards as they are involved in household's activities, animal caring, child rearing etc. As we know, women's contribution is more than her male counterpart, in different fields. But still they are unrecognized at their society, community and work places. The importance of the work place cannot be avoided where the worker spend his/her quality time and give his/her best input to achieve the goal. The end product or output is the fruit from his/her hard work. Therefore it is very essential to assess the work station/work place of farm women to help them and make them more comfortable at their work place. Some of the parameters which can be assessed and modified for suitability farm women according to their need.

Technological Empowerment of Rural Women

As per population statistics of our country, the female population in agriculture work force is increasing (20% in year 1971 to 41.9% in year 2007, based on estimate). This statistics clearly indicates about more involvement of farmwomen in agriculture and they might be the key factors in modern Indian agriculture. In our country, women perform multifarious activities in the home, farm and allied activities, which include milking of animals, cleaning animal sheds, mud plastering of house & preparing cow dung cakes for fuel, fetching of water & other house hold activities are not only fatiguing but also time consuming (Jamal, 1994). They perform these activities in their own convenient posture like sitting, standing, bending or squatting without realizing the harmful affect on the body. Due to this ignorance women might be suffering from various health hazards. Mostly farmwomen are likely to be faced physical, mechanical, chemical, biological, psycho social, accidental hazards. Given the specific needs of women, most work places do not take care to protect the reproductive health of women workers. Elimination of exposure to chemicals, radiation, biological contaminants, poor working posture and stressful working conditions is yet to be prioritized. In order to empower technically and improve the women farmers' productivity, they need to have proper farm training and capacity building programs to compete various challenges in their rural livelihood. There should be more emphasis given to designing, modifying and refining women friendly tools and equipments to reduce drudgery among rural farm women. The women friendly technologies should be made available to the rural women in lower cost or in subsidies. The training of technical knowledge, skill and expose them in field condition is very much required for the rural women to perform their job best. This will ultimately enhance their knowledge, working efficiency and work productivity and finally help them to reduce drudgery.

Preventive Measures to reduce drudgery and Occupational Health Hazards

i- Improved tools and equipment for farmwomen

There are more than 50 improved hand tools/ manually operated equipment developed by various research organizations in the country. Out of these 21 hands tools/equipment have been ergonomically evaluated at DRWA CIAE/SAUs and found suitable for farmwomen. These can suitably be taken for commercial manufacture for making available to farmwomen for reducing drudgery and hazards

Use women- friendly tools and equipment help to achieve.

- Reduce drudgery
- Increase utilization efficiency of inputs

- Ensure timeliness in field operations and reduce turnaround time for next crop
- Increase productivity of worker-machine system
- Conserve energy
- Improve quality of work and also quality of produce
- Enhance the quality of work life of agricultural workers

ii-Safer Alternatives to Pesticides

Synthetic pesticides are usually toxic for human and domestic animals. There are natural substances and herbs, those will not only reduce the hazards but also enhance the eco-system.

iii- Protective Measures

There are protective wears i.e. apron, goggles, face mask/respirator, gloves, ear muffs are available in market. Use of above devices will prevent the hazards.

iv- Improved smoke less Chula at Rural households

v- Institutions & Manufactures: How productivity will increase by analyzing and addressing drudgery and Occupational Health Hazards of farmwomen.

2-Stipulations of rest periods.

Every function of the human body can be seen as a rhythmical balance between energy consumption and energy replacement or between work and rest. This dual process is an integral part of the operation of muscles of the heart and of the organism as a whole. Rest pauses are indispensable for farm workers as they do more grueling job and repetitive motions during agricultural activities. Farm women are exposed bending, squatting, stooping or standing posture for long periods during their work. Lifting or carrying heavy loads are also part of agricultural activities. These awkward postures and heavy work cause musculoskeletal injuries.

Turner (2004) affirmed that instituting micro pausing might reduce discomfort and pain by reducing muscle and nerve tension. Swanson and Sauter (1992) have also showed that frequent breaks increased productivity and decreased musculoskeletal; stress.

3-Improvement of Workstations and Work methods

By improving work station and work methods, it will increase the productivity. Simply a good working posture, which requires a minimum of static muscular effort, will be better and the body discomfort will be less.

Suggestions

The challenges for reducing OHH among farmwomen are significant.

- 1- There is a need for researches to make agricultural health and safety as priority along with musculoskeletal disorders among farmwomen at the most
- 2- There is a need to develop low cost technologies for the critical field problems of repetitive and forceful tasks such as weeding, harvesting, lifting and carrying heavy loads and so on.
- 3- There is an urgent need to train farm women about using women friendly technologies and operating improved tools and equipment.

- 4- There is a need for conducting awareness, intervention and prevention programs about OHH for farm women.
- 5- Setting up of industries in rural areas to produce gaseous and liquid fuels from biomass should be encouraged in terms of availability of easy finance and tax benefits.

Conclusion

The quality of work life of women in agriculture is characterized by long hours of work, awkward postures and drudgery experiences at work due to work load and unsuitable farming equipments. There were more drudgery and stress among the farm women due to adoption of very awkward static postures and performed task repetitively which was responsible for drudgery, musculoskeletal disorders and leads to occupational health hazards. They need more attention for better health and productivity. Above all women friendly ergonomically designed farm tools or implements should be designed to reduce drudgery and health hazards. It also provides a platform to the researcher to refine the work station at various working environment and fit the worker within the environment. If the workplace will be modified ergonomically then drudgery, health and safety issues of the farmer/farmwomen/ worker can be solved ultimately. This also leads in the direction of technological empowerment of rural women involved various agriculture, household and allied activities.

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ECO- FRIENDLY PLANT PROTECTION PRACTICES AND ORGANIC FARMING WITH WOMEN PERSPECTIVE

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Agriculture is and will continue to be central to all strategies for planned socio-economic development in India. Quality food production as a national objective was placed on the policy agenda much earlier than in other developed and developing countries. Despite having achieved national food security the well being of the farming community continues to be a matter of grave concern for the planners and policy makers in the country. With the initiation of green revolution in mid sixties the insect pest scenario became more complex due to altered microclimate. Casual approach and indiscriminate application of insecticides incited resistance and resurgence of pests, and threatened health. Present day agriculture in India faces two major challenges, sustainable agriculture production and food security for the ever increasing population with due care of environmental degradation.

The eco-friendly practices including ancient wisdom has sustained food production for several millennia was ignored in our approach. With biodiversity concerns being pushed up-front in recent times, 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 to low levels of literacy and education.

In deliberations on quality food and safe food, the situation at micro levels in rural areas is often overlooked. 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 IPM. Women experience barriers in accessing technology, more than men and they are going in their own path. Rural women face several risks and problems out of which technical risks is the major one. Therefore, our agriculture policy and programme should not be only pro poor and pro environment but it must be pro women.

Pesticides and toxic waste alter DNA

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, has some of the following alarming situation:

1. Significantly high rate of miscarriages among women and slow growth in children.
2. Pesticides have also been detected in vegetables, blood as well as human and cattle milk samples.
3. Evidence of genotoxicity in some cases.
4. DNA mutations in 65 percent of the blood samples.
5. Drinking water has turned toxic due to high concentration of heavy metals such as mercury, copper, cadmium, chromium, and lead. These chemicals have seeped in to the village's groundwater from the polluted drain water. Evidence of these metals entering the food chain.
6. Gastrointestinal, skin, eye, dental and bone problems significantly higher in these areas compared with villages not in proximity of drains.
7. Early symptoms of neurotoxicity.
8. Children complain of rashes and boils.
9. Old men insist their hands and fingers are turning numb.

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. Thus eco-friendly technologies for plant protection to increase safety with reduced drudgery with gender perspective are the need of hour at country level as well as at global level.

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. Importing countries dictating terms of import which resulting into heavy losses to

exporters from India. This has opened the options for Integrated Pest Management by precise use of pesticides and utilization of organic manure preferably vermicompost. At present a big questions how to achieve the best security of safe food without environment disturbance. This is just possible. The ways to do are:

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

Development of safer molecules is now the key issue and the newer molecules, which are coming for registration, are certainly much safer than the broad-spectrum pesticides. Strict control of spurious pesticides is an important issue. Suppliers of pesticides need to develop some code of conduct for this. Majority of the pesticides are sprayed and broadcasted which is an inefficient process. Around 10-20% of the pesticides applied as dust and 20-25% 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 as 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 monitor the use of pesticides from farm to ship.

About 1/3 of the pesticide poisoning cases in world are reported from India only. 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. Poor awareness of sale practices for handling chemicals and a lack of appropriate protective equipment also contribute to hazards. In most developing countries, poor 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, immunosuppression, neurotoxicity, impairment of reproductive functions, carcinogenicity, tumorigenicity, 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.

INTEGRATED PEST MANAGEMENT including 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. Men who were previously engaged purely in agriculture are migrating to other places for non-farm jobs available at urban and semi-urban places. 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.

Technological gap in crop protection measures among farmwomen of Orissa.

Survey conducted in twenty villages of Khurda, Puri, Cuttack and Jagatsinghpur districts of Orissa revealed the technological gap in crop protection technology (vide table -1). Farmwomen are having good knowledge of seed storage of vegetables but there was a vast gap in the knowledge of seed treatment and bio-pesticides, which varied from 78.4 to 95.2%. Overall, technological gap among farmwomen in vegetable protection technology was found 52.6% in Orissa. Gaps identified during the study were helpful for further formulation of training programme. A total number of 556 farm women were trained through 19 training programmes on various aspects related to eco-friendly pest management. During survey various eco-friendly pest management technologies and ITKs related to vegetables were collected from different sources and presented in table-2.

Table-1 : Estimation of technological gap in the knowledge of crop protection measures among farmwomen of Orissa.

Sl. No	Different aspects of crop protection technology	No. of farm women interviewed	Maximum score	Average score obtained	Difference in score	Technological gap in knowledge (%)	Rank
1.	Seed Treatment	200	12.5	2.7	9.8	78.4	II
2.	Nursery Protection	200	12.5	8.8	3.7	29.6	VI
3.	Spray Solution preparation	200	12.5	8.3	4.2	33.6	V
4.	Pesticidal Hazards	200	12.5	9.3	3.2	25.6	VII
5.	Waiting Period	200	12.5	4.9	7.6	60.8	IV
6.	Bio Pesticide	200	12.5	0.6	11.9	95.2	I
7.	Botanical Pesticide	200	12.5	3.2	9.3	74.4	III
8.	Seed Storage	200	12.5	9.6	2.9	23.2	VIII
		Total	100	47.4	52.6	52.6	

The following components may be included for eco- friendly plant protection practices and organic farming with women perspective.

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. Afore- mentioned cultural operations are performed manually using locally made tools and implements. Beside dislodging the pests from their protective habitat and subjecting them to unfavorable conditions for survival, these scientifically tempered cultural practices also improve aeration of the soil and facilitate proper percolation of water into the soil. 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 pest 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 inter-planting 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 or blackgram at the ratio of 3:1 (Logiswaran and Mohanasundara, 1985) and with pearl millet at a 4:1 ratio (Baskaran and Thangavelu, 1990; Sathiyandam *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. (Sathiyandam 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. have 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 xyliana*). 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 raised on 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 severe 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 wilt disease 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 IPM. Several resistant varieties of crops have been evolved against major pests, through intensive breeding programmes. Development of varieties with multiple resistances to several pests and diseases is essential. 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 of all such insect control methods. These are rooted in simple practices that man, as a farmer, has learnt 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 ecofriendly, 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 traps in pest management

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 Yellow sticky trap

White coloured traps are most effective in attracting the pigeon pea fly, *Melanagromyza obtusa* yellow colour attract cotton whitefly, *Bemisia tabaci*, cotton aphids, *Aphis gossypii* G. and green house white fly. *Trialeurodes vaporarioru* (Bhatnagar and Davies, 1979 and Gillespie and Quiring, 1987). Models combining the sticky trap with water pan have also been developed to 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 been used 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 mate. 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 tools in order to reduce health hazards of 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 decades 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 20th century. One approach is to build upon traditional methods, which evolved over the first 10,000 years of agriculture.

9. Use of plant products/botanicals as Novel pesticides

Recent studies have also indicated the presence of photo-activated Secondary Phyto Chemicals (SPCs) (Photosensitizers/phototoxins), i.e they become toxic to insects in the presence of light (Arnason *et al.*, 1992). These SPCs are involved in the plant defence 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.

Why Organic Farming?

India first battle, political freedom, won in 1947. The second battle, freedom from hunger. This battle was won through the famous Green revolution. The country is now ready to fight the third battle to gain freedom from sick environment. This Third battle leads the path of Organic food production.

Agricultural practices have made soil vulnerable to erosion, contaminated with agrochemical residues, destroying natural soil fertility, reducing water absorption/retention capacity and decimating beneficial soil organisms that suppress bacterial and fungal diseases. Cropping systems as well as crop management practices have resulted in loss of diversity at gene, species and ecosystem level. Predator species of insects, birds, amphibians and reptiles as well as pollinators find it difficult to survive. Mosquitoes, rodents and imported weeds are flourishing. Our cropping farming systems today produce high yield of few selected crops but yield lower and lower in biomass terms creating shortage of fodder, firewood, mulch and manure materials etc.

Our farms have become dependent on higher and higher use of off farm inputs, which the farmers have to buy and the prices of synthetic fertilizers, fossil fuels, hybrid seeds etc., have risen much faster than farm produces. Energy efficiency of our production systems are steadily declining and use of renewable energy is being replaced steadily by non-renewable energy sources.

The dream of everyone is obviously: unpolluted environment, soil, water and air conserved biodiversity, organically produced green food and sustainable agriculture. Demand of organically grown agricultural produce (green food) in export markets at a premium has been giving a boost to green food production. Politicians and masses are realizing the necessity of clean environment and safe food. As a result, the demand for green food is increasing.

Basic components of Organic Farming is feeding of "Agriculture in harmony" with surrounding environments and considers the agricultural production site as an agro ecosystem and based on environmental sustainability rather than economic growth efficiency. Organic Farming is a "Holistic management system that promotes and improves the health of the agro-system related to bio-diversity, nutrient bio-cycles and soil microbial and biochemical activities. Green foods are all kinds of agricultural products like grains, meat, dairy, eggs, fibre, flowers and processed food products which are produced organically. The basic components of organic food production are briefly discussed below:

1. **Sustainability:** Green food production is comparatively free from complex problems encountered in modern cultural practices. Green food provides many sources of income, employment, hence sustainable.
2. **Conservation of Biological Diversity:** Cultivation of variety of green food promoting biological diversity on farm diversity instead of monocropping is essential.

3. **Soil Fertility Management:** Continuous and excessive use of chemical fertilizer especially nitrogen supplying ones cause depletion of native humus content. Use of phosphatic fertilizers causes traces metal contamination like arsenic, fluoride, cadmium etc., in soil and plants. Application of potassium chloride (muriate of potash) causes chloride toxicity in Fruits specially in grapes and citrus. Chemical fertilizers reduce the growth and multiplication of microorganism. Therefore, use of organic mulching, legume cultivation, green manuring, vermicomposting, different type of cakes, farmyard manure and compost and biofertilizers are the essential elements in green food production.
4. **Pruning and Training as a tool for pest management:** Development of proper plant architecture by way of training and canopy management and pruning for removal of dried, diseased and insect infested twigs helps in reduction of pest loads and thereby avoids pesticide use.

Eco-friendly attributes of Organic food production

1. Importance of indigenous Germplasm

The new high yielding varieties may it be rice, wheat, cotton, pulses, vegetables or horticultural plants, are more susceptible to pest and disease, compared to the traditional varieties. The high yielding varieties while giving higher yields, cause environment pollution through use of chemical fertilizers and toxic pesticides. Unrestricted use of such chemicals may cause serious environment problems. The above problems, associated with modern agriculture, have forced the scientist, planners and Extension Agencies to look for alternative methods for reducing environment pollution as well as checking 'gene erosion'.

2. Relevance of Biofertilizer

The increase in agricultural productivity, which was obtained during the initial stages of Green Revolution, is in the decline and to restore the same a larger amount of chemical fertilizers are being applied progressively causing serious damage to the ecology and environment. To minimize this problem the knowledge on the use of organic manure, bio-fertilizer in the agricultural practice should be disseminated among the farming community failing which a disaster in food production could not be avoided in near future.

3. Relevance of Vermiculture

A major feature of global change in the tropical regions, is the land use associated with agricultural intensification. About 40% of most fertile land is already degraded. It is essential to maintain quality production with sustainability not only to feed the growing population but also the growing value addition to the economic standard and material development. Green revolution of the sixties is no greener in post eighties because the technology detracted natural functions of productivity and entered into ecological backlash.

4. Natural resource Conserving Technologies in Organic Farming

Green food production primarily aims to maintain sustainable agricultural productivity. In order to maintain sustainability, natural resources conservation technologies as well as natural processes are utilized to reduce external inputs in the farming system. Major farm resources like nutrients, water, soil, predators are conserved through use of appropriate technologies. New introduction of water harvesting structures, nitrogen fixing plant species or new predators into the farming system and resources without incurring external resource costs. These functions performed by these technologies are called as soil conservation,

water management, integrated nutrient management or pest and predator management. For example, the introduction of green manure crops in the farming system influences pest management by reducing pest carry-over, helps plant nutrition by adding of soil nitrogen, checks soil erosion by conservation and increases infiltration and water retention of soil by water management. Although, such technologies are traditional, but such understanding of ecological principles functioning of their farming system is very important in green food production.

5. Bio-control Approaches

Pollution free life support system is essential for sustenance of life of all living organisms on the earth. Intensive agriculture with adoption of high yielding varieties of crops with use of agro-chemicals has no doubt resulted in manifold increase in the production of farms commodities but Public concern about these chemical residues (insecticides, fungicides, bactericides, herbicides etc.) in food, food products and degradation of environment has stimulated increased interest in biological controls. Bio control approaches besides reducing chemical load in the environment and increased food safety has the advantage of reducing farm workers exposure to hazardous chemicals. Further it provides a foundation for pest management and reduces the problem of pest resistance to chemicals. Bio-control agents avoid damage to non-target crops, beneficial microbes and other organisms in the ecosystem.

