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(16-20 March, 2015)

CAPACITY BUILDING OF FARMING WOMEN

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Sponsored by

State Institute for Management in Agriculture (SIMA)
Lucknow, Uttar Pradesh



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ICAR- Central Institute for Women in Agriculture
(Indian Council of Agricultural Research)
Bhubaneswar-751 003, Odisha

CAPACITY BUILDING OF FARMING WOMEN

(Compendium: National Training Programme organized in collaboration with State Institute for Management in Agriculture (SIMA), Lucknow, Uttar Pradesh at ICAR-CIWA, Bhubaneswar from 16th to 20th March, 2015)

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PREFACE

Efforts for gender mainstreaming are required to bring social, cultural and attitudinal changes which not only strive for ending the invisibility of women's contribution to agriculture, but of eliminating the drudgery that blights the lives of millions of working women in India. It is important to recognize that women's empowerment through technologies can raise their status only through a meaningful stimulation. There is therefore, needed to have the participation of women at every level in decision making, program formulation and implementation. There is a need to tailor technologies to meet the needs of women agricultural workers- and to make them cheap enough for women to access. It should be ensured that technologies are accessible, income generating, poverty reducing, women friendly and drudgery eliminating, both for pre and post- harvest operations. The technologies that are reducing drudgery of women must be publicized through the media and as an extension activity. These need to introduce them into the capacity building programs for reducing drudgery and increasing output of women workers.

In this context, a National Training Programme on 'Capacity Building of Farming Women' was organized in collaboration with State Institute for Management in Agriculture (SIMA), Lucknow, Uttar Pradesh at ICAR-CIWA, Bhubaneswar from 16th to 20th March, 2015, for extension officials of SIMA, NGOs and progressive farm women from Uttar Pradesh to strengthen the gender perspective in agricultural development.

We are highly indebted to Dr. S.K. Srivastava, Director (Acting), ICAR-CIWA for necessary guidance and support in organizing the programme and for bringing out this compendium. Further, we express our sincere gratitude to SIMA, Uttar Pradesh for sponsoring this programme. Thanks are also due to all the in-house and external resource persons, technical and the administrative staff of ICAR-CIWA, without whose cooperation, this programme would not have been a success.

Coordinators

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CIWA AND GENDER RESEARCH

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In the agricultural sector, women participate in a number of agro-production systems that govern the nature and extent of their involvement. There is a significant heterogeneity across regions, states, locations and context in the role of rural women and their participation in agricultural and other economic activities. Most significant agricultural activities undertaken by women include farming, post harvest management, horticultural crop production, livestock management, fisheries and homestead resources. In paddy, women are mainly involved in transplanting, weeding, harvesting, drying harvest, winnowing and seed storage. As far as total workload is concerned, women spend 40.2 percent of their time per season, performing transplanting (39.1 hours), harvesting (29.8 hours) and weeding (19.0 hours) as the major activities (AICRP Report). In sugarcane based cropping system, women participate in activities like manure and fertilizer application at first step, preparation of sugarcane sets for sowing, placing these sets into the ridges, irrigation, weeding, harvesting, tying the bundles, carrying sugarcane bundles and loading it in to the vehicle. Again these are not women dominant or exclusive activities and are performed jointly with males. The data on role profile indicates that joint participation of rural women with men was higher than independent participation of women in all activity areas.

Globally, farmwomen suffer from poor access to various kinds of productive resources and services, most importantly access to inputs, extension and market services, which is an important cause of their low productivity. According to a FAO (2011) study, had they enjoyed the same access to productive resources as men, women could boost yield by 20-30 percent; raising the overall agricultural output in developing countries by two and a half to four per cent. This gain in production could lessen the number of hungry people in the world by 12-17 percent, besides increasing women's income.

The results of gender researches reveal that despite the important role women play in agricultural production, they remain disadvantaged in numerous respects. On one hand, women have limited access to a wide range of agricultural inputs including seeds and fertilizers, technological resources, equipments, land and so forth. In addition, women often lack the capacity needed to deploy these resources. For example, women

may have access to land but lack the capacity needed to deploy these resources. For example, women may have access to land but lack of access to the fertilizer needed to farm the land productively or lack of knowledge of how to properly apply fertilizer. Illiteracy, neo-literacy and lack of scientific knowledge are the major impediments in their growth. Furthermore, many non-tangible assets, such as social capital, human capital, rights and decision-making power, are more difficult for women to access.