Conclusion

To avoid the dangers to environment, ecology and human being, the adoption of eco-friendly plant protection practices by blending with new technologies and vermicompost technologies with the incorporation of traditional and ecological farming is the best alternative. It will reduce the exposure of farmwomen and their families to pesticides; and would make agriculture more sustainable for future.

Vermicomposting is always considered basic component for Organic Farming as a viable alternative of chemical fertilizers. However, it can emerge as a profitable venture for economic and social upliftment of farmwomen if undertaken as a business, based on proven scientific knowledge, technology, training and proper planning.

India has tremendous potential to emerge as major supplier of organic product in the world's organic market. However, its exploitation is limited on account of lack of awareness of eco-friendly plant protection measures and organic farming . There is an urgent need to disseminate such type of technologies at micro level, to bring rural women in mainstream. Once women are awakened and given the rights, needed orientation of literacy and skill development chemical hazards faced by them will be minimized as well as quality food/ safe food will be available for the consumers.

STRENGTHENING LIVELIHOOD SECURITY OF WOMEN FARMERS THROUGH HORTICULTURAL INTERVENTIONS

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Horticulture sector plays an integral component in Indian agriculture. Presently, the sector contributes around 30 % of the country's agricultural GDP from 8.5 % of total cropped area. The diverse agro-climatic conditions and rich biodiversity of the country facilitates the production of wide range of horticultural crops. Horticulture sector includes a wide range of crops *viz.*, fruits; vegetables; flowers; spices; plantation crops like coconut, cashewnut and cocoa; beverages like tea and coffee; medicinal and aromatic plants. Presently, the horticultural production is 295.6 MT (2016-17). India is the world's largest producer of horticultural products, contributing around 11 % of vegetables and 15 % of worldwide fruits production. The sector is well known for its prospective to enhance the farm income, ensure livelihood security and earn foreign exchange. It is expanding at an enormous rate in terms of area expansion and quantity production. Even the consumption of fruits and vegetables has grown at a rate of 18-23 % and 10-20% in rural areas during 1993-94 to 2011-12 (Jha *et al*, 2019), however there exist a gap between the actual per capita availability of fruits *i.e.* 95 g/day and the recommended per capita intake by Indian Council of Medical Research *i.e.* 120 g fruits /day. Out of the overall growth rate of 3.56 % in agriculture during 2000-2011, fruits and vegetable alone accounted for 19.2 %. Horticultural sector also accounts for about 37 % of the total exports of agricultural commodities. Besides, it also provides employment opportunities to several stakeholders. As the Government of India has proposed to double the farm income by 2022, the horticulture sector has an enormous role to play and can be one of the most important component in enhancing the farm income.

Considering the significance of the sector, it is imperative to state that the sector has immense potential for many stakeholders including the women farmers, who are backbone of Indian agriculture. Farm women contribute significantly in both farm and non-farm activities. However, they lack access to technological interventions that can strengthen their livelihood due to several social, cultural and economic constraints. Horticulture encompassing its on-farm production to postharvest operations has many innovative interventions that are women friendly and can be promising in strengthening the livelihood opportunities of women farmers. Some of which include planting material production *i.e.* nursery raising activities along with vegetable seed production, high value vegetable production including precision farming & off season farming, improved quality commercial fruit production and value addition.

Community based nursery raising activities and Vegetable seed production:

Assured quality planting material is the most important critical input to initiate any plantation. To ensure supply of quality planting material, the Govt. of India has imposed stringent regulations in accreditation/ recognition of the nursery through issue of certificate of recognition to the nurseries by National Horticulture Board. Mostly there are Government and private nurseries, community based nursery can be a popularized as a profitable enterprise for small villages/ communities at a larger scale. The enterprise can be successfully initiated by village communities, having organized plantations of established varieties of fruit crops which can be used as mother blocks/ orchards. The nursery activities are mostly women centric, which involve filling of polybags, raising of rootstocks, care and maintenance of grafts along with other nursery management

practices. However, the communities are required to be supported with financial assistance in form of Govt. schemes & subsidies, skill based training & capacity building programmes for initiating the grafting and budding activities, rural infrastructure facilities in form of mother orchards, rootstock raising and grafting areas, sale outlets and storage rooms etc. and finally, the community should be linked with market channels for easy, timely and profitable disposal of their grafts and other planting materials.

Vegetable seed production:

India accounts for 0.07 % of the total vegetable seed imports by volume in 2016 and the total import of vegetable seed is estimated to be 3.94 thousand MT by volume and USD 82.64 million by value (India Vegetable Seed Market-Segmented by Type-Growth, Trends, and Forecast 2018-2023). Seed one of the critical input has also become an expensive input due to involvement of several multinational companies in its production and distribution system. This in return has devastated the farming community who are completely dependent on private companies on timely availability of vegetable seeds for successful farming. Realizing the high investment in procurement of vegetable seeds, the concept of vegetable seed village can be popularized among the farming community with special focus on landless women farmers, who can be successfully involved in the local seed network for strengthening the supply of ample quantity of quality vegetable seeds at grass root level. Vegetable seed production at their homestead areas can prove effective in ensuring livelihood security to farm families. New technologies of vegetable grafting, which is easy, cost-effective and viable is required to be popularized among the farming community to ensure that they get quality seeds and planting materials at their vicinity and at a cheaper rate. Optimum quantity of high quality seed will be available to the farm community at appropriate time at reasonable prices. Capacity building and skill enhancement of women farmers will boost their confidence in field of vegetable seed production. This may trigger the women groups primarily engaged in seed production to evolve as successful entrepreneurs by forming women groups and producer companies. There will be tremendous growth in seed production at farmers' field thereby reducing the dependency on private seeds thus making vegetable farming more sustainable at present and profitable in near future. However, some of the major challenges in this sector include lack of rural infrastructures for optimum processing and drying of vegetable seeds and market linkages. Complexity of seed production process, lack of soil testing information, optimum plant protection measures and timely irrigation are some of the constraints for successful seed production at village level.

Good Agricultural Practices:

Quality production has become essentially important on account of growing consumers' demand due to increase in purchasing ability, awareness and health consciousness. Due to lack of quality production of horticultural commodities in the country, its share in global market is insignificant, it account for only 1.7 % of global trade in vegetables and 0.5 % in fruits. Sufficiency in horticulture production and productivity has been attained but quality production is doubtful on account of poor management practices by growers. Concerns about food safety and quality, environmental protection, worker safety and welfare have gained importance. In this context, Good Agricultural Practices (GAP) is essential to address the harvest quality in terms of maturity standards, residues of pesticides and other contaminants, microbial loads, etc. The concept of Good Agricultural Practices (GAP) has emerged in recent past to ensure quality production to meet the requirements of global markets in the scenario of a rapidly changing and globalizing food concerns and in keeping up commitments of a wide range of stakeholders in relation to quality food production, food safety and in maintaining environmental sustainability. According to the Food and Agriculture Organization (FAO), GAP is the application of existing knowledge to address environmental, economic and social sustainability for

on-farm production and post-production processes resulting in safe and healthy food and non-food agricultural products. Many farmers in developed and developing countries already apply GAP through sustainable agricultural methods such as integrated pest management, integrated nutrient management and conservation agriculture. The country has enhanced its horticultural production but it's high time for the horticultural growers to secure entry of their farm products in global markets by upgrading their produce quality to meet international standards. In this context, the farmers should orient themselves into Farmer Producer Groups (FPOs), adopt Good Agricultural Practices of their crops in a larger scale and ensure the timely export of their consignments to international markets. The farmers groups can be trained on organic farming, permaculture, precision farming, and off-season protected cultivation practices to enhance their produce quality for catering the demands of diverse group of consumers.

Value addition:

Food processing coupled with allied interventions including post-harvest management, cold-chain, logistics & distribution are integral component for ensuring efficient food supply chain for any country. With change in life style, there has also been shift in consumer's preferences for processed food products on account of busy scheduled life style, change in dietary habits, and increase in purchasing capacity of middle income group. On one hand there is a need to feed the expanding population by increasing food production and in other hand there is a challenge to reduce post-harvest losses. At the same time there is also a need to create livelihood opportunities for vulnerable communities. Post-harvest management and processing of horticultural crops can be one of a sustainable approach to bridge the gap between supply and production of Horticultural produce along with ensuring income opportunities for the poor landless farming communities. Post- harvest losses of fruits and vegetables accounts to be 30 %. Value addition has ample scope in sustaining livelihood. There is always availability of raw materials in bulk quantity during its season of production, which often renders the growers or gatherers to end up with distressed sale, while a huge quantity is wasted due to poor transportation and cold storage facilities. These wastes can be diverted into wealth by integration of suitable location specific, economically viable and consumers' preference aligned post-harvest technologies. Besides, the commercial horticultural crops, the country is also blessed with wide varieties of under-utilized fruits and vegetable crops which can also be processed into several value added products. It has been observed that women form the bulk of the labour force in the horticultural processing units, but they are concentrated in unskilled and low-paying jobs. They are often considered as temporary workers or have casual employment status. Women are not involved in commercial level of processing, as they lack technical knowledge and skill (Verma *et al.* 2014). Post-harvest handling and processing to produce value added horticultural products can be a sustainable livelihood option for many landless women farmers and rural youth with suitable institutional support, appropriate hand holding and with an assured market.

Challenges in the horticulture sector:

There exist several challenges in the sector, which include fragmented supply chain of quality inputs viz. seeds, planting material and other critical inputs, high transportation cost, inadequate storage facilities, cold storages etc., lack of cold chain facilities i.e. provision of refrigerated vans, poor marketing channel, fluctuating market prices, poor quality produce, huge post-harvest losses, poor value addition, lack of processing infrastructure facilities at production sites and several others which have increased the risk of investment by poor farmers in the sector. There is a steady growth in the sector, however, the progress in the sector can be hastened and a regular flow of substantial income to the growers can be assured with suitable Govt. schemes and policies. There is a need to create better infrastructure facilities at village level

for promoting protected cultivation, mechanized & precision farming, quality production through supply of quality inputs and training on Good Agricultural Practices, encouraging community based nursery raising activities, promoting post-harvest operations & processing activities through provision of suitable post-harvest infrastructure facilities in rural areas. As the demand for horticultural commodities is increasing at a faster pace on account of consumers' rising income and growing interest in a variety of fresh fruits and vegetables, the sector has ample scope, avenues and enormous space to encompass a wide population of rural women and youths thus enabling them in stabilizing their farm income and enhancing their livelihood options.

EXTENSION APPROACHES FOR ENGENDERING AGRICULTURAL RESEARCH AND EXTENSION

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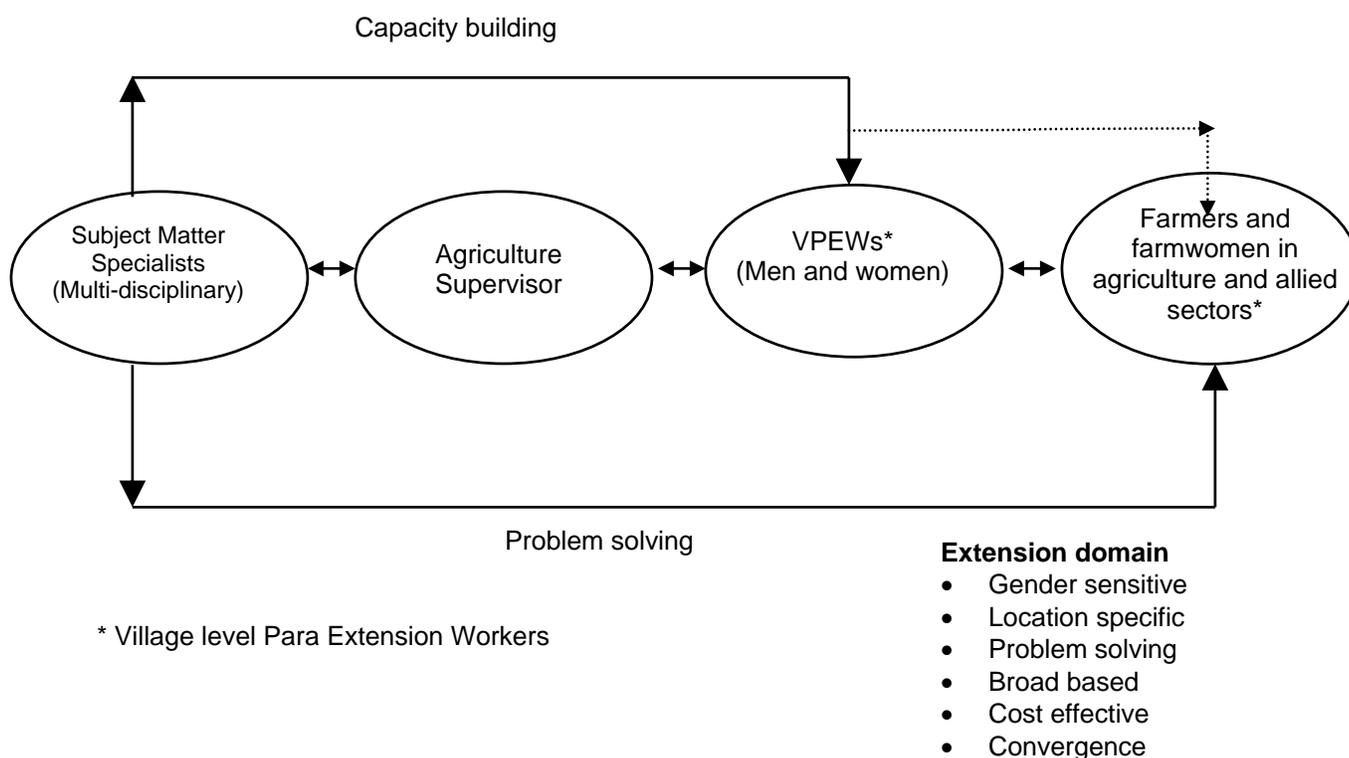
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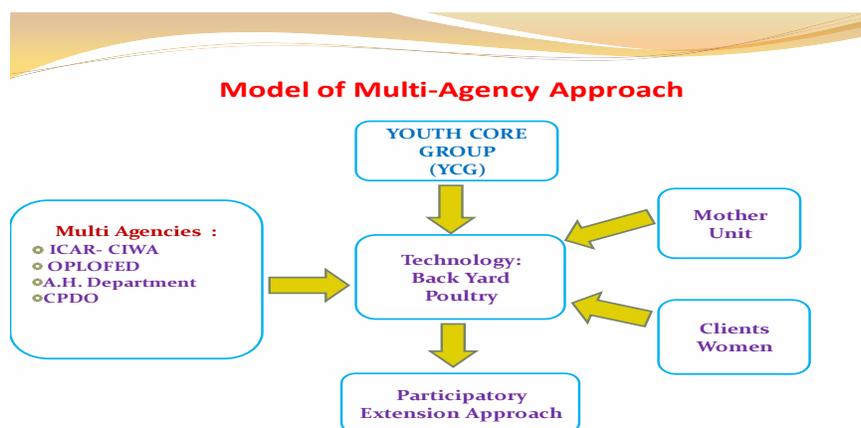
The agricultural extension services are an vital tool for transfer of information on new technologies. For the reason, a number of extension approaches have been demonstrated at national level to congregate the wants of farmers and particularly of farm women. But, still there is gender gap in successful deliverance of extension services for the farm women. They are often over looked by extension agents without identifying the extension needs of both the gender. Keeping this in view, ICAR-CIWA, Bhubaneswar has developed some of the extension strategies for gender mainstreaming in agriculture as follows:

Models for Gender Mainstreaming:

1. Gender Sensitive Extension Model : The Central Institute for Women in Agriculture has developed a gender sensitive extension model with involvement of Village level Para Extension Worker (VPEW) in extension. It is made in such a way which can be accommodated in the existing institutional frame of the State and Central Government. Here, the model is based on public-private partnership to address gender sensitivity, cost effectiveness, leadership development among farm women, technological location specificity and subject matter support from specialists.



2. Gender Sensitive Multi Agency Participatory Extension Model (MAPEM) : The project designed in action research mode to evaluate the effects of the model on sustainability of backyard poultry farming by involving the resource poor farm women. The Youth Core Group (YCG including 1 male + 1 female) member was selected from experimental villages to act as a bridge between the villagers and the agencies. The identified multi-agencies were distributed their respective roles and responsibilities. The Mother Unit concept was introduced in the villages to rear the day old chicks up to one month to reduce the mortality rate. The capacity was built for both the Youth Core Groups and the farm women through training, demonstration, exposure visit and literatures. Youth Core Groups gave tips to render advisory services, advocacy, and meetings and organize demonstrations. Feedback and transfer of solutions were taken up through telephone calls and visits. Monitoring, concurrent evaluation and group dynamics were taken up during the period of project implementation.



3. Checklist for Assessing Gender Sensitivity in Institutional Environment : A positive work environment makes employees feel good about coming to work, and this provides the motivation to sustain them throughout the day and respect the organization's philosophy, mission and values. Gender sensitive working environment provides a safe and secure workplace for women staff which is free from sexual harassment/discrimination with leisure, health and hygiene and ensures justice. They should be treated with respect and listened to, and judged on the merits of their ideas and job performance. This checklist follows a gender analysis framework and is intended to be comprehensive, flexible and adaptable. There is need for institutionalization of gender concept in RE&D institutions as we must move from the existing concept of gender balancing to gender sensitivity. The checklist may be used as reference while assessing the gender sensitive working environment of ICAR and other institutions for supporting gender sensitive research. Further, this will provide opportunity for self gender sensitization among the staff on how to improve working environment by addressing gender.

4. Checklist for Assessing Gender Sensitivity in Extension Methods : Women have less access than men to agriculture related assets, inputs and services. It is mainly caused by cultural and traditional behaviour and norms, and can be closed through gender sensitive extension interventions. This will be possible through a checklist for ensuring gender sensitivity in every stage (planning, implementation and follow up stage) of extension methods. So, effectiveness and sustainability of the agricultural technologies can be achieved when extension methods are selected appropriately in the process of problem identification, planning, executing and monitoring activities. However, the extension personnel should be very careful to focus on above checklists while implementing the extension methods especially for farmwomen. Further, this will provide

opportunity for self gender sensitization on how to incorporate gender in the extension methods for betterment of farm women.

5. Checklist for Assessing Gender Sensitivity in Institutional Programme : For making the programme gender sensitive, gender components should be incorporated in every major stages (planning, rapport building, execution and impact assessment) of programme implementation. Therefore, effort has been made to prepare a checklist which can be used by the programme coordinator from the beginning of the programme (pre and post implementation at each stage) so that the gender component can be incorporated to the maximum extent. A gender sensitive programme must address the constraints of women and men equally, thereby improving programme performance and outcomes. The checklist may be used as reference while developing a programme and stage wise assessment can be made for self appraisal of gender sensitivity of the programme. This tool has been prepared for self gender sensitization of the coordinators on what is the scope for incorporating gender in any programme and how much was achieved so that after understanding the gap further improvement is possible.

In addition, some other strategies / approaches to address the gender issues in agriculture are as follows:

- Gathering ergonomic data on farmwomen.
- Strengthening linkage between extension and research needs.
- Mobilization of more female para extension personnel.
- Capacity building to farm women.
- Gender sensitization among general public, policy makers, planners, etc.
- Participatory gender sensitive policy formulation.
- Collection of gender disaggregated data.
- Establishment of gender cells/units at different organizations.

**PROMOTING GENDER EQUITY THROUGH DEVELOPMENT OF WOMEN FARMERS GROUPS ON
AGRICULTURE VALUE CHAIN**

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In 2015, the global community achieved a landmark by agreeing on a comprehensive development agenda under the rubric of 17 Sustainable Development Goals (SDGs). India attaches high priority to the 2030 agenda for Sustainable Development Goals (SDGs) which the United Nations adopted unanimously in September, 2015, and which will have great significance for the well-being and progress of humankind. India has, over the past years, directed its development pathway to meet its priorities of employment, economic growth, food, water and energy security, disaster resilience and poverty alleviation. India has also aimed to restore its natural capital and adopt transparent and robust governance along democratic lines. However, emerging challenges of climate change impacts, increasing inequities, and lagging human development indices are well recognized by both the citizens as well as the government.

India was ranked at 108th position among 144 countries in Global Gender Gap Index 2017 slipping by 21 places as compared to 87th rank in 2016. India's global Gender Parity Score is 0.48, which represents an 'extremely high' level of gender inequality. On every parameter of the gender inequality index (GII), India lags behind even both of its neighbouring countries, Pakistan and Bangladesh. Now, what makes India perform so poorly on gender related assessments even after being large geographical entity with great natural resources, remains to be explored.

As a part of the strategy to reduce the gender gap and to boost women's empowerment, the Government of India has initiated a number of policies, programmes and schemes in last five decades including the most recent 'Beti Bachao Beti Padhao' scheme. Despite all attempts, a considerable gender gap still not only exists but is continuously widening. These gaps are far more prevalent in rural areas. This simply means that there is further need for research on these issues with a focus on region specific solutions. Present strategies need to be evaluated and improved to tackle gender issues.

Women comprise, on average, 43 percent of the agricultural labour force in developing countries. Women are farmers, workers and entrepreneurs, but almost everywhere they face more severe constraints than men in accessing productive resources, markets and services. This "gender gap" hinders their productivity and reduces their contributions to the agriculture sector and to the achievement of broader economic and social development goals.

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 E's** Concept).

Access to assets is the single most urgent need for the upliftment of women in general and farm women in particular. Indian constitution has given equal rights and opportunities to both men and women in the political, economic and social spheres and it also prohibits any kind of discrimination against women, but the condition in actual sense is not so. Farm women still do not have ownership on land. Due to this they do not take independent decision on various agricultural aspects. Though women make substantial contributions to

rice farming, their access to productive resources is limited and availability of institutional credit is most limiting. Since they are not land owners, the credit flow generally goes in the name of male members. Many cultural barriers restrict their access to technology. A critical analysis of the five-year plans over the years starting from independence reflects that in the earlier phase of development planning, the concept of women development was mainly 'welfare' oriented. During sixties, women's education and maternal and child health received priority. During seventies, there was a shift from 'welfare' to 'development', which started recognizing women as participants of development. The eighties adopted a multidisciplinary approach with a special thrust on 'health, education and employment' and a number of programmes were launched for the purpose under different sectors of agriculture and its allied activities. Recognizing the role and contribution of women in development, in early nineties made a beginning in concentrating on 'training for employment-cum-income generating programmes' for women with the ultimate objective of making them economically independent and self reliant. No doubt, that because of these developmental efforts, have brought lot of positive changes and achievements towards betterment of women folk.

Women in Agriculture

Across the globe, women make up a large part of agricultural labor: In Sub-Saharan Africa in 2015, they represented 40 % of the agricultural labor force. In some developing countries, their contributions exceed 50%. Closing the gender gap could increase yields on women-run farms by 20-30%. This could raise total agricultural output in developing countries by 2.5- 4%.

But women own fewer assets (land, livestock, human capital), and have less access to inputs (seeds, fertilizer, labor, finance) and services (training, insurance,) than men. To further complicate things, equal access to resources does not guarantee equal returns for women farmers. Women need specialized agricultural training, child care and customized support to ease their double work load as farmers and caregivers. The right resources could help rural women maximize economic opportunities, increase productivity, and improve food security, education and healthcare, since women tend to reinvest in their households.

In rural India, the percentage of women who depend on agriculture for their livelihood is as high as 84%. Women make up about 33% of cultivators and about 47% percent of agricultural labourers. These statistics do not account for work in livestock, fisheries and various other ancillary forms of food production in the country. In 2009, 94% of the female agricultural labour force in crop cultivation were in cereal production, while 1.4% worked in vegetable production, and 3.72% were engaged in fruits, nuts, beverages, and spice crops.

Women's participation rate in the agricultural sectors is about 47% in tea plantations, 46.84% in cotton cultivation, 45.43% growing oil seeds and 39.13% in vegetable production. While these crops require labour-intensive work, the work is considered quite unskilled. Women also heavily participate in ancillary agricultural activities. According to the Food and Agriculture Organization, Indian women represented a share of 21% and 24% of all fishers and fish farmers, respectively. Despite their dominance of the labour force women in India still face extreme disadvantage in terms of pay, land rights, and representation in local farmers organizations. Furthermore, their lack of empowerment often results in negative externalities such as lower educational attainment for their children and poor familial health. An estimated 52-75% of Indian women engaged in agriculture are illiterate, an education barrier that prevents women from participating in more skilled labour sectors. In all activities there is an average gender wage disparity, with women earning only 70 percent of men's wage. Additionally, many women participate in agricultural work as unpaid subsistence labour. The

lack of employment mobility and education render the majority of women in India vulnerable, as dependents on the growth and stability of the agricultural market.

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.

Some Successful Results at Global Level

In Vietnam in 2013, a Rural Finance project increased women rural entrepreneurs' access to financial services by requiring that women borrowers account for at least 40% of short-term loans for household and microenterprises. Of the 1,20,000 borrowers who invested US\$430 million in projects, 42% are women.

In 2014, a land-husbandry project in Rwanda helped 85% of its beneficiary women farmers become clients of formal financial institutions. Seventy percent secured tools to improve their farming methods.

In Mali in 2015, the Bank helped develop horticultural value chains, where women are key players particularly at the agro-processing STAGE. About 40% of project beneficiaries are women who have acquired new skills and employment through the project.

In Cameroon, the Bank helped to finance women farmers and processors of cassava, maize and sorghum and linked them to markets. The project also enhanced household nutrition by diversifying the crops women produce for their families, and introducing tools that help women cook and process food faster and efficiently. As of 2016, 79,000 households have benefited-60% of them headed by women.

Starting in 2011, the India National Rural Livelihoods Project mobilized rural women into 3,00,000 self-help groups (SHGs) at the village, sub-district, and district level. The SHGs promote savings among the rural poor, particularly women, so that they can build up their financial capital and become clients of banks, microfinance institutions, insurance companies and other financial institutions that provide credit and other financial services. Member households have cumulatively saved more than \$70 million to date.

In the Republic of Kyrgyzstan women comprise the majority (92%) of membership in rural self help groups. Since 2013, the Bank has trained SHGs in sustainable agriculture practices and vegetable conservation.

In Kenya in 2015, women and men have been trained on new agricultural technologies and agri-business development. The majority of women reported an earnings increase of 35% from their agriculture activities.

Family Farming: A Way for 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.

Women and Family Farming

Agriculture Sector employs 4/5th of all economically active women in the country. 48% of India's self-employed farmers are women. There are 75 million women engaged in animal husbandry as compared to 1.5 million men. Despite such significant contributions of women those engaged in formulating packages of technologies, services and public policies for rural areas have often tended to ignore the productive role of women.

Family farms have traditionally placed a heavy workload and responsibility on the shoulders of the women who have no right over the land they work on. Women-managed small family farms are usually handicapped for credit as well as technological support. Support systems should be put in place to ensure women-run farms do not lag behind in the race. According to Food and Agriculture Organization of the United Nations (FAO), the role women play in family farming is becoming increasingly important, but truly unleashing their full potential requires a transformation of the technical assistance and rural extension systems with a gender-based focus.

Family Farming vs. Gender Equality? Are they Actually Compatible?

Many family farms are effectively managed by women yet family farms do not provide autonomy to women workers or the means to realize their potential as farmers. Hence a nod toward gender equality is not enough. The problems women face as farmers are structural and deep-rooted, and would need to be addressed specifically redistributing productive assets such as land and inputs within peasant households in gender-equal ways, and directing state services to cater better to the needs of women farmers, such as services relating to credit, extension, training, information on new technology, field trials, input supply, storage and marketing. Institutional innovations involving only women rather than entire families hold potential gains, both in terms of productivity and equity.

How will unequal gender relations embedded within families be tackled? Indeed an emphasis on family farming, which often depends on women's unpaid labour, could go in the opposite direction, unless intra-household inequalities are addressed. The issue of gender inequality is especially complex and may be difficult to address by prioritizing individual family farming. Alternative institutional arrangements based on proactive farmer cooperation in production, especially cooperation among women farmers, may be more conducive to gender equality, but that could go contrary to individual family farming.

The various forms of co-operative and group/collective farming can be an alternative to individual family farms, which may be more empowering and transformative for women.

All these points indicate that family farming as it is generally perceived might not be so compatible with gender equality, but that perhaps the two can be compatible if creative and innovative alternatives to standard models and approaches are pursued.

The Gender Gap in Family Farming, Nutritional Security and Poverty Reduction

FAO defines family farming as “a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family labour.

The “gender gap” in agriculture further hampers the potential of family farming. This is especially worrying given the prominent role of women in agriculture: women represent on average 43 percent of the agricultural labour force, yet in many countries their productive role is relegated to that of unpaid family labour, and as a consequence women are in many cases excluded from statistics (FAO 2011). Moreover, the majority of small-scale farmers are women, yet due to structural barriers, they have lower productivity levels compared with men, and thus their contributions are marginalized (FAO, 2011).

In the context of family farming, there are several critical areas where gender inequalities should be addressed to ensure the sustainable enhancement of production and livelihoods. Among the inequalities accounting for women’s under-performance in family farming is their lower access to productive resources; intra-household division of labour, of which women bear the brunt; discrimination from formal and customary institutions, particularly with regards to inheritance, property rights and land tenure; the exclusion of women farmers from groups such as producers’ organizations, which are often a source of knowledge, inputs and power; and women’s lack of access to the resources and learning opportunities which are crucial to making the most productive use of men and women farmers’ time. FAO estimates that if women had the same access to productive resources as men, they could increase yields on their farms by 20–30 percent and could increase agricultural output in the developing world by 2.5–4 percent, on average, with higher gains in countries where women are more involved in agriculture and the gender gap is wider (FAO, 2011). Furthermore, women’s contributions to food security go beyond their productivity levels due to their role as primary caretakers in the household.

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 Value Chain : A Success Story in Odisha

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 combuster; 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.

- Rice Value Chain (RVC) as an approach to increase farm income and promote entrepreneurship. Besides having the fundamental benefits, the RVC has some added prospective, namely (i) rice will continue to dominate the farm production for various socio-economic and cultural reasons in spite of poor financial gains and market glut, (ii) demand in the national and international market for quality rice is quite apparent (iii) apart from farmers, other stake holders can join the chain leading to creation

of additional employment and (iv) quality and specialty rice varieties developed by research institutes can spread quickly with less investment in extension.

- ❑ Having the above logic in view, ICAR-NRRI, Cuttack has developed a Rice Value Chain (RVC) on 23rd April, 2015 through a Five-Party MoU from Seed Breeder to Seed Miller wherein, the '*Ananya Mahila Bikash Samiti*' is a signatory for producing paddy of the high value aromatic rice variety '*Geetanjali*'.

The Process

- ❑ The objective of the rice value chain was to promote large scale cultivation of high quality rice varieties of this institute in contiguous patches, undertake its processing and trade so that the consumers have access to its premium quality and all the parties involved in the value chain are benefitted. The first party i.e., ICAR-NRRI, Cuttack in consultation with rice processor and trader decided the variety *Geetanjali*, a long slender grain aromatic rice to include in the rice value chain. The institute being the developer of the variety and having knowledge about its characteristics is involved in its maintenance and production of quality rice. The institute provides breeder seed of *Geetanjali* to a seed company for production of foundation seeds to be used by the participating farmers in the chain. Another group of stake holders in rural areas like farmer and farmwomen associations are involved which need to undertake survey of the rice ecology, motivate farmers to participate in the chain, monitor the production and arrange lifting of production by the rice processor-cum-trader. The final party in the process is the rice processor and trader who lifts the production from the production site and make immediate payment to the farmers at a price better than the MSP. The processor-cum-trader finally takes the responsibility to maintain the quality and take up market strategy including pricing to create a market demand for the rice variety. The responsibility and benefits for each party have been decided and agreed upon through a memorandum of participants (MoUs).

Parties in the Rice Value Chain

- ❑ 1st Party- ICAR-NRRI, Cuttack (Supply of breeder seeds, technical backstopping);
- ❑ 2nd Party- Sansar Agropol Pvt. Ltd., Bhubaneswar, (Seed Company for multiply the seed and distribution to the farmers);
- ❑ 3rd & 4th Party- Ananya Mahila Bikash Samiti, Sankilo & Mahanga Krushak Vikas Manch, Cuttack for large scale promotion of '*Geetanjali*' ;
- ❑ 5th Party- Sabitri Industries, Pvt. Ltd., Mayurbhanj (Procurement and Marketing).

Major Benefits

- ❑ Farmers get doorstep procurement and 20% more over MSP.
- ❑ Quick spread of NRRI variety with less investment in extension.
- ❑ Business to the seed company.
- ❑ Additional income to the farmers groups towards coordination.
- ❑ Business and profit to the Rice Processor and Trader.

The Success of the Rice Value Chain

- ❑ Under this programme, Breeder Seed of 6.6 Qt (Geetanjali) was supplied to Sansar Agropol by NRRI, Cuttack. A total of 49.5 acres were covered under seed production in four different locations of Odisha. About 500 qt of Truthfully Labeled (TL) Seeds have been produced for 1000 ha for production of rice. The Monitoring Team of NRRI visited the different sites of seed production and gave suitable advice to the company for higher yield
- ❑ During the first cycle, with the involvement and mobilization by the Women farmer group i.e., '**Ananya Mahila Bikash Samiti**' (3rd party), the grain was produced in three clusters totaling 166 acres of Khurda and Cuttack districts involving 82 farmers during dry season/ *rabi*-2016. The average yield of the crop was recorded at 4-4.5 t/ha. After keeping for seed and household consumption, 202 tons of paddy grains were sold by the participating farmers to the 5th party i.e., Sabitri Industries at the rate of Rs. 1,740/- per quintal (i.e., 20% above MSP), amounting to a total of Rs. 35.15 lakhs. Similarly, during *kharif*-2016 and *rabi*-2016-17 136 tons of paddy grains were procured by the Processor. Now, the grains are being processed and packaged for marketing by the 5th party.

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.

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PERCEIVED CONSTRAINTS AND MITIGATION IN PROMOTION AND ADOPTION OF WOMEN FRIENDLY FARM TOOLS

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Agriculture in India employs 263 million human workforce, of which about 37% are women workers. By 2020, the ratio of agricultural workers to total workers will go down to 40% from 56% at the present and the number of workers would be around 230 million, of these about 45% will be women workers as against 37% at present. Farm mechanization saves time and labour, cuts down crop production costs in the long run, reduces post-harvest losses and boosts crop output and farm income. Empirical evidence confirms that there is a strong correlation between farm mechanization and agricultural productivity. States with a greater availability of farm power show higher productivity as compared to others. There are about 120 million agricultural machines operated by either tractors, power-tillers, electric motors, diesel engine, animal or human workforce. The number of agricultural hand tools is about 400 million.

Negative effects of farm mechanization on women in agriculture:

It is observed that the women labourer's growth was less as compared to male agricultural labourers during this 2001 to 2011 indicating reduction of share of women workers in agriculture. It is because of the fact that when a machine is introduced for some operations (which may be women dominated), it is generally operated by male workers, reducing opportunities for women workers. This leads to displacement of the work, causing majority of rural women to have insufficient income. Women are forced to do low-paid, labour-intensive arduous agricultural tasks (weeding transplanting, harvesting etc) Farm mechanization implies changing skills, thus causing deskilling of women. Because of these women are often displaced in favour of men. Due to improper notions such as "machines for men" the skills of women have become irrelevant or ill adapted to the needs of new production technologies. There is loss of wage labour opportunities for poor rural women due to introduction of technology that mechanizes task that they traditionally perform (rice mills, papad making machines).

Women in agriculture and allied sector:

Women play different type of roles in the field of agriculture and allied sector. Field operations in crop production such as sowing behind the plough, transplanting, weeding, interculture, harvesting and threshing. Argo-processing activities like cleaning / grading, drying, parboiling, milling, grinding, decortication and storage etc. Operations in commercial agriculture such as Tea plucking, tobacco leaf harvesting, lac cultivation and processing. And animal upkeep and dairy activities.