Genesis of DRWA

Recognizing the significant role played by women in agriculture on one hand, and lack of proper appreciation of their contribution on the other, the Working Group on Agricultural Research and Education constituted by the Planning Commission for the formulation of the Eighth Five Year Plan (1992-97) in its report recommended establishment of a National Research Centre for Women in Agriculture (NRCWA) during the Eighth Five Year Plan to undertake research relevant to the needs of farm women and identify, test and develop women specific technologies related to crop production, animal husbandry, horticulture, sericulture, fisheries, home management etc. The Group observed that the research information and the technologies developed in the ICAR Institutes and State Agricultural Universities rarely incorporated the farm women perspectives and, therefore, there was a gap in the technology available at the research stations and the technologies suitable for farmwomen. Moreover, women's needs are different from that of their male counterpart, but the fact is persistently overlooked; women are very important for growth and sustainability of agriculture, but largely ignored; programmes and policies were mainly designed for sectoral goals and targeted at farmers, but lacked gender perspective. Therefore women should have a role both in technology development and dissemination. The Farming Systems Research and On-Farm Research Programmes should take into consideration the needs of farm women for their income and livelihood security and also their contributions in family-based agricultural production.

Accordingly, the National Research Centre for Women in Agriculture (NRCWA) was established in 1996 at Bhubaneswar, Odisha. Now called the Directorate of Research on Women in Agriculture, this institution marked the beginning of systematic research efforts on women in agriculture. This unique institution is expected to catalyze and facilitate agricultural R & D institutions to integrate gender perspective in their programmes, develop women friendly technologies and policies to make women better and effective partners in the process of agricultural growth.

Accordingly the mandate of DRWA is to carry out basic, strategic and applied research to identify gender issues and test appropriateness of farm-technologies/ programmes/ policies with women's perspective and capacity building of stakeholders.

Gender research -why?

Today gender research has become an important part of the research paradigm, particularly in the context of agricultural research. . It is now realized that sustainable growth of agriculture in the face of emerging challenges is not possible without addressing gender issues and empowerment of women. Therefore it is imperative to integrate gender perspective in agricultural research. Gender research has three objectives- identifying gender issues, understanding gender issues and addressing gender issues. Depending on the type of gender issues, interventions to address gender issues could be technological, socio-economic, policy related and institutional. DRWA as a premier gender research institution has been working in these broad areas to develop gender based solutions to issues that are affective women in agriculture.

Thrust areas of research

Since its inception, DRWA has been undertaking research on issues concerning women in agriculture. It has identified some thrust areas of research and focused on participatory action research in different technology based thematic areas to test suitability of homestead and farm technologies for women and make them women friendly.

I. Technology assessment and development

Considering the urgency of incorporating women's needs in technology development process and make agricultural technologies gender sensitive, DRWA has been undertaking research in crop, horticulture, livestock, fisheries etc. Several women friendly crop and horticulture technologies have been tested and refined to develop cropping models such as mango and guava based models and intercrops to meet needs of women and their family. Storage methods and techniques using ITK have also been standardized for safe storage of cereals, pulses and other commodities by women. The Directorate has undertaken research on participatory mode involving women in aquaculture on developed institutional innovations to augment availability of quality fish seeds at village level. It also successfully demonstrated scientific management of backyard ponds and large areas of derelict water bodies involving women. Other activities include empowering women in backyard poultry rearing and using unconventional feed sources such as azolla and Chaya plant leaves for preparation of poultry feed

II. Occupational health risk and drudgery

Important researchable issues include ergonomic evaluation of activities performed by women, design of women friendly tools, health risks in occupation and creating stress free work environment for women. DRWA has so far evaluated and refined more than 20 farm tools to reduce drudgery of farm women. Some of these are_ hand ridger,

fertilizer broadcaster, seed drill, cono weeder, twin wheel hoe and dibbler. A women friendly maize dehusker-cum-sheller has also been developed that can reduce drudgery and increase efficiency of women in dehusking and shelling of maize.

III. Food and nutrition security

Considering the growing concern of malnutrition in India on one hand and the significant role of women in food and nutrition security on the other, DRWA has been undertaking R&D activities relating to nutrition. Some of the areas that DRWA is focusing are weaning food, developing need based nutrition gardens, impact of nutrition programmes, changing livelihood profile etc.

IV. Socio-economic and gender based methodologies

Assessment of women's participation in different farming systems and agricultural activities like rice farming, horticulture, fisheries and livestock and identification of gender issues are some of the aspects of research that are being focused. Dynamics of gender work participation, access to resources and technology and linkage with technological and structural changes in agriculture are also being studied.

Under gender based methodologies, main activities are gender sensitization, development of indices and models for gender based decision making and gender mainstreaming. DRWA has developed a Village Level Para-Extension Workers (VPEWs) model to bridge the gender gap in access to extension services and strengthen the linkage between farmers/farm women and development officials by facilitating two-way flow of information. The Directorate has developed methodologies for integrating gender in agricultural research.

Lack of gender disaggregated data related to many of the activities of women in agriculture and related sectors is a severe constraint in understanding gender issues and formulating gender sensitive interventions. Therefore generating evidences on women's role, successful interventions, gender based knowledge and their sharing with wider audience are critical for strengthening our efforts for women empowerment. A portal called 'Gender Knowledge Centre' has been created with information and statistics for dissemination among stakeholders.