Women in Poultry, Dairy and Fisheries:

Livestock

Live stock (dairy, goat etc)rearing is an activity which supplements agriculture income in most of the Indian rural families. It also plays a vital role in ensuring a proper nutritious intake in the family members. Women are engaged in various activities such as

- Cleaning of animal and sheds
- Watering of cattle

- Milking the animals
- Fodder collection
- Preparing dung cakes
- Collection farm yard manure

Except grazing and sales, other activities are predominantly performed by women. Men, however, share the responsibility of taking care of sick animals. It is evident that the women are playing a dominant role in the livestock production and management activities.

Poultry

Back yard poultry comprises 25 % of total poultry production in India. Feeding and management to marketing is entirely handled by women. The following activities are taken care by women in backyard poultry:

- preparation of shelter for birds,
- care of newly hatched chick,
- brooding,
- feeding,
- watering,
- collection of egg,
- preservation of egg,
- care of hatching egg,
- care during natural incubation,
- control of broodiness,
- control segregation of young chicks from adult,
- identification of ailing birds, and taking birds for treatment,
- marketing of live bird etc

Fisheries

In India out of a population of 5.4 million fishers, 3.8 million are fishermen and 1.6 million are fisherwomen. The major activities in which women contribution is visible in fisheries sector is

- Aquaculture (ornamental fisheries)
Breeding
Taking care of hatcheries and fingerlings
- Fish processing (pre and post harvest operations in captured fisheries)

Curing

Peeling

Drying

Value addition (fish pickle, chutneys, RTS etc)

- Marketing
- Making of nets
- Sea weed collection etc

Why there is a need for adoption of mechanization by women?

Studies show that 37.2 % agricultural labour force in India is female (AICRP on ESA). And it is predicted that this value is going to increase. Major reason behind this is the male rural-to-urban migration. Male members of the family are leaving the agriculture profession and migrating to cities in search of higher paying jobs. This leaves the females in charge of the house and the farm. Hence, women face increasing workload and wider scope of agricultural task, decision making etc., but the degree to which they have access to improved agricultural technologies needs a special consideration.

As men leave there is unavailability of labour during critical time period of farm operation. Thus, there is a need for skilled agricultural labour along with improved work efficiency to complete the operations timely operations.

Hence it can be concluded that women are playing the dual role of labour and also that of a decision maker. There is a rapid feminization of agriculture. So, it is essential that we equip the women with the agricultural advances for enhancing productivity and reducing the drudgery.

The current farm power availability of India is 2.03 kW/ha. By 2022, we need to increase to 2.5 kW/ha and by 2030 the same should be 4.00 kW/ha to sustain the increasing population. From the agriculture census 2015-16 data it can be observed that the operated area has decreased along with the average size of land holding. It may also be observed that number of land holdings have increased in small and marginal categories from 2010-11 to 2015-16. Operated area also follows the same trend. Percentage share of females with respect to land holding and the operated area have also grown over the time. Thus, it can be concluded that there is a need to introduce women friendly tools and equipment via custom hiring to increase productivity and ensure sustainability.

At present, majority of the agricultural workers including women in our country are used as a source of muscular power. However, it is known beyond doubt that human beings are not suited best as a source of muscle power, but, as controller of machines. They have a vast potential and capacity for information processing and taking actions on that basis. Therefore, as far as possible, it is always better to use human workforce as controller of machines.

In future, for most of the farm activities, there will be machines available which may be self propelled or power operated or engine operated manually guided. It is estimated that as of today, in case of male workers about 20% work as controller of machines and 80% as source of power. In case of women workers, the corresponding figures are 99.99% and 0.01%. This situation is going to change in future and it is projected that by 2020, in case of male workers about 30% will work as controller of machines and remaining 70% as source of power. The corresponding projections for female workers are 5% as controller of machines and 95% as source of power.

To ensure that the women are equal beneficiaries if the agricultural mechanization, it is necessary to develop women-oriented training modules, machines, equipment, tools etc. But to successfully implement a programme a researcher also needs to study the root cause of the problem. In the present context it is “lower level of mechanization among the farm women”.

To improved technology package has been developed in the country for agriculture and agro-processing but these have selectively been adopted mainly by male farmers. The female farmers remained passive spectator and continued to adopt traditional practices. The reasons may vary from technological to marketing and social barriers.

The classification of constraints made by Nikkade and Bhole (1989) on the basis if studies made in India, known as the “standardized categorization of constraints” is given below:

Economic constraints

1. Lack of capital
2. Non-availability of loans to defaulters

Input constraints

1. Non-availability of inputs
2. High cost of inputs
3. Untimely availability of essential inputs

Information constraints

1. Lack of technical knowledge
2. Lack of skill

Technological constraints

1. Complexity of certain improved technologies
2. Susceptibility of improved strains to pests and diseases

Psychological constraints

1. Perception of risk
2. Perception of low profitability
3. Non-perception of necessity for suitable technology
4. Impact of beliefs and traditions

Infrastructural constraints

1. Non-availability of draught animals
2. Non-availability of improved implements and machinery

Situational constraints

1. Unsuitability of soil for particular crop
2. Inadequate sources of irrigation
3. Use of inputs restricted to items available in the local co-operatives

Solutions to be adopted for mitigating constraints:

Economic constraints

- Appropriate policy changes should be ensured for mitigating the economic constraint.
- Organizing women groups for custom hiring of tools to avoid individual purchase

Input constraints

- Since marketing of inputs requires movement away from the village, it will be appropriate to organize group societies to look after such issues
- Custom hiring of high cost inputs
- Creating a seasonal if not permanent input market in the village cluster for timely availability of inputs

Information constraints&

- Facilitating counseling
- Developing a database of
 - Activities and multiple roles of women
 - Women specific tools and equipments
 - Success stories
- Using progressive farm women as a resource person

Technological constraints

- Training of trainers
- Training for women farmers for skill up-gradations to increase productivity and reduce drudgery
- Considering the ergonomic needs and differences of farm women

Psychological constraints

- Training women in safe handling and safety precautions to avoid risk perception
- creating awareness of existing technologies
- Attitudinal changes are needed specially amongst the male member about the machinery operation by women workers

Infrastructural constraints

- On-the-spot guidance/maintenance systems
- Manufacturers of improved women friendly tools and machines need to be given incentives through various policy initiatives.

Situational constraints

- Awareness of the schemes, subsidy patterns, natural disaster managements techniques and other initiatives by the government to facilitate the local farmers should be done by the KVKs, line departments, central governments institutes and NGOs etc working in the field to mitigate the situational constraints.

Work done for equipping the women in agriculture with proper tools and equipments :

Central Institute for Women in Agriculture (CIWA), Central Institute of Agricultural Engineering, All India Coordinated Research Project on Ergonomics and Safety and All India Coordinated Research Project on Home Science and SAUs carried out ergonomical evaluation/ refinement/ development of hand tools/ equipment suitable for women workers.

Central Institute for Women in Agriculture:

CIWA work on dissemination of the developed technologies to the women. But first and foremost they work for creating the awareness, gender mainstreaming and empowerment of women in agriculture. Thrust areas for R & D activities for CIWA are :

- Creating a repository of gender disaggregated data and documentation
- Technology assessment & evaluation
- Farming system approach
- Capacity building of R & D functionaries
- Resource management
- Gender mainstreaming
- Nutrition and livelihood security

ICAR-CIWA, with its mandate of research on gender, has been striving to address gender issues in agriculture for achieving higher efficiency and productivity in agriculture. In order to demonstrate the output and utilities of gender research, ICAR-CIWA is forging partnerships with ICAR institutions, KVKs, SAUs, development agencies, NGOs and international organizations to strengthen the efforts of gender mainstreaming which is very much required to achieve gender equality which is one of the Sustainable Development Goals before the global community.

Improved Tools and Equipment for Women Workers

The improved hand tools and equipment help to achieve one or more of the following:

- Reduce drudgery.
- Increase utilization efficiency of inputs.
- Ensure timeliness in field operations and reduce turn around time for next crop.
- Increase productivity of worker-machine system.
- Conserve energy.
- Improve quality of work and also quality of produce.
- Enhance the quality of work life of agricultural workers.

Thus it can be concluded that, farm mechanization enhances the food productivity of country. Women need to be equal beneficiaries of the technological advances in the agricultural sector. Certain technological, sociological and economical aspects cause hazards in promoting the women friendly tools and equipments. Proper design methodology, extension practices and attitudinal change can lead to better adoption of women friendly farm tools and equipments, thus ensuring enhanced productivity and reduced drudgery.

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LIVELIHOOD SECURITY AND ECONOMIC EMPOWERMENT OF WOMEN FARMERS THROUGH DAIRY FARMING

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Woman empowerment is the process of building a woman's capacity to be self-reliant and to develop her sense of inner strength. It enables women and gives opportunity to better their own lives and society in general which is multi-dimensional in its approach and covers social, political, economic and social aspects. However, economic empowerment is of utmost significance in order to achieve a lasting and sustainable development of society with livelihood security. Women in India are mainly responsible for their household sustenance and wellbeing. To keep up to this task and other social expectations, they engage in agricultural production and livestock farming. 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 due place they deserve. 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. 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. They are effective role players in both income-generation and household management. However, lack of awareness and adoption of scientific managerial practices in animal husbandry, gender asymmetries 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 (Lalitha and Seethalakshmi, 2001). 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 (Taneja, 2013). 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).

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 indeed for women empowerment

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 preventing 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, Brucellosis, 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*, *toon* 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 byproducts

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 a 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, maintains the animal without any other supplement. Animal can consume up to 0.5 to 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/cm² 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.

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. However, 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 income. 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 dairy farm women 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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RURAL POULTRY PRODUCTION FOR POVERTY ALLEVIATION AND GENDER EQUITY IN INDIA

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Poultry production has increased significantly over the past fifty years to accommodate increased demand for poultry products. Today poultry production for egg and meat is one of India's most innovative industries. Having evolved from the backyard to a vertically integrated and organized sector it has achieved unprecedented growth during the last four decades. The constant efforts in up-gradation, modification and application of new technologies paved the way for the multifold and multifaceted growth in poultry and allied sectors. Today, the development of poultry sector is not only been in size but also in productivity, sophistication and quality. Availability of high yielding layer (320-330 eggs) and broiler (2.4-2.6 kg at 6 wks) varieties together with standardized package of practices on nutrition, housing and management, and disease control have contributed to spectacular growth rates in egg (6-8% per annum) and broiler production (10-12% per annum) in India. Though considerable growth has taken place in poultry sector, the consumption of egg and meat is far below the recommended (Nutritional Advisory Committee) consumption of 180 eggs and 10.8 kg poultry meat per person per year.

Egg and chicken meat are expensive in rural India in comparison to urban sectors. It is primarily due to lack of viable marketing system. However organized poultry production is still a dream in disorganized sector due to lack of basic infrastructure, compounded feed and availability of health coverage. India has nearly 70% of its population living in rural areas. However, in the present scenario most of the commercial poultry production is concentrated in urban and peri - urban areas. Just 25% population living in urban areas consumes about 75-80 % of eggs and poultry meat. The per capita consumption of egg is 100 and poultry meat is 2.2 kg per person per annum in urban areas. However, in rural areas it is restricted to only 15 eggs and 0.15 kg 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. It is also true that poultry production is the only endeavour which can create subsidiary employment and income generation provided right type of bird is made available to them with a package of services like supplementary vaccination against major diseases (Ranikhet disease, Marek's disease, etc.) and availability of medicine against parasitic infestation and coccidiosis. Moreover, it will not only help to meet the demand of animal protein for rural population but also provide them supplemental income to improve their socioeconomic status.

The rural people are practicing backyard poultry keeping since time immemorial in India and other Asian and African countries. Small and landless farmers as well as those belonging to weaker sections, including tribal and scheduled castes people traditionally keep local breeds for their subsistence. These birds forage and scavenge for their food in the back yards of human dwellings and provide eggs and meat at insignificant cost. They provide rich nutritional food and regular source of income for the rural / tribal poor. 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. Therefore, the need of the hour is to promote free range and backyard poultry farming in rural, tribal and underdeveloped areas of the country.

Why Poultry is the choice?

- Poultry farming is an essential activity of the typical rural/tribal household system in India, touching their social, cultural and economic lives (Kumtakar and Kumtakar, 1999).
- According to a Survey by Anthropology Survey of India, majority of Indian population is non-vegetarian. Moreover poultry has no religious sentiments, as it is acceptable to all sections of society irrespective of cast, creeds and colour. Presently poultry meat is accounting for about 27% of the total meat consumed and is the most popular meat from any single livestock species (FAOSTAT, 2006).
- Poultry is the choice of species because it needs minimal use of land, labor and capital. Also it gives quickly turnover as, the growth cycle is very fast, only 42 days (broiler chickens). So it generates fast cash.
- It also easy to handle and does not require special attention.
- The poultry products like egg and meat is nutritious and the biological value of egg protein is very high (Table 1). Poultry meat is low in fat and cholesterol and hence choice of health conscious people. By going for poultry production in rural area it not only assures the availability of eggs and meat to cater the food need besides providing additional income. Thus has a potential to fight poverty and malnutrition and provide scope for high employment generation and solving gender issues in employment.

Table 1. Comparative nutritive value of eggs and other food stuffs

Foodstuffs	Biological value	Protein efficiency ratio	Net Protein utilization	Chemical Score	Digestibility%
Egg	96	4.5	93	100	97
Milk	85	3.0	81	65	94
Meat	80	2.8	76	70	82
Chicken	82	2.9	78	71	85
Fish	85	3.0	72	70	85
Soybeans	64	2.0	54	57	73
Peas	56	1.6	45	42	72
Potato	60	1.8	49	48	82
Rice	64	2.0	57	60	90
Wheat	58	1.7	47	42	90
Maize	45	1.3	34	35	85
Bajra	62	1.8	52	52	88

Why Rural Poultry?

Adoption of commercial exotic breeds in rural / backyard system of rearing is a difficult scenario because of the limited resources of the poor people. The lack of basic infrastructure, compounded feed and proper health coverage still make, it a dream to go for organized poultry production. On the other hand, high mortality rate, malnutrition and adverse climatic condition in many areas are antagonistic to the successful raising of high producing germplasm. In these circumstances there is a need to rear such type of germplasm which can produce 120-150 eggs per annum and attain around 1 kg of body weight at 12 weeks of age with minimum or no inputs. Moreover, they will be hardy, resistant to common poultry disease and need less care.

Advantages of Rural Poultry Farming

- ❖ It is easy to manage and handle.
- ❖ It needs minimal use of land, labor and capital.
- ❖ There is higher demand and higher price for eggs and birds of native fowl.
- ❖ It requires little intervention in rearing, the major intervention is in the areas of feed and water supplementation, over night housing and to a much lesser degree in health management.
- ❖ It can easily integrate with other agriculture, aquaculture and livestock farming.
- ❖ It can contribute to the village economy.
- ❖ The most important is women in rural areas can operate family poultry with maximum involvement.
- ❖ Rural poultry plays a significant role in the cultural life of rural people as a gift to visitors and relatives, as starting capital to youths and newly married maidens, as sacrificial offerings in traditional worship, as a potential source of employment and easy source of income for small scale farmers.
- ❖ The poultry products such as egg and meat are highly nutritious and the biological value of egg is very high. Poultry meat is low in fat and cholesterol and hence choice of health conscious people.
- ❖ Poultry farming in rural area not only assures the availability of eggs and meat to cater the food need but also provides additional income. Thus has a potential to fight poverty and malnutrition and provide scope for high employment generation and solving gender issues in employment

Poultry Production and Poverty Alleviation

The United Nations Food and Agriculture Organization (FAO, 2014) estimates that about 805 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic hunger or undernourishment, of which 791 million people are from the developing countries, representing 13.5 percent, or one in eight, of the population of developing countries. Poultry represent an important system to feed the fast growing human population of developing countries of South Asia and to provide income to poor small farmers, especially women. Increased production of poultry, both commercial and rural, is a vital contribution to food security at both the household and community levels. Rural poultry production continues to make a significant contribution to poverty alleviation and household food security in many developing countries. Village poultry production is ideally suited to rural areas where the conditions for a

successful commercial poultry sector are rarely met. Indigenous poultry breeds are excellent scavengers, transforming feed resources considered unsuitable for human consumption into high quality products such as poultry meat and eggs. The ability of indigenous breeds to scavenge, to flee predators, to lay and hatch their own eggs and to contribute to pest control results in a production system that complements other farm activities without directly competing with humans for cereal crops. Village poultry are generally owned and managed by women and children and are often essential elements of female-headed households.

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. It is a central organizing principle of societies, and often governs the processes of production and reproduction, consumption and distribution’ (FAO, 1997). Despite this definition, gender is often misunderstood as being the promotion of women only. However, as we see from the FAO definition, gender issues focus on women and on the relationship between men and women, their roles, access to and control over resources, division of labour, interests and needs. Gender relations affect household security, family well-being, planning, production and many other aspects of life (Bravo-Baumann, 2000). The role of family poultry in poverty alleviation, food security and the promotion of gender equality in developing countries is well documented. Family 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. This is because all household members have access to livestock and poultry and are involved in production, processing and marketing of these products. 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.

Chicken rearing has a history of over 5000 years in India. Red jungle fowl, the wild native chicken is believed to be the basic source of all the modern breeds reared throughout the World. Poultry farming was confined to rearing of few chickens and ducks in the back yards till early 1960s and egg and chicken meat production was insignificant. The per capita availability of eggs in 1960 was only 0.3 kg (FAOSTAT, 2006). Realizing the importance of eggs and chicken meat in human nutrition and the increasing requirements of growing human population, efforts were initiated for increasing poultry production in the country. The fruits of commercial poultry production in India have been limited to the urban and semi-urban areas and the rural poultry sector remained unchanged. Egg production from native chicken contributes only 21% of total egg production of the country. In rural areas, the poultry products are sold at 10-40% higher price than the prices at urban and semi urban areas. Further, the incidence of protein deficiency is prevalent among the susceptible groups like children, pregnant women, nourishing mothers and aged people in rural areas, which can be alleviated by adopting small scale poultry farming in backyards of rural households. Besides, the backyard poultry production relies on minimal cost inputs in the form of kitchen waste, locally available grains, tender leaves, worms, insects and other material available for scavenging. The production potential of the native chicken breeds is very low. Realizing the importance of backyard poultry farming in India and the need for high

yielding varieties, research efforts were initiated in the recent past at ICAR Institutes and SAUs for developing new strains suitable for rural farming. Crosses like Vanaraja, Giriraja, Gramapriya, Girirani, Krishna J, Gramalakshmi, CARI Gold, Niocbari etc. have been evolved and being raised in different parts of the country.