DRWA-Future Role

DRWA envisages growing as global level institution to facilitate gender mainstreaming and women empowerment in agriculture.

- A Centre of Excellence in gender research to develop core competency in several emerging areas related to gender
- A Think Tank for gender based policy making to make agricultural and development policies and programmes gender sensitive and equitable.
- A Resource Agency for empowerment of women in agriculture to support women SHGs, govt. departments and NGOs with new ideas, models and innovations for empowerment of women in agriculture.
- A Global Hub for human resource development in the areas such as gender sensitization, gender analysis in agriculture, gender planning in agricultural research and extension, gender monitoring & evaluation and methodologies for gender studies

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GENDER SENSITIZATION: ROLE IN REFORMING THE SOCIETY

Dr. H. K. Dash

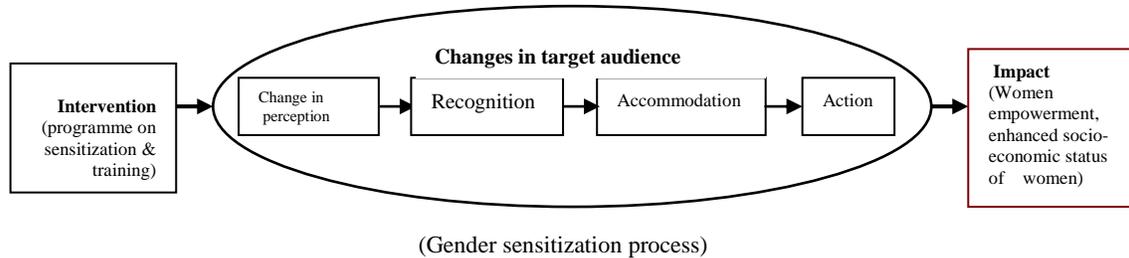
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Sensitization is the most effective way to change the behaviour of people. It is by-far a non-confrontationist approach of reforming the society. Gender sensitization is the process of changing the stereotype mindset of men and women, a mindset that strongly holds that men and women are 'unequal entities'; they have different roles to play and needs to fulfill, and they are to function within different socio-economic space, both inside the households and outside. Gender sensitization increases the sensitivity of people at large towards women and their problems. In the process it creates a class of responsive functionaries at different level, from policy making to grass root level, who are convinced that any form of gender biasness is an obstacle on the way of attaining an equitable social and economic order, and therefore consider addressing gender issues in their own situation as a matter of priority.

The concept of 'gender' itself connotes the differential position and importance of men and women in society. Therefore gender sensitization should seek to change not only the impression of men towards women i.e. the way men think of and treat women, but also the attitude of women i.e. the way women think of men and of themselves and their behaviour in this context. Its goal is essentially to create a value system in society that accords explicit and spontaneous recognition to the contribution of women in socio-economic development, and respects their wisdom; a value system that makes women more sensible, encourages them to recognize their own contribution, and make them feel proud of.

Gender sensitization process

Gender sensitization programmes are generally organized for group of people. But the very aim of such programmes is to bring a definite orientation in the feelings, practices and approach of individuals concerning gender. Insights from monitoring of gender sensitization programmes conducted under different gender related projects in rural areas firmly suggests that the gender sensitization process that individuals, particularly the men, undergo involves four stages; namely, change in perception, recognition, accommodation and action.



These changes take place in response to certain interventions i.e. sensitization courses or trainings that are, very often, required to be repeated.

Change in perception

Gender sensitization initiates us to start looking the things differently. Gender sensitization, in first instance, tends to change the perception that men and women have of each other. It creates a mindset in men that no longer sees in women the stereotypical image. The impression that women are a 'weak and unequal entity' no more clouds the minds of common men. Rather, they are seen as responsible and equal partners in socio-economic development. At this stage men realize the ill-effects of biasness against women on family and society. The general perception of men and women on the rigid gender division of labour and other orthodox practices relating to gender begins to die down. Women also tend to develop the perception that they are no subordinate to the men and they are equally important for decision making at household, community and organizational level.

Recognition

Persons exposed to gender sensitization also start looking the other way. At this stage the male folk come around to recognize the virtues of women and their importance to the family and the society. There is spontaneous appreciation for women's involvement in multifarious activities. The men, who are reluctant to admit of women's contribution, come around under the influence of sensitization to recognize their contribution. As a result, women's contributions become more and more visible. Further, women's talents and capabilities, that normally goes unnoticed and unexplored, become subject of attention. Women too become more conscious of their capability and contribution, and take pride in the same. On the other hand, women, cutting across socio-economic boundaries, tend to see their problems in larger perspective of women development and come forward to recognize the efforts of fellow women. They even visualize the important role that men can play in their socio-economic development. In a nutshell, such an orientation marks the beginning of a definite realignment in gender relations. Social image of women improves and their concerns are shared by men.