The role of family poultry in poverty alleviation, food security and the promotion of gender equality in developing countries is well documented (Guèye, 2000). Family 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 (Gujit, 1994; Alders, 1996; Kitalyi and Mayer, 1998). It makes good use of locally available resources, requiring low inputs. Though generally considered secondary to other agricultural activities by smallholder farmers, poultry production makes an important contribution to supplying local populations with additional income and high quality protein. Poultry products can be sold or bartered to meet essential family needs such as medicine, clothes and school fees. Village chickens are active in pest control, provide manure, are required for special festivals and are essential for many traditional ceremonies. Studies in neighbouring countries like China, Bangladesh and Sri Lanka have shown that Family poultry farming has a useful role and is worth studying to take up appropriate steps to improve the productivity.

Important Aspects of Rural Poultry Production

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 focal points for rural / backyard poultry production is

- Adoption of appropriate technology
- Utilization of locally available resources
- Training of farmers
- Proper health management
- Organized marketing system

Development and adoption of appropriate technology

There is 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. The productivity of these stocks should be 120-150 eggs per annum and around 1kg meat in 10-12 weeks of age. Upgrading and cross breeding are the most easy and quickest method for improvement of indigenous germplasm for traits of economic importance. Genetic characterization and breed description of indigenous fowl breeds like Kadaknath, Assel Naked neck and Frizzle have received priority in research conducted so far. Some important genes, already proved for their special utility in the tropics are naked neck and Dwarf gene. Introduction of naked neck gene into broiler genome is receiving considerable attention in recent years for tropical broiler production because of its superior heat tolerance, adaptability and protein conversion efficiency. Many institutions are working hard to develop varieties of chicken suitable for rural poultry farming and some of them are given in the Table 2 below.

Table 2. Chicken varieties developed for rural poultry production

Variety	Type	Developing agency
Giriraja	Dual	KVAFSU, Bangalore
Girirani	Egg	KVAFSU, Bangalore
Swarnadhara	Egg	KVAFSU, Bangalore
Vanaraja	Dual	ICAR-DPR, Hyderabad
Gramapriya	Egg	ICAR-DPR, Hyderabad
Krishibro	Meat	ICAR-DPR, Hyderabad
Srinidhi	Dual	ICAR-DPR, Hyderabad
CARI Debendra	Dual	ICAR-CARI, Izatnagar
CARIBRO Dhanraja	Meat	ICAR-CARI, Izatnagar
Krishna J	Egg	JNKVV, Jabalpur
Narmadanidhi	Dual	JNKVV, Jabalpur
Nandanam IV	Dual	TANUVAS, Chennai
Gramalakshmi	Egg	KAU, Kerala
Kalinga Brown	Egg	CPDO, Bhubaneswar
Rajasree	Egg	SVVU, Hyderabad

Utilization of locally available resources

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.

Disease control

Constant outbreak of poultry diseases in the recent past is one of the havocs for rural poultry production. The single most important disease concerning to 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. Also there is a need for reliable diagnostic tests and facilities to differentiate various poultry diseases and also efficient vaccines must be made available at reasonable cost. Training on proper management and Bio-Security should be imparted to prevent spread of diseases. More women should receive training in husbandry practices and gain access to poultry health services for successful poultry activities. The vaccination schedule for rural poultry is given in Table 3.

Table 3. Vaccination schedule for rural poultry

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

Marketing system

This sector is neglected so far. Most of the birds in rural areas are sold live. Sometimes the birds are slaughtered and displayed for sale in the open air without any concern for hygiene. Therefore, there is a need for development of reliable and stable market chain round the year for proper marketing of the poultry products. Also facilities for hygienic slaughter and preservation of eggs should be made available at market places in rural areas. Formation of producer co-operatives/ Associations and Rural market yards will help in proper marketing. A well-organized marketing system, accessible to women, is the key to guaranteeing a better price for their poultry products is the need of the hour.

Training and extension services

Many times failure in backyard poultry rearing is observed due to lack of knowledge, experience and sufficient exposure to poultry rearing. Training programs at village level targeting the stakeholders, women and youth should be organized for effective implementation of the farming. Providing extension services including management, vaccination, disease diagnosis, market information and other inputs like supply of chicks, quality feed etc. is a major challenge for the system to be successful.

Conclusions

Rural poultry production is an important tool to alleviate poverty and improve livelihood of poor farmers in rural India. Success of rural poultry production will not only ensure nutritional security but can also be a tool for rural development and the entry point for promoting gender balance. If properly adopted and implemented, definitely rural Poultry production will be a boon for the poor farmers.

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ENHANCING LIVELIHOOD OF WOMEN THROUGH IMPROVED LIVESTOCK PRODUCTION

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Livestock sector provides an important livelihood option in the predominantly agrarian economy of India. It is an important source of income for the rural poor in India where 70% of the livestock is in the hands of small and marginal farmers and landless labourers who own less than 30% of the land area. In the recent years when the agriculture sector has been under stress with growth rate hovering between 0.7% in 2015-16 to 1.5% in 2012-13, the livestock sector has continued to showed impressive performance. The share of the crop sector in GVA has been on the decline from 65 per cent in 2011-12 to 60 per cent in 2015-16 whereas the share of livestock in GVA in agriculture has been rising gradually from 22 percent in 2011-12 to 26 percent in 2015-16. The structural changes that are being witnessed by the agriculture sector in India necessitates re-orientation in policies towards this sector in terms of strengthening the agricultural value chain by focusing on allied activities like dairying and livestock development along with gender-specific interventions. There has also been a shift in composition of farm income. In 2002-03 the share of livestock in total farm incomes was only 4 per cent which increased to 13 per cent by 2012-13. The ownership of livestock is tilted towards marginal, small and semi-medium farmers who have an average operational holdings of area less than 4 ha and they own about 87.7% of the livestock in the country. India has vast resource of livestock and poultry with 190.9 million cattle, 108.7 m buffalo, 65.1 million sheep, 135.1 million goats and 10.3 million pigs as per 19th Livestock census (2012). A total of 512 million livestock in the country are vital asset for the rural people. This plays a vital role in improving the socio-economic conditions of rural masses.

Women are vital to food security and family well-being and their need for labour saving and income generating technologies are acute. However, until now, most technical solutions have ignored women's actual needs. Studies have shown that livestock contribute significantly to the income of poor households-particularly the income controlled by women, and enables poor and landless women to earn income using common-property resources. The expanding market for livestock products also offers an opportunity for augmenting their income to those who do not have access to land and capital resources.

The domestic animals like goats, sheep, pigs, chickens, ducks and rabbits can be reared easily by women while attending to other household activities and they are also important for household nutritional security. Identifying and supporting women's roles as livestock owners and strengthening their decision-making power and capabilities are key aspects in promoting women's economic and social empowerment. Recent review conducted by ILRI shows that if livestock technologies are developed in ways that consider the needs, interest and concerns of women and men, they can reduce women's work load, increase productivity and contribute to the generation of income.

Women play an important role in activities dealing with livestock such as care and management or transformation and marketing of certain livestock products. Furthermore, livestock ownership patterns especially for small stock and poultry appear more equitable than that of other assets like land, capital, and knowledge. These reasons have possibly contributed to an increasing inclusion in one way or another of gender aspects in livestock development projects. Gender aspects should be understood as 'practical needs' on the one hand (access to technologies, more access to better welfare) and as 'strategic needs' on the other hand (revised rules and regulations, long term improvement of women's position).

Concerning livestock development, there is a high level of agreement in the literature that socio-economic and institutional frameworks play an important role in determining who does what, and who gets what. Social and cultural norms dictate the division of labour and control over assets. Policy and institutional structures often restrict existing sources of support to women, particularly credit to acquire large ruminants. Values, norms and moral codes embedded in culture and tradition have very strong influence on gender issues as they determine attitudes and the organisational set-up of the whole community system. Like culture and traditions, political, institutional and legal structures also change slowly. Hence, these latter factors often impede the implementation of gender balanced programmes. Hence, it is important to consider the socio-economic factor while implementing livestock programmes from gender perspective. Social and cultural factors determine the possible margin of action of women and their activities. In cases where women are excluded from community meetings, have no access to education and training, and where their capacity to become actively involved is not strengthened, they will always be left behind. Economic factors are the basis for change because with a greater economic independence, self-confidence and possibilities of upward socio-economic movement increase. To achieve a broad-based impact with a particular intervention, gender aspects should be looked at simultaneously and all factors including political, institutional and cultural aspects should be considered.

Gender Issues in livestock production

Women and men livestock keepers typically have different needs and interests, and face different livelihood opportunities and constraints in managing livestock as well as in coping with emerging challenges such as poor access to markets, services and technical information, periodic drought, flood and disease, competing resource use, policies that favour larger-scale producers or external markets, and weak institutions (Table 1). In most system, women provide labour for various tasks related to livestock production but may or may not control the process of decision making, particularly over the disposal of animal and animal products. Similarly, women may be involved in production, but may or may not own the means of production, including livestock, land and water.

Table 1: Gender-based constraints, needs and opportunities in livestock production

Constraints	Needs	Opportunities
Low women's participation in livestock development programmes and training	<ul style="list-style-type: none"> • Gender sensitization for more women's participation in formal discussions • Increased access to information, use of visual aids where there are problems of literacy • Include women in training and development programmes-very much open to innovations • Organise training programme in those periods and days when women are not involved in other duties 	<ul style="list-style-type: none"> • Adoption of improved technology that can suitably be integrate in traditional production system • Raise awareness of potential of livestock in increasing household food security and household economies and promotion of gender equality. • Conduct training programme in villages with flexibility in schedule and venue

Constraints	Needs	Opportunities
	<ul style="list-style-type: none"> • Organise training programme on-site (village) • Introduce leadership development and confidence building measures 	
Time constraint in livestock management during peak labour periods	<ul style="list-style-type: none"> • Introduction of labour-saving technologies/devices • Introduction of skills on livestock management, e.g. full hand milking, use of locally made crates, revolving stool for milking, use of long handle rack /spade for removing dung • Look at case studies where women play a leading role in livestock production for exposure visits 	<ul style="list-style-type: none"> • Reduce livestock mortality and morbidity • Reduction in women's work drudgery • Development of other small enterprises
Low scale of production limiting access to inputs and markets	<ul style="list-style-type: none"> • Introduction of group approach/ women self help group /farmers' groups or associations • Facilitation of support services at village level (AI, vaccination, deworming, credit etc.) through women self help groups • Training on capacity building of women SHGs for livestock enterprise development 	<ul style="list-style-type: none"> • Improvements in access to inputs, technical assistance and in marketing system • Women's empowerment and increasing gender equity
Lack of common pool resource (grazing, water and forest) for livestock production and other micro-enterprises income generation	<ul style="list-style-type: none"> • Improve access of women's to common pool resources through community participation and management • Develop mechanism at village level for provision of water and fodder during scarcity period 	<ul style="list-style-type: none"> • Improvement in the productivity of CPR • Enhance women's' right to control and manage CPR and livestock • Increasing livestock assets for the landless women
Informal and poor marketing system	<ul style="list-style-type: none"> • Improvements in infrastructure and transport services • Improving women's management and skills in value addition and processing 	<ul style="list-style-type: none"> • Increase demand for livestock products and promote production

For successful livestock interventions the following factors have to be considered:

a) Livestock production system

The role of women in varies according to the different livestock production systems and types of animals; crop/livestock linkages; feeding; availability and quality of natural resources, ecological conditions and vitality of land and pastures; soil quality; natural water sources; other common property resources; availability and cost of inputs; use of manure and crop residues; technology used. While considering the gender roles in livestock production we should take into account the proportion of households with livestock and their social structure; ethnic, cultural and social relations; household activities and intra-household organization; seasonal migration; relation between livestock and other activities; gender disaggregated seasonal occupation and sources of income.

In India livestock are generally raised in mixed farming systems, where animals very often have different functions. During earlier times they were a symbol of wealth and were vital for agricultural operations. Of late, with the mechanization of agriculture large the role of draft animals have diminished and cattle and buffalo are mainly reared for milk production. However, in areas where the mechanization of agriculture has not taken place, they are still an important source of draft power, dung and milk. The livestock activities are normally integrated into the existing farming systems: animals graze on fallow land and browse on hedges, utilize crop residues as feedstuffs and produce milk and meat, manure for biogas and power for traction.

Sheep and goats are generally kept on grazing only with little supplementation of the household leftovers. In most of the cases, women are the custodians of sheep and goats in the household and often children also actively take part in their management. Backyard poultry (BYP) is also an important activity for rural women as it generates cash income and provides employment opportunities while increasing the availability of meat and eggs that improve household nutrition. Studies conducted at DRWA in Odisha have revealed that BYP provides an income of Rs. 2000 per unit of 6-8 birds over a period of five months. The rural women mostly preferred Vanaraja and CARI Devendra birds for backyard poultry rearing as both the birds as well as eggs fetch high price as compared to other birds.

b) Ownership of different livestock species

Generally, men and women tend to own different animal species. In many societies, cattle and larger animals are usually owned by men, while smaller animals, such as goats and backyard poultry which are kept near the house, are more women's domain. However, ownership patterns of livestock are more complex and are strongly related to the livestock production system and to social and cultural factors. Ownership of larger animals is often related to ownership of the land.

c) Access to capital and knowledge

Men have easier access to government provided credit than women. Women are rarely considered creditworthy because they have no collateral. In addition, they often cannot read and write, and are not used to frequent governmental or official institutions without their husbands consent and being accompanied. In the most countries in Asia, Africa and Latin America, animal husbandry services are mainly oriented towards men. Veterinary services and extension programmes and advisory services have been mainly designed by men for men. Extension personnel are often not trained to teach technical subjects to women or to react their specific questions. Due to limited resources in time and material, attention is first given primarily to men's animals. Extension work with women often requires special didactic knowledge and communication skills because women often speak only the local language or dialect and illiteracy is high.

d) Responsibilities and division of labour

Patterns of gender division of labour are location-specific and change over time. Although the most typical pattern of gender division of labour is that women are responsible for animals kept at the homestead, there are many variations to this pattern from non-involvement in livestock to the management and herding of large stock.

If new livestock activities are introduced, it is mainly males who decide on whether or not to participate. The intra-household division of labour then depends on household labour availability, the number and type of livestock, economic development of the household and estimated income out of the new activity. But in fact, many decisions in a family are joint decisions, although they may not be formally recognized.

In Odisha women perform all the day to day activities related to caring, feeding, cleaning, health and production of livestock. These activities performed by women may appear to involve low skill levels, they are, however, most critical to the survival, health and production of the livestock. Activities performed by men are occasional in nature, involve less time, energy and labour and largely occur in the public domain, outside the confines of the household. Activities such as vaccinations, deworming, grazing, purchase of fodder and medicines, and taking animals to the dispensary are generally taken care of by men because they involve greater mobility, access to new technology and information, greater interaction with the market and the outside world. Despite this division of work, livestock production and management continues to be a household activity with flexible arrangements of work between women and men. Women's access to information and training in modern livestock management and dairying is limited and even indirect, lowering their involvement and efficiency.

e) Role of livestock in the household nutrition

One of the major reasons for keeping livestock in the household is to get direct nutrition in terms of milk and meat, but the income derived from sale of milk, and animals are also used to buy other food items. The manures produced by keeping animals improve household food production like vegetable and other food crop production. Generally, increased livestock production can have a positive influence on the nutritional level and the well-being of household members. Increased income from livestock production changes the intra-household distribution and control over products and earnings. When higher production and marketing activities become more important, women often lose their control over products and income. The level of nutrition within the family may decrease if the animals from which the products are derived are sold and the earnings spent on personal necessities, without taking into consideration the household well-being.

f) Influence marketing of livestock products in the household economy

Women tend to have greater control on the income from sale of poultry, eggs, milk and small ruminants. They tend to spend the money they earn from livestock activities on the welfare of their families. Income from livestock activities is also invested into diversification of agriculture, to buy animals and even to buy land. In many societies, the little income derived from daily milk sales is sometimes used by men for drinking.

g) Training in livestock activities

Livestock production is generally a joint activity carried out by both men and women but, compared to women, men have easier access to technology and training, mainly due to their strong position as head of the household and greater access to off-farm mobility. The decisions in activities related to livestock sector,

such as breeding, handling, feeding and health care, are largely taken by men. Livestock extension services are often controlled by men and the extension personnel are primarily men hence, the extension programmes and educational materials are mainly designed by and oriented towards men. Although in most societies all household members are involved in some way or another in livestock production, the decision making processes within the family and the division of labour for activities such as feeding, milking, health care, processing and marketing differs between regions, societies and households.

Women's access to information and training in modern livestock management and dairying continues to be limited and even indirect. Successful training should be oriented towards those household members which execute these tasks. For example, in societies where sick animals are mainly treated by women, they have knowledge of the symptoms and cures for animal diseases. But if they have no access to training, progress in best practices and appropriate herding to reduce diseases is difficult. Therefore, where extension services are dominated by men and where women have little access to training due to socio-culturally defined gender roles, men need to be persuaded to see the relevance and the benefit of training women. Only through a carefully planned gender approach can livestock production goals and successful training of women and men be achieved.

h) Role of Self Help Groups

Targeting livestock development through SHGs can accelerate the process of learning and arranging the inputs like credit.

Gender analysis in livestock production

Gender analysis requires taking into consideration factors which could influence the potential impact of a project and presents opportunities or constraints to project goals and activities. It helps in determining factors which can facilitate or constrain the project. The following factors have to be considered while making gender analysis in livestock production:

- Gender should not be an issue of mistrust and prejudice, but of creativity, inspiration and positive spirit for men and women.
- Social and cultural factors (norms and traditions which influence the behaviour of men, women and children, organization of the daily life of the household members, specific religious rules for men and women)
- Economic factors (poverty level, inflation, infrastructure, income distribution and distribution among family members, etc.)
- Institutional structure (government, extension, education, health care, funding agencies etc., and their gender approach in theory and practice)
- Environmental factors (quantity, quality and availability of land by households and intra-household distribution, water, energy, etc.)
- Political factors (power relationship, system of decision making, legal system, etc., and their influence on the relationship of men and women)
- Demographic factors (migration, life expectancy, infant mortality, etc.)
- Legal parameters (right to ownership, law of succession, etc.)

Conclusion

Sustainable development in agriculture can only be achieved through optimum utilization of natural resources. Livestock development interventions must take into consideration the land and livestock ownership pattern. Client-oriented participatory research is needed in developing appropriate livestock technologies for women in order to identify production constraints and to develop techniques that reduce women's workloads while at the same time increasing their productivity. Such research should take into account women's roles and responsibilities, as well as their workload. The following issues should be considered in designing appropriate technologies for livestock production: (i) their implications for women's labour requirements and workloads; (ii) their suitability in terms of consumption preferences; (iii) their implications in terms of women's control over the means of production; (iv) their expansion and use of women's indigenous knowledge; (v) the participation of women in their trials; and (vi) the importance of incorporating women's physical, social and cultural assets when designing research activities.

Participation of women is essential for developing and promoting technical interventions. Women's self help groups should be encouraged to take up activities related to livestock production. This is often the only way for poor women to obtain sufficient resources (material, capital and labour) to initiate livelihood activities. The experiences suggest that there is need to focus equally on technology development and the enabling factors (availability and access to markets, credit, labour), which allows women to adopt new interventions. Providing support either in the form of funding or stock animals are good tools in starting the livelihood programme for vulnerable women, as it facilitate more effective utilization of unpaid family labour, more stable households and increased self-reliance. A favourable policy environment in terms of access to and control of productive and natural resources such as land, livestock, micro-credit, veterinary services and assured markets will have to be provided and socio-economic and technical constraints needs to be addressed in order to strengthen women's influence and social empowerment.

ISSUES AND OPPORTUNITIES FOR WOMEN IN FISH PROCESSING

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Introduction

Agriculture is the main source of livelihood for over 80% of the rural poor in India. Fisheries sector contributes about 1.2% of the National GDP and to 5.3% of the agricultural GDP. It has great importance in terms of employment, income generation, poverty alleviation, export promotion and foreign exchange earnings. In world fisheries, women represent almost 50% of the total workforce. In India, of the 756,391 fisherfolk involved in fishing-related activities, 365,463 are women (approximately 48%). Since decades women have retained their domain of activity in fisheries, i.e., marketing of fresh fish, curing and processing. Nearly 81.8% of the fisherfolks engaged in marketing and 88.1% of the fisherfolk engaged in curing and processing are women. The involvement of fisherwomen in the fisheries related activities provides additional income to their family. But the income they are getting is not always the same as compared to the wages for men for the same work (Abha et al, 2014). Women in a fishing community are subject to responsibility of household management including food, childcare, education, health and financial management including getting and repaying the debts. The off season cues an additional burden of resource management. Women-headed households are on the increase as a result of economic recession, changing labour needs, increasing urbanization, and the break-up of extended family structures. While all these factors add to impasse of women, realization that active fishing alone cannot support the family due to highly fluctuating earnings owing to uncertainty in marine fisheries has necessitated mainstreaming women to adopt profitable enterprises.

Role of women fish processing and marketing

Since decades, women of fishing communities of India have been playing important roles in marketing of fresh fish, and processing surplus catch for sale at a later date in the form of cured fish. The women involved in marketing and fish processing activities could be classified as head loaders, petty fish traders and dry fish traders. The investment levels of head loaders are the lowest and hence their risk-bearing abilities are very low. Petty fish traders are women who deal with medium value species and have considerably higher investment capacities and are therefore considered credit worthy by non-institutional credit sources. They often move out of their villages to sell the produce, have access to the suburban markets and use the public transport systems. This group is able to survive only in areas where they have links with men in harbours or landing centres. Dry fish traders are primarily involved in fish salting and drying in a large scale. Fish for processing is procured during glut landings of a particular species and they usually employ family labor in curing of the fish. These women access weekly markets and are usually wholesalers. The study conducted by DRWA reveals that 90-95% of coastal fisherwomen of Orissa are active dry fish producers and vendors and they contribute around 20000/- to their family's annual income through dry fish trade. One of the major constraints the women fish vendors in India face is the fact that they are not allowed to travel in the buses as they are considered unclean. Secondly, there are no adequate bus services that link women to landing centers and markets at the right time. Consequently, women lose out on good quality fish, prices and consumers. Moreover, the modernization of the fisheries sector has resulted in concentration of fish landings in harbours and hence displacement of women from fish vending.

Women involved in post fish harvest activities are usually unable to invest in hired labor or labor-saving technologies because they lack access to resources like institutional credit or technological innovations like ice boxes and proper storage mechanisms. Low level of literacy, restricted mobility, limited access to training programmes and information, lack of organized women groups, social and cultural issues, no partnership in decision making and ignorance on modern processing techniques like hygienic curing, good practices in handling and preparation of diversified and value added fish products are some other factors that impedes their progress.

Studies on the nature of work and role of women in landing centres, the problems and competition they face, their involvement in organizations, and how things have changed over time, would help in understanding the adapting ability of women. It is necessary to understand the role women play in fish marketing, value chains and the drudgery involved in the process, problems they face in transport, in accessing market facilities, credit, etc. It would provide useful information for policy initiatives.

The displacement of women from fish vending have landed them as wage earners in fish processing plants in peeling and grading of prawns, processing of squid and scuttle fish, clams and mussels, filleting and packing of fish and related activities. Women form about 90% of the labour force in seafood processing industry but the wages paid to them is almost 30% less than that paid to men. It is usually migrant women between the age group of 18-25 who are preferred as laborers in these units. These women have to stay away from their homes for longer periods, which makes it more difficult for them to fulfill their domestic roles and they experience poorer working conditions. They are usually housed under very unhealthy conditions and made to work 12-15 hours. Their employment is seasonal and carries with it a large number of health hazards. Workers of pre processing plants usually does not wear personal protective devices like gloves, gumboots or respiratory masks as they are not provided with these devices by the plant owners (Nag and Nag 2007). Some of the health risks associated with working in fish processing plants, are safety risks (mechanical and electrical accidents), excessive noise levels, low temperatures, bacterial and parasitic infections and the presence of bioaerosols (which contain seafood allergens, microorganisms and toxins). These commonly result in fatal or non-fatal injuries and occupational diseases such as frostbite, noise induced hearing loss, skin infection and sepsis, allergic respiratory diseases, musculoskeletal cumulative trauma disorders, and stress related health problems. The poor ergonomic practices of long hours of standing or awkward floor sitting postures result in musculoskeletal pain and discomfort, with the greatest prevalence localized in the lower back, followed by knees, upper back, calf, shoulder, and other areas (Nag and Nag 2007). The workers are often inflicted with cut and stab wounds because of the use of cutting tools with poorly designed handle grips and finger guards and also due to loss of dexterity caused by the low temperature in the plants. Most fish factory employees are grossly deprived of health care services with no obligation from their employers. An in depth study on the working conditions of women in the sector, wages and gender-biasness in wages, the changing nature of employment, the impact of changes in technology and markets etc is needed in order to advocate welfare measures for women employed in this sector.

Opportunities for women in post harvest fisheries sector

It is important to provide alternate as well as additional livelihood options for the fisherwomen which will make a positive impact on their earnings and quality of life. Value addition of food also plays a major role in employment generation, entrepreneur ventures and boosting exports from a country. Value addition in fish could range from a simple display of hygienically dressed and iced fish which lures the customers to preparation of dry fish, mince based ready to cook or ready to eat products or byproducts like fish silage. Dry

curing of fish is an age old practice adopted by coastal fisherwomen of India. But in the coastal areas of India, the handling of fish is highly unhygienic let alone it's processing. Nowadays "hygiene" and "value addition" are two terms which are increasingly becoming popular with the rising urbanization and globalization which are deciding the market price and acceptability of the product.

Hygienic dry fish production is a viable enterprise that has been adopted by fisherwomen by following scientific hygienic processing procedures. Adoption of solar drying (using solar dryers/mechanical dryers) will result in faster and hygienic drying which will fetch a higher price for the produce in the market. Through the network project on "Capacity building of coastal fisherwomen through post harvest technologies in fisheries" the process of creating awareness through training and demonstration on hygienic production of dry fish among the women dry fish producers of the coastal districts of Odisha was initiated by ICAR-CIWA. With the help of National Fisheries Development Board (NFDB), Hyderabad, a community fish drying unit has been set up at Penthakota, Puri, Odisha as a common facility centre for the fisherwomen. An enterprise on production different coated fish products like fish cutlet, fish balls or mince based products like fish momos or fish samosa is also a viable livelihood option for fisherwomen. Fish/shrimp pickle has which has huge demand in the market can also be adopted as a livelihood option by rural women. For byproduct utilization, fisherwomen can utilize fish waste that remains after processing to be marketed as fish silage. Fish silage has high potential to be used as manure and poultry feed supplement. A low cost technology of organic manure production from fish waste has been disseminated among the fisherwomen who are willing to take it up as an enterprise option. ICAR-CIWA has developed a string of value added products from fish which are Prawn pickle, Fish cutlet, fish momos, prawn chutney powder, hygienic dry fish and organic manure from fish silage under the DSIR funded project on Adding value to fish: a potential livelihood option for rural women of Odisha. Through the project, about 203 rural women have been trained in the preparation of these products and they are equipped and facilitated with the entrepreneurial skills, credit and market linkage for successful establishment and sustainability of their enterprises.

AGRI-STARTUP: AN INNOVATIVE APPROACH FOR WOMEN EMPOWERMENT

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Introduction

“Farming is a profession of hope.” India holds the record for the second-largest agricultural land in the world, with around 60% rural Indian households making their living from agriculture. This not only speaks about millions of hopes associated with agriculture but also points out to the huge scope for agritech startups in the country to make those hopes of Indian farmers come true. Likewise, the central and state governments are proactively pursuing policies to improve farmers’ lives in India. In fact, PM Modi’s government has an aim to double the average farmer’s income by 2022. No wonder, agritech became the new buzz word in the Indian startup ecosystem in 2017 and a hot topic for discussion in most of the startup conferences and events in India.

The size of agriculture and allied activities in the country underwent a near 100% growth between FY14 and FY15. Agricultural exports increased from \$24.7 Bn in 2011-12 to \$32.08 Bn in 2015-16; a CAGR of more than 6.75%. But a drop in landholdings (average 1.4 hectares), small and fragmented land holdings, a decreasing agricultural land versus a growing population, decreasing groundwater levels, poor quality of seeds, and lack of mechanisation are some of the challenges for the growth of agriculture in India. And that’s not enough, an absence of an organised marketing structure for produce, malpractices in the existing unorganised agricultural markets, inadequate facilities for transportation and storage, scarcity of credit, and limited access to superior technology are some of the many afflictions which obstruct the Indian agricultural sector. Thus, a massive opportunity for agri-tech startups in India.

Opportunities lie in areas like how to increase crop production, improving the nutritional value of the crops, reduction in input prices for farmers, improving the overall process-driven supply chain, and reducing wastage in the distribution system, among others. Agri-tech startups are also leveraging technology in the area of market linkages such as retail, B2C and B2B marketplaces and digital agronomy startups. They are now able to address input challenges of agriculture in India from the very beginning.

The agri-tech startups are able to provide correct information, techniques, and efficiencies to farmers both for pre-harvest applications and post-harvest use cases. Accenture estimates the digital agriculture services market to hit \$4.55 Bn by 2020, thus pointing out to the ample scope of growth for agritech startups in the country.

Women empowerment

Women are the invisible whose contribution is immense but not visible because of their contribution is primarily seen as part of their household works which is not considered as a formal sector of work. In our country when technologies were introduced, men were the key recipients of it. This was because of the lack of recognition given to women’s contribution. 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 centers for other means to earn a living.

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 centers 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 is due to the fact that there is social and psychological conditioning in the society. It is definitely easier for them to further harness their multi-tasking skills at home and at the farm taken together.

Micro-credit in India has turned into a big movement to empower women. It has been adopted by various NGOs as well as the government and has served as a huge medium of women empowerment. Women acquire the biggest strength i.e. social capital by being part of a well-knit group which serves as a forum where they can be their own and also develop their management skills. Agri-startup can benefit women to empower and take it up as an enterprise as well as replenishing the needs of their families. However women need proper guidance and support to take up start-ups

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 technologies globally.

Most profitable agri-startup ideas for empowering women

- Agricultural farm mechanization
- Vermicompost and organic fertilizer production
- Dried flower business
- Fertilizer distribution business
- Organic farming and green house cultivation
- Poultry farming
- Mushroom farming business
- Hydroponic retail store
- Food product development

Startup India Mission

Startup India Mission was launched to build a robust eco-system for entrepreneurship and encourage enterprising individuals. The Startup India programme is about setting up a sustainable growth system. With Startup India programme, the Narendra Modi Government aims to empower startups to expand through innovation and design.

What is startup entrepreneurship?

A startup is a young company founded by one or more entrepreneurs in order to develop a unique product or service and bring it to market. By its nature, the typical startup tends to be a shoestring operation, with initial funding from the founders or their families

What classifies as a startup?

A startup is a company that is in the first stage of its operations. These companies are often initially bankrolled by their entrepreneurial founders as they attempt to capitalize on developing a product or service for which they believe there is a demand.

Is a startup a business?

A startup (or startup-up) is a company typically in the early stages of its development. These entrepreneurial ventures are typically started by 1-3 founders who focus on capitalizing upon a perceived market demand by developing a viable product, service, or platform.

What are the benefits of startup India?

- Financial benefits. Most of the startups are patent based
- Income tax benefits. Startups enjoy a good amount of benefits under the income tax head
- Registration benefits
- Government tenders
- Huge networking opportunities

Blueprint for launching your startup company

1. Make a business plan.
2. Secure appropriate funding.
3. Surround yourself with the right people.
4. Find a location and build a website.
5. Become a marketing expert.
6. Build a customer base.
7. Prepare for anything.
8. Conclusion.

Source of funding

The Investors prefer different stages of the company for funding as there is no set rule for this. They have their own specializations regarding company's growth cycle stage. These firms invest in majorly five stages depending upon their specialization i.e., Seed, Start-up, Early, Expansion and Mezzanine. Some other nomenclatures are also there in practice. However, they are a bit loosely defined. An analogy has been made to properly understand the same is given in Table 1. The expectations regarding manifold returns are generally higher if the investors invest in the initial stages of the company's growth as compared to their later counterparts on the basis of their increased stay within the company.

Table 1. Stages of funding for startups in India

S. No.	Nomenc- lature A	Nomenc lature - B	Activities performed	Amount of funding required in Mn (INR)
1.	Seed Stage	Angel Round	Prototype development, market research	<1
2.	Startup stage	Seed round	Introducing and positioning the product into the marketplace	1-5
3.	Early stage	Series A Round	Increasing sales, improving efficiency	5-20
4.	Expansion stage	Series B Round	Product or market diversification	>20
5.	Mezzanine stage	Series C,D...Round	Becoming ready for M& A or IPO-	

There are various funding agencies involved in this; Government, debt mechanism and private funding ventures. The details of these institutions are listed below:

Government grant-in-aid: Government supports agricultural startups with a variety of modes. One of them is the grant-in-aid support, which is being given to the startups based on their eligibility and selection. Technology Development Board's grant, BIRAC's BIG Grant, NIDHI-PRAYAS, MSME etc are few names in the list of funding agencies. The entrepreneurs either have to directly apply to these agencies or they have to apply through business incubators. The grant-in-aid is generally given for product and market development. But it is a tedious and cumbersome process that takes months to execute in many cases and the ticket size is also small.

Debt funding: Generally, it is thought that only banks provide debt funding, but, it is not true. Some government agencies and private investors are also providing debt assistance. Technology Development Board, InnoventCapital, Trifecta Capital etc are amongst the list of private and public-sector entities. The good news with debt capital is that the entrepreneur doesn't lose any control over the firm for raising the finances, although, raising the debt capital is a tough task.

Equity funding: When someone establishes a company, s/he creates equity stakes (shares) adjacent to the money invested in the company. Here the startups are being provided with funds by charging them a percentage of their equity stakes (percentage of shares). This is how the investor becomes the shareholder of the company and is eligible to have board seat, voting rights and dividends. Although the one who invests in equity doesn't have the ambition to stay with the firm for long. They invest in the company, stay there on the board for some time till when they get their desired RoI and then they move out of the company by selling the shares. The following entities fund the startups through this mode:

Government: A 'fund of funds' of INR 10,000 crores has been established by GoI for supporting tech driven startups and agriculture is one focus area for this. The fund is being managed by Small Industries Development Bank of India (SIDBI). SIDBI is investing this fund in SEBI registered Alternate Investment Funds

(AIFs) and they have given 605.7 crores to 17 AIFs (Jan, 2018). Apart from this, Technology Development Board also provides equity capital to agricultural startups.

Incubators: Business Incubators also provide funding to startups from their pool of funds and charge equity against it i.e., Villgro, CIIE Ahmedabad etc.

Angel Investors: These are individual investors who have an urge to invest in startups with their surplus money. Now they are also associated with some consortium of angel investors and collectively select as well as invest in startups. As they enter at the seed stage of the company, they bear the highest risk after the founder and hence they charge handsome amount of equity from the founder upto 30 per cent. They also bring expert mentoring to the startup along with funds.

Venture Capitalists (VC): Venture Capital funds are pool of funds collected from different entities and bodies i.e., PPF, Corporate Pension Funds, Insurance Companies, HNIs, Foundations, Fund of funds etc. These are being managed by General Partners. There are many VC firms who are providing funds in agriculture i.e., Omnivore, Aspada, Ankur Capital, Unitus Seed Fundsetc.

Private Equity: Private Equity may be termed as a more mature investment where unlike any other options given above, the investors invest in mature firms and buy major stakes and control of the company. They provide working capital for its diversification, expansion, new product development, new market development etc. India Value Fund is one such firm providing private equity in Agriculture.

Venture debt funding: It refers to debt funding being given to venture capital backed companies in their later stages of development. It is given to companies who have already captured a good market share, raised equity finance and are in expansion stage. Here, the companies have a decent repayment capacity and risk is also lower as compared to other stages. Many venture capital and private equity firms provide funding at this stage.

Agriculture has been a rewarding activity since ages and agribusiness is also following the same notion but it comes with its own set of challenges. Crop production and fortunes of farmer depends on weather gods to large extent. Besides this, the prototype development and validation of the offering also takes a hefty amount of time. The validation of the offering/product is necessary to comply with regulations. Unlike other areas i.e., IoT, FMCG, validation of products is on the basis of data collected from fields majorly. For this, trials need to be run on specific crops. It takes a lot of time and perseverance. Funding is a big challenge because of lack of collateral, unproven business idea and lower Return on Investment as compared to other tech sectors. Apart from this, the exit period for an investor is quite high as compared to other hot investment destinations.

Despite of all of these challenges, the investors are looking for disruptive technologies that blend traditional agricultural practices with smart solutions. They are interested in profitable ventures that witness convergence of disciplines i.e., Machine Learning (ML), Artificial Intelligence (AI), Internet-of-things (IoT) etc. They are keen on sectors that enable people to achieve highest efficiency. They believe that with better accessibility to technology, agriculture can be redefined in a better way which is being stared as the most problematic occupation signaling farmers' suicides, inefficient practices, food wastages etc. It creates a hope of revisiting the wealthy tradition of converging entrepreneurship with agriculture in a prosperous way.

How to register your startup with Startup India

Step 1: Incorporate your business

Step 2: Register with Startup India

Step 3: Documents to be uploaded (in PDF format only)

Step 4: Answer whether you would like to avail tax benefits

Step 5: Finally, you must self-certify that you satisfy the following conditions

A list of successful Indian agri-tech startups

Crofarm: Founded in May 2016 by Prashant Jain and Varun Khurana, Crofarm is an F2B (Farm to Business) venture. According to the website, it has over 10,000 farmers in its network and has partnered with Reliance Retail, Grofers, Big Basket, Jubilant Foodworks, Big Bazar and Metro Foods.

Aarav Unmanned Systems: An unmanned aerial vehicle startup incubated at IIT Kanpur with a team of designers, artists, developers, and engineers from IIT Kanpur, IIT Bombay, IISc Bangalore & IIST, Aarav Unmanned Systems aims to build the future of drones and their applications in the enterprise space.

Aibono: Founded by IIT Madras graduate Vivek as Airwood Aerostructures and rebranded as Aibono in January, the agritech company provides farm-related intelligence, technology, expertise and gadgets to farmers. Engaging in precision agriculture, the company helps small farmers gain from economies of scale by sharing resources and expertise. The agritech startup also advises farmers on the right amount of inputs to use for maximum yield.

CropIn: CropIn integrates the agricultural sector with Information and Communication Technology (ICT) by putting a network of ERP and BI (Business Intelligence) across rural India. By doing so, the agritech startup collaborates with the different value chain participants along the supply chain to monitor farm produce status closely. The agritech startup provides farm businesses a farm management software and mobile app, which enables them to do connected and data-driven farming.

Gold Farm: The origin of farm equipment aggregator Gold Farm can be traced back to Surya Power Magic, which was founded by Abhilash Thirupathy in December 2012 to educate farmers about solar water pumps. The Multilateral Investment Firm-backed company has assisted more than 750 irrigation pump owners in Karnataka harness solar power. As an aggregator, Gold Farm partners with local entrepreneurs, who can invest in tractors and other agricultural machinery. These types of equipment are, in turn, rented out at the village level on an hourly basis. The aggregator platform currently boasts a user base comprising of 25,000 farmers from three village districts in Karnataka and Andhra Pradesh. At present, it takes a 10% to 15% cut from each transaction.

Ninjacart: Due to marginal farming, poor logistics and zero market information, a number of middlemen get involved in sourcing the produce from farmers to markets. As a result, the farmer gets only one-fourth of what the consumer pays and also there is much wastage in the supply chain. It is this problem which Ninjacart addresses-cutting out the middlemen from the supply chain. In the last one year, it focussed on building a cost-efficient, reliable and scalable supply chain that can handle 300+ tonnes a day.

Waycool: WayCool aims to fix the disorganised perishable supply chain. It is an omnichannel fresh produce distribution company that distributes fruits and vegetables to multiple end-use segments spanning small local shops, modern retail outlets. The company has a retail presence currently in Chennai, through the SunnyBee brand, operating retail stores, mobile stores on trucks. In addition, there are a number of private label products that SunnyBee produces and brands through partnerships with sister companies.

EM3 Agri Services: Farm mechanisation services company EM3 Agri was established in 2014 by the father son-duo of Rohtash Mal and Adwitiya Mal. EM3 Agri provides pay-per-use farm services for every step of the cultivation process, including land development, land preparation, seeding, sowing, planting, crop care, harvesting and post-harvest field management.

Intello Labs: The Bengaluru based agritech startup offers a product DIGITAL AGRI which uses computer vision algorithms to see the minutest detail on every plant and harness human intelligence to grade agricultural commodities. Intello Labs aims to revolutionize agriculture by enabling farmers, traders, millers, retailers and end users in communication through images for product quality, infestation, plant health or even soil conditions.

FarmLink: Mumbai-based FarmLink is an agritech startup that functions as a supplier of value-added fresh produce. It currently specialises in end-to-end supply chain of fruits and vegetables. The company launched its commercial operations last year, and counts Star Bazaar and Vista Processed Foods as its clients.

Gramco Infratech Pvt Ltd: Indore-based Gramco primarily operates in the vicinity of villages and producing areas where it is involved in creating and leasing full service agri-infrastructure to the farmers. The infrastructure it provides spans across inputs, warehousing, collateral finance and contract farming/seed production, fully automated handling/cleaning/grading and procurement of agri-commodities by creating market links for farmers.

Tessol: Owned and operated by Thermal Energy Service Solutions Pvt. Ltd, Tessol was founded by Rajat Gupta, an alumnus of IIT Delhi and Harvard, in 2013. Rajat founded Tessol in 2013 with a vision of creating a farm to fork cold supply chain.

Conclusion

There is a great scope for empowering women through agri-startup. In India, women involve and supervise most of the agricultural operations. Women friendly agro-techniques reduce drudgery of women and encourage women to involve actively in decision making. Agri-startup is one of the approaches for empowering Indian women.

IMPACT OF CLIMATE CHANGE ON GENDER AND MITIGATION OPTIONS

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In recent years, climate change and its variability are emerging as major challenges to Indian agriculture. The 4th and 5th IPCC reports clearly outlined the global and regional impacts of projected climate change on agriculture, water resources, natural ecosystems and flood security. Although climate change impacts are being witnessed world over, the countries in which larger population is dependent on agriculture, such as India, are more vulnerable. The risks are likely to be experienced more by small and marginal farmers of rainfed and other risk prone regions with poor coping mechanisms. The climate change projections for Indo-Gangetic region indicated that during maximum temperature to increase in the range of 2.946 to 4.067 °C (2020 to 2080) over baseline (1976 - 2005) temperatures, while minimum temperatures are projected to increase in the range of 2.741 - 3.533°C (2020 to 2080) under RCP4.5 scenario.

Changes in temperature, rainfall and seasonality compromise agricultural production in many regions, including some of the least developed countries, thus jeopardising child and women health and growth and the overall health and functional capacity of adults. As warming proceeds, the severity (and perhaps frequency) of weather-related disasters will increase – and appears to have done so in a number of regions of the world over the past several decades. Therefore, in summary, global warming, together with resultant changes in food and water supplies, can indirectly cause increases in a range of adverse health outcome which includes malnutrition, diarrhea, injuries, cardiovascular and respiratory diseases and water borne and insect-transmitted diseases.

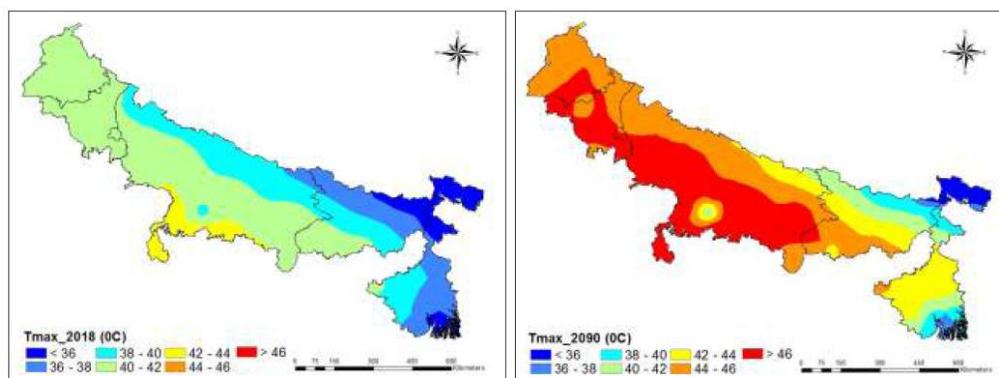


Fig. 1 Trend of maximum temperature change under RCP 4.5 scenario, 2018 (left), 2090 (right)

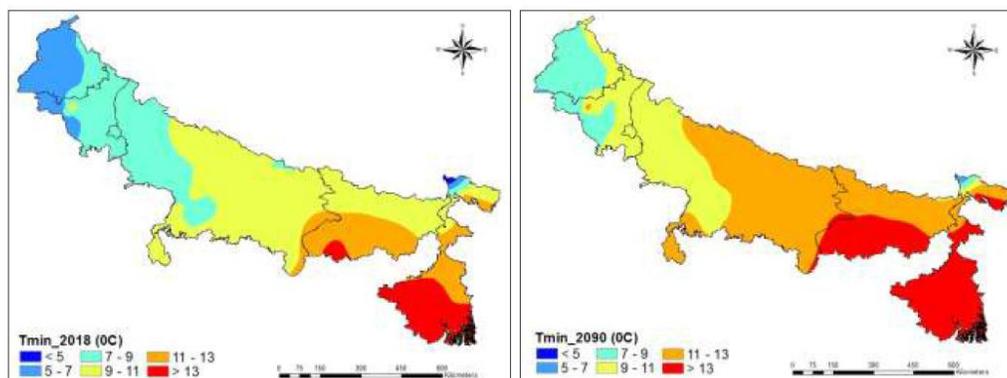


Fig. 2 Trend of minimum temperature change under RCP 4.5 scenario, 2018 (left), 2090 (right)

Climate change poses a wide range of risks to population health – risks that will increase in future decades, often to critical levels, if global climate change continues on its current trajectory.^[12] The three main categories of health risks include: (i) direct-acting effects (e.g. due to heat waves, amplified air pollution, and physical weather disasters), (ii) impacts mediated via climate-related changes in ecological systems and relationships (e.g. crop yields, mosquito ecology, marine productivity), and (iii) the more diffuse (indirect) consequences relating to impoverishment, displacement, resource conflicts (e.g. water), and post-disaster mental health problems.

A changing climate thus affects the prerequisites of population health: clean air and water, sufficient food, natural constraints on infectious disease agents, and the adequacy and security of shelter. A warmer and more variable climate leads to higher levels of some air pollutants. But due to temperature rise and more potential evapotranspiration, water footprints are incrsing, means more water is needed for sustain life. Water footprints of rice and wheat in India-Gangetic region due to climate change was estimated. At the end of the century, 8.5 to 14.3% water footprints of rice and wheat were projected to increase in different districts of Indo- Gangetic region.(Figs. 3 & 4).

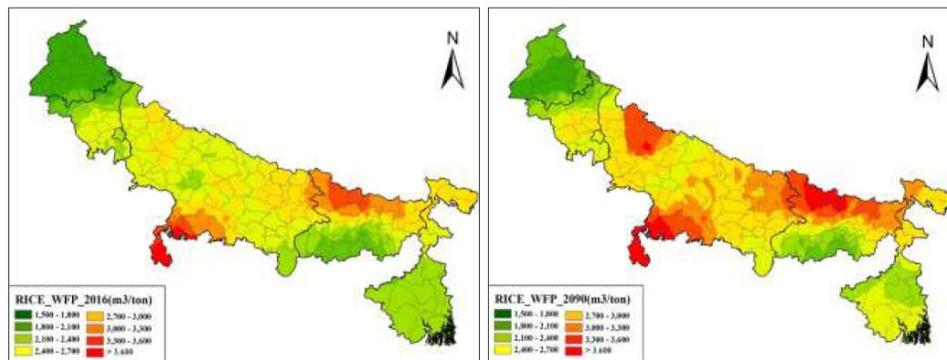


Fig. 3 Impact of climate change (RCP 4.5) on water footprints of rice in Indo-Gangetic region

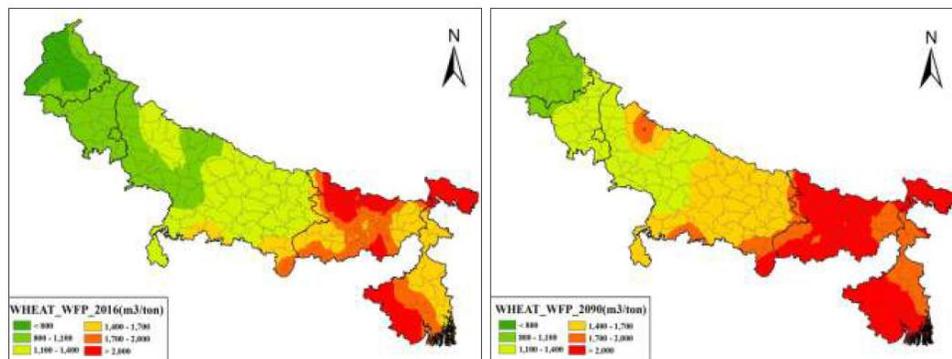


Fig. 4 Impact of climate change (RCP 4.5) on water footprints of wheat in Indo-Gangetic region

There is now strong evidence that the earth’s climate is changing rapidly, mainly due to human activities. Increasing temperatures, sea-level rises, changing patterns of precipitation, and more frequent and severe extreme events are expected to have largely adverse effects on key determinants of human health, including clean air and water, sufficient food and adequate shelter. The effects of climate on human society, and our ability to mitigate and adapt to them, are mediated by social factors, including gender. Globally, natural disasters such as droughts, floods and storms kill more women than men, and tend to kill women at a younger age. These effects also interact with the nature of the event and social status. The gender-gap effects on life

expectancy tend to be greater in more severe disasters, and in places where the socioeconomic status of women is particularly low. Other climate-sensitive health impacts, such as undernutrition and malaria, also show important gender differences.

Gender differences occur in health risks that are directly associated with meteorological hazards. These differences reflect a combined effect of physiological, behavioural and socially constructed influences. For example, the majority of European studies have shown that women are more at risk, in both relative and absolute terms, of dying in heatwaves. However, other studies have also shown that unmarried men tend to be at greater risk than unmarried women, and that social isolation, particularly of elderly men, may be a risk factor.

Differences are also found in vulnerability to the indirect and longer-term effects of climate-related hazards. For example, droughts in developing countries bring health hazards through reduced availability of water for drinking, cooking and hygiene, and through food insecurity. Women and girls (and their offspring) disproportionately suffer health consequences of nutritional deficiencies and the burdens associated with travelling further to collect water.

Women and men differ in their roles, behaviours and attitudes regarding actions that could help to mitigate climate change. Surveys show that in many countries men consume more energy than women, particularly for private transport, while women are often responsible for most of the household consumer decisions, including in relation to food, water and household energy. There is also evidence of gender differences in relation to the health and safety risks of new technologies to reduce greenhouse gas emissions. Such information could support more targeted, more effective efforts to bring about more healthy and environmentally friendly policies. These differences are also reflected in the health implications of potential greenhouse gas mitigation policies. For example, inefficient burning of biomass in unventilated homes releases high levels of black carbon, causing approximately 2 million deaths a year, mainly of women and children in the poorest communities in the world. The black carbon from such burning is also a significant contributor to local and regional warming. At the household level, women are sometimes critical decision-makers in terms of consumption patterns and therefore the main beneficiaries of access to cleaner energy sources.

Resources, attitudes and strategies to respond to weather-related hazards often differ between women and men. For example, studies in India have shown that women tend to have much lower access to critical information on weather alerts and cropping patterns, affecting their capacity to respond effectively to climate variability. The same study showed that when confronted with long-term weather shifts, men show a greater preference to migrate, while women show a greater preference for wage labour. Evidence from case studies suggests that incorporation of a gender analysis can increase the effectiveness of measures to protect people from climate variability and change. In particular, women make an important contribution to disaster reduction, usually informally through participating in disaster management and acting as agents of social change. Many disaster response programmes and some early warning initiatives now place particular emphasis on engaging women as key actors. There are important opportunities to adapt to climate change and to enhance health equity.

Approaches to adaptation have evolved from initial infrastructure-based interventions to a more development-oriented approach that aims to build broader resilience to climate hazards. This includes addressing the underlying causes of vulnerability, such as poverty, lack of empowerment, and weaknesses in health care, education, social safety nets and gender equity. These are also some of the most important social determinants of health and health equity.

Gender-sensitive assessments and gender-responsive interventions have the potential to enhance health and health equity and to provide more effective climate change mitigation and adaptation. Gender-sensitive research, including collection, analysis and reporting of sex-disaggregated data, is needed to better understand the health implications of climate change and climate policies.

Heatwaves and increased hot weather

Warming and increased humidity contributed in some health risks, and these can be anticipated to continue in the future. There is evidence that vulnerability varies by sex: more women than men died during the 1998 Odisha heatwave, and the majority studies have shown that women are more at risk, in both relative and absolute terms, of dying in such events). There may be some physiological reasons for an increased risk among elderly women. Social factors can also be important in determining the risk of negative impacts of heatwaves.

Rising temperatures may increase the transmission of malaria in some locations. Pregnant women are particularly vulnerable to malaria as they are twice as “appealing” as non-pregnant women to malaria-carrying mosquitoes. During pregnancy, blood flow to the skin increases, which helps heat dissipation, particularly in the hands and feet. The study also found that the abdomen of pregnant women was on average 0.7 °C hotter than that of non-pregnant women.

Windstorms and tropical cyclones

In the 1999 Odisha super cyclone which killed about 10,000 people in the region, about 70% of victims were children and women. This is because of the fact that more women than men are homebound, looking after children and valuables. Even if a warning is issued, many women die while waiting for their relatives to return home to accompany them to a safe place. Other reasons include the dresses like ‘sari’ restricts the movement of women and puts them more at risk at the time of a tidal surge, and that women are less well nourished and hence physically less able than men to deal with these situations.

Sea-level rises, heavy rain

Heavy rain and flooding are also contributing to sea-level rises, and precipitation is becoming heavier and more variable in many regions, potentially increasing flood risks and multiple associated health hazards. It is important to recognize that vulnerability to flooding is differentiated by social dimensions. In both developing and industrialized nations, health and other impacts may fall disproportionately on women, children, people with disabilities and elderly people. Due to saline contamination of drinking water in coastal regions, large numbers of pregnant women may suffer eclampsia and hypertension etc.

Drought

Globally, fresh water resources are distributed unevenly, and areas of most severe physical water scarcity are those with the highest population densities. The health impacts of drought and their gender dimensions may be exacerbated further by climate change. Shifting rainfall patterns, increased rates of evaporation and melting of glaciers, and population and economic growth are expected to increase the number of people living in water-stressed water basins. Extended periods of drought are linked not only to water shortages and food insecurity but also to increased risk of fires, decreased availability of fuel, conflicts, migration, limited access to health care and increased poverty. In times of water scarcity women have little choice but to carry water home from unsafe sources, including streams and ponds that are likely to be contaminated. This can lead to water-related diseases such as diarrhoeal disease, which in developing countries is a leading cause of death among children under 5 years of age (WHO, 2005). Moreover, when water is scarce, hygienic practices are commonly sacrificed to more pressing needs for water, such as drinking and cooking. The lack of hygiene

can be followed by diseases such as trachoma and scabies, also referred to as “water-washed diseases. Many women of developing countries are already victims of diseases associated with poor water and sanitation facilities.

Indirect consequences of droughts are social instability, food insecurity and long-term health problems and can damage or destroy related livelihoods. In most developing countries, women are intrinsically tied to water. They are responsible for collecting, storing, protecting and distributing water. For women, long journeys walking to the nearest wells and carrying heavy pots of water not only causes exhaustion and damage to bones but also is accompanied by opportunity costs, such as time that could be spent productively going to school or working. Women collect water from sources that are increasingly further away as each drought takes its toll. With fewer water sources nearby, women often walk long distances to fetch drinking water. Women also cook, clean, rear children and collect firewood, so they cope with enormous physical burdens on a daily basis.

Several factors are responsible for women-centric vulnerability due to climate change:

1. Limited access to resources. In many poor communities, women have limited access to crucial resources such as land, livestock, tools, and credit. Access to land and security of tenure is often highlighted as an important cause of women’s vulnerability (Agarwal, 2003; Jacobs, 2002; and Davison, 1988). Women’s access to land is gained either through the state, family (typically in Africa) or the market (typically in Asia). Often, women may have access to resources, such as land, but have limited control over it, as they do not own it and therefore cannot make decisions regarding its use. This is particularly ironic, given the central role of women in agriculture.

2. Dependence on natural resources and sexual division of labour.

As the primary users and managers of natural resources (being typically responsible for fetching water and wood and bringing it to the house, for example), women depend on the resources most at risk from climate change. Projected climate changes such as increases in temperature and reductions in precipitation will change the availability of natural resources such as forests and fisheries and potentially affect the growth of staple crops.

3. Lack of education and access to information. In the developing world in particular, priority is still placed on boys’ education rather than girls’, and girls are thus likely to be the first ones pulled out of school when resources are short. As a result, girls typically receive fewer years of education than boys. Without education, women are at a disadvantage, as they have less access to crucial information and fewer means to interpret that information. This can affect their ability to understand and to act on information concerning climate risks and adaptation measures.

4. Limited mobility. Women are often restricted from leaving their communities, even though migration is a coping mechanism often used by men. This is due to the fact that gender roles dictate that they remain at home and carry out reproductive tasks and to the fact that, having less education, they are less likely than men to find employment. Remaining at home can leave them vulnerable in two ways: first, they stay where climate change has hit hard, and second, they miss out on the economic opportunities and enrichment of personal experience that migration affords

5. Limited roles in decision-making. Women’s voices are often muted in family and community decisionmaking (Quisumbing, 2003). This is particularly unfortunate, given women’s close relationship with natural resources and awareness of conservation and potential adaptation measures.

Community based adaptation

Climate change is not happening in isolation, but is coinciding with many other trends and stresses on livelihoods, including economic liberalization, globalization, population growth, geopolitical conflict, and unpredictable government policies. As stated above, women are vulnerable not because of natural weakness (i.e., because of their sex), but rather because of the socially and culturally constructed roles ascribed to them as women (i.e., because of their gender). Given the severity of gender inequality, particularly in the developing world, climate change is likely only to magnify. Gender inequality can be reduced by increasing the education level of the women and by sensitizing them about the possible consequences of climate change.

Use of cotton cloth cover during dry summer and hot period, frequent drinking of clean water, restriction of movements upto 11.00 AM and after 4.00 PM during heatwave are some of the coping mechanisms for women due to climate change.

References:

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GENDER SENSITIVE INDICATORS FOR SUSTAINABLE AGRICULTURE

Ananta Sarkar, Lipi Das and Gayatri Moharana

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Sustainable agriculture rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet future needs. Long-term conservation of natural, livestock and human resources is of equal importance to short-term economic gain from agriculture. Taking care of human resources includes consideration of social responsibilities such as working and living conditions of laborers, the needs of rural communities, and consumer health and safety both in the present and the future. Conserving land, livestock and natural resources involves maintaining or enhancing the quality of these resources and using them in ways that allow them to be regenerated for the future. Farmers may try to reach these goals by capitalizing existing natural processes, or by designing biologically-integrated agro-ecosystems that rely more on the internal cycling of nutrients and energy, it is often possible to maintain an economically viable production system with diverse and adaptive knowledge base and much fewer potentially toxic interventions.

Sustainability in agriculture is a complex concept and there is no common viewpoint among researchers about its dimensions. Various parameters for measuring agricultural sustainability have been used by different researchers. A good compilation considering three components of sustainability (social, economic and ecological) can be found in Hayati et. al. (2010).

Twenty international, regional and country level gender and related indicators/ indices available in public domain were collected and compiled. The list of the indicators/ indices are as follows:

List of indicators/ indices related to gender/ women:

1. African Gender and Development Index
2. African Women's Progress Scoreboard
3. African Gender Scorecard
4. Gender Development Index
5. Gender Empowerment Measure
6. Gender Equality Index
7. Gender Equity Index
8. Gender Inequality Index
9. Gender Parity Index
10. Gender Status Index
11. Gender Work Participation Index
12. Global Food Security Index
13. Global Gender Gap Index
14. Human Development Index
15. Livelihood Assets
16. Quality-of-Life Index
17. Social Institutions and Gender Index

18. Women's Economic Opportunity Index
19. Women's Empowerment in Agriculture Index
20. Women Empowerment Index

The indicators/ indices were further tabulated by name, developing agencies, purpose of the indicators and components, sub-components and variables with conceptual framework used in developing the indices and are available at <http://icar-ciwa.org.in/gks/index.php/information-and-statistics-section/119-gender-related-indicators>. Among all these indicators few indicators are directly related to agriculture. Very less attempt was made in this direction specially for sustainable agriculture. In this present chapter an attempt is made to provide direction so that researchers working in the field of agriculture may make use of the following indicators in their study and finally may come out with a proper measure of gender sensitive indicator for sustainable agriculture. Some important gender sensitive indicators developed in the field of agriculture are as follows:

Gender Sensitive Indicators in Agriculture

Indicators	Measurement	Dimensions	Range /Score	Interpretation
Access to and control over resources	Access to Resource Index (ARI) Availability, Affordability, Suitability, Capability	Human, Physical, Natural, Social, Financial resources	0-1	1 indicates highest level of access
	Empowerment of Crop Production Index (ECPI)	Access, Decision Making, Participation, Capability	0-1	1 indicates highest level of empowerment
	Women Empowerment in Agriculture Index (WEAI)	Production, Resources, Income, Leadership, Time	0-1	1 indicates highest level of empowerment
	Women Empowerment Index (WEI)	Mobility, Economic activities, Decision making	0-1	1 indicates highest level of empowerment
Women friendly technologies (drudgery reduction)	Checklist for assessing women friendliness of agricultural technologies (Women Friendliness Value)	14 statements	0-1	1 indicates highest level of women friendliness
Mitigating occupational health hazards	Occupational Health Hazard Index (OHHI)	Household, Farm, Animal rearing	0-1	1 indicates higher level of hazards
Nutritional status	BMI Score	Height, Weight	<ul style="list-style-type: none"> ▪ 20-25 ▪ 18.8-20.0 	<ul style="list-style-type: none"> ▪ Normal ▪ Low weight

Indicators	Measurement	Dimensions	Range /Score	Interpretation
			▪ <18.5	▪ Chronic Energy Deficiency

References:

<http://www.icar-ciwa.org.in/gks>

<https://www.nature.com/scitable/knowledge/library/sustainable-agriculture-23562787/>

Dariush Hayati, Zahra Ranjbar, and Ezatollah Karami. 2010. Measuring Agricultural Sustainability. E. Lichtfouse (ed.), Biodiversity, Biofuels, Agroforestry and Conservation Agriculture, Sustainable Agriculture Reviews 5, DOI 10.1007/978-90-481-9513-8_2



भा.कृ.अनु.प. - केन्द्रीय कृषरत महिला संस्थान, भुवनेश्वर
ICAR - Central Institute for Women in Agriculture, Bhubaneswar



**ICAR sponsored Short Course on
“Gender Gaps and Interventions to Address Gender Issues in Agriculture”**

Course Director: Dr. Lipi Das

**Course Co-ordinators: Dr. Ananta Sarkar
Ms. Gayatri Moharana**

Venue: Conference Hall, ICAR-CIWA

Duration: 17-26 September, 2019

Day-to-Day Schedule

Date & Time	Topic	Mode	Resource Person/ Facilitator
Day-1, Tuesday (17.09.2019)			
10:00-10:30	Registration of Participants	---	Ms. Nagma Saik Ms. Shriyadarshini Mahapatra
	Ice-breaking	Interaction	Dr. Lipi Das Dr. Ananta Sarkar Ms. Gayatri Moharana
10:30-11:30	Group formation and discussion for developing concepts on women in agriculture by the participants	Interaction	Course Coordinators
Tea Break (11:30-11:45)			
11:45-13:30	Gender Concepts, Gaps and Sensitization of Stakeholders	Lecture-cum-interaction	Dr. Charles Jeeva, Principal Scientist, ICAR-CIWA
Lunch Break (13:30-15:00)			
15:00-17:00	Opening Function (Welcome, Participants-Resource Persons Interaction: Analysis of Expectations; and Sharing of Experiences by Participants)		
15:00-15:05	ICAR Song		Sh. Subrat Kumar Das
15:05-15:15	Welcome Address		Dr. Ananta Sarkar Course Co-ordinator
15:15-15:25	Orientation to the Short Course		Dr. Lipi Das Course Director
15:25-15:45	Introduction of Participants		Participants
15:45-16:00	Address by Director		Dr. S.K. Srivastava, Director, ICAR-CIWA,
16:00-16:30	Address by Chief Guest		Dr. Himanshu Pathak Director, ICAR-NRRI, Cuttack

16:30-16:40	Vote of Thanks		Ms. Gayatri Moharana Course Co-ordinator
16:40-17:00	Group Photography		Participants and Training Team
Day-2, Wednesday (18.09.2019)			
10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Coordinators
10:30-12:00	Integrating Gender Dimension into Agriculture Research and Development Projects	Lecture-cum- interaction	Dr. B.N. Sadangi, Emeritus Scientist, ICAR-CIWA
Tea Break (12:00-12:15)			
12:15-13:45	Gender Disaggregated Data: Importance in Planning and Policy making	Lecture-cum- interaction	Dr. Ananta Sarkar, Senior Scientist, ICAR-CIWA
Lunch Break (13:45-14:30)			
14:30-16:00	Gender Analysis Tools for Developing Sustainable Gender Inclusive Growth	Lecture-cum- practicals	Dr. B.N. Sadangi, Emeritus Scientist, ICAR-CIWA
16:00-17:30	Enhancing Farm Women's Access to Agri-inputs through Innovative Approaches	Lecture- cum- Interaction	Dr. L.P. Sahoo, Senior Scientist, ICAR-CIWA
Day-3, Thursday (19.09.2019)			
10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Coordinators
10:30-12:00	The Role of Microfinance Institutions in Empowering Women Economically	Lecture-cum- interaction	Dr P. Nanda, Principal Scientist, ICAR-IIWM
Tea Break (12:00-12:15)			
12:15-13:45	Bio-fortification of crops for nutritional improvement among farm women	Lecture-cum- interaction	Dr. D. N. Sarangi Tech. Officer, ICAR-CIWA
Lunch Break (13:45-14:30)			
14:30-16:00	Participatory Monitoring, Evaluation and Impact Assessment: Tools for Agriculture Research and Extension	Lecture-cum- interaction	Dr. Charles Jeeva, Principal Scientist, ICAR-CIWA
16:00-17:30	Field visit to CIWA experimental plots	Field Visit	Mr. M.R. Prusty Tech. Officer, ICAR-CIWA
Day-4, Friday (20.09.2019)			

10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Coordinators
10:30-12:00	ICT and innovative schemes for women empowerment and entrepreneurship	Lecture-cum-Interaction	Dr. Debabrata Sethi Scientist, ICAR-IIWM
Tea Break (12:00-12:15)			
12:15-13:45	Identification of Drudgery for Farm Women and their Suitable Measures	Lecture-cum-Interaction	Ms. Gayatri Moharana, Scientist, ICAR-CIWA
Lunch Break (13:45-14:30)			
14:30-16:00	Impact of Climate Change on gender and mitigation options	Lecture-cum-Interaction	Dr. G. Kar Principal Scientist, ICAR-IIWM
16:00-17:30	Discussion with participants relating to preparation of conceptual note	Interaction	Coordinators
Day-5, Saturday (21.09.2019)			
10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Co-coordinators
10:30-12:00	Eco-Friendly Plant Protection Practices and organic farming with women perspective	Lecture-cum-Interaction	Dr S. K Srivastava, Director, ICAR-CIWA
Tea Break (12:00-12:15)			
12:15-13:45	Strengthening Livelihood Security of Women Farmers through Horticultural Interventions	Lecture-cum-Interaction	Mrs. Ankita Sahu, Scientist, ICAR-CIWA
Lunch Break (13:45-14:30)			
14:30-16:00	Extension approaches for engendering agricultural research and extension	Lecture-cum-interaction	Dr. Sabita Mishra, Principal Scientist, ICAR-CIWA
16:00-17:30	Gender Sensitive Indicators for Sustainable Agriculture	Lecture-cum-Interaction	Dr. Ananta Sarkar/ Dr. Lipi Das, ICAR-CIWA
Day-6, Sunday (22.09.2019)			

10:00-17:00	Field Visit to adopted villages of CIWA for Interaction with the Progressive Farm Women	Field Visit	Ms. Gayatri Moharana Sh. S.K. Das Sh. A.C. Hemrom Sh. B.C. Sahu
Day-7, Monday (23.09.2019)			
10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Co-coordinators
10:30-12:00	Promoting gender equity through development of women farmers groups on Agriculture Value Chain	Lecture-cum-Interaction	Dr. Lipi Das, Principal Scientist, ICAR-CIWA
Tea Break (12:00-12:15)			
12:15-13:45	Agri-Startup: An innovative approach for women empowerment	Lecture-cum-Interaction	Dr. M. Nedunchezhiyan , Principal Scientist & Head (I/c), ICAR-CTCRI (RS)
Lunch Break (13:45-14:30)			
14:30-17:00	Perceived Constraints of Farm Women and Promotion of Women Friendly Farm Tools and visit to Ergonomics Lab	Lecture-cum-Interaction	Er. Chaitrali S. Mhatre, Scientist ICAR-CIWA
Day-8, Tuesday (24.09.2019)			
10:00-17:00	Visit to Local ICAR Institutes at Cuttack and Bhubaneswar	Visit	Coordinators
Day-9, Wednesday (25.09.2019)			
10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Co-coordinators
10:30-12:00	Livelihood Security and Economic Empowerment of Women Farmers through Dairy Farming	Lecture-cum-Interaction	Dr B. Sahoo, Principal Scientist, ICAR-CIWA
Tea Break (12:00-12:15)			
12:15-13:45	Rural Poultry Production for Poverty Alleviation and Gender Equity in India	Lecture-cum-Interaction	Dr. A.K. Panda, Principal Scientist ICAR-CIWA
Lunch Break (13:45-14:30)			
14:30-16:00	Enhancing Livelihood of Women through Improved Livestock Production	Lecture-cum-Interaction	Dr. Anil Kumar, Principal Scientist ICAR-CIWA

16:00-17:30	Issues and Opportunities for Women in Fish Processing Centre	Lecture-cum-Interaction	Dr. Tanuja S, Scientist ICAR-CIWA
Day-10, Thursday (26.09.2019)			
10:00-10:30	Recapitulation of the previous day's inputs	Interaction	Co-coordinators
10:30-13:30	Group Presentations	Presentation -cum- Interaction	Participants
Lunch Break (13:30-14:30)			
14:30-15:15	Group Presentations		Participants
15:15-15:45	Post-Training Evaluation		Participants
15:45-17:00	Valedictory Session		Coordinators



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