Accommodation

The barrier between men and women starts crumbling down in real sense and the society slowly moves to get over the perennial problem of adjustment between them. Men tend to rationalize their behaviour by burying their ego as far as gender relations are concerned. Instead of complaining or reacting to the behaviour of women, men learn to exercise patience and restraint, and take the things in a positive way. The difference between men and women narrows down as men allows women to function in a comfortable environment in the available socio-economic space. Problem creators, i.e. those who discourage and obstruct women in their socio-economic participation, become sympathizers and supporters. In the family, women start gaining importance as their opinions and suggestions are counted for overall development and management of family. At the community and organizational level too, women are encouraged to play their role in matters of management. Women, on their part, tend to underplay the problems with their male counterpart and wish to solve their problems through dialogue.

Action

Gender sensitized persons become instruments of change as far as status of women in the society is concerned. They become action oriented and alert to see that women are neither neglected in any way nor discriminated against, and they get their due status in the society. Conscious efforts are made to create a favourable climate that would nurture women's talent and provide more flexibility and freedom to women. Moreover, sensitized persons become more inclined to take such steps that would make the gender equations more even and balanced. A number of affirmative actions are initiated to bring improvement in conditions of women. Women also become open votaries of empowerment and organize themselves for collective action against different forms of biasness and discriminatory practices. They tend to become proactive to gain a respectable position in family and in the society.

Gender sensitization Strategy

Forms and intensity of gender biasness varies according to the socio-cultural and economic situations, educational background and other characteristics of people. Gender sensitization, for creating the desired impact on the society, must be based on a well-thought strategy and should be developed considering the prevailing socio-cultural and economic and psychological situation of target group. The strategy basically involves three components- selecting the target audience, deciding the content and deciding the methodology. Since the content and methodology of the programme are decided according to the target group, one should be clear about the composition and characteristics of the target groups while designing the sensitization programmes.

Target audience

Different programmes can be designed for different target groups. Men and women could be considered either together or separately for sensitization. They could be from similar background or from different background. Even both men and women from different age-groups could be considered separately. For example, separate sensitization programmes can be designed for researchers, policy makers and personnel associated with various social and economic services within the system. Even there can be programmes in rural areas wherein men and women from different age groups and from same households can be involved in participatory discussion in an enabling environment so as to make them realize real life experiences that depict gender biasness.

Methodology

Methodology part deals with overall designing of the programme, its structure, form and style of presentation, language to be used etc. Since reaching the target audience, impressing upon them and changing their traditional mindset are crucial to make the programme effective, a great deal of thought should go into deciding the methodology. Importantly, gender sensitization materials need to be developed for different category of people; men, women and children of different age groups and background. We will inevitably require some gender sensitive modules containing case studies; situation analysis etc. to sensitize planners, researchers and middle level functionaries. Even gender sensitive materials could include leaflets, booklets, posters, and videos on different theme areas. Organization of sensitization camps and plays in rural areas coupled with sustained campaign by mass media will go a long way in creating a healthy environment in the society as far as gender relations are concerned.

Content of the programme

The content part basically means the topics, theme areas or issues to be considered for the programme. Topic should be relevant and content should have the power to communicate the intended message to the audience, and should be easily understandable by them. Content of the programme can be decided depending on its very purpose. It could be to sensitize people about ill-effects of gender biasness and discriminatory practices on women, men, family and society. Gender sensitization may focus on spreading the message 'how women play important role in family and in the society' and 'how both men and women in their mutually supportive role can contribute to family welfare, growth and development of their villages'. Contents should initiate friendly debate among larger audience on the ill effects of gender biasness and what can be done to remove gender biasness. It can focus on the conduct of men and women in a household and case studies can be very useful in this context. Content part can also be developed to spread the message of some kind of affirmative action.

Gender education in school curriculum

Topics relevant in the context of gender sensitization should be introduced in school curriculum to sensitize the children on the prevailing gender biasness in our society and the way these are impeding the socio-economic development. This calls for somewhat higher doses of social science including gender studies in educational institutions. To make students awakened to the realities, both boys and girls can be encouraged to debate and discuss the gender issues and examples from real life experiences. Such an exposure will bring a definite change in attitude and perception of students towards gender. While boys, as they grow, can become more sensitive to and more concerned about issues affecting the girls and women; the girls and women, on the other hand, will become more vigilant against prevailing biases and awakened to the emerging opportunities. At the same time, we can expect better understanding between boys and girls, men and women characterized by spontaneity in adjustment and collective efforts to find solutions to gender problems. This would create a long term impact on society by reducing abuses and violence against girls and women. Can we not create a social climate that would hold discrimination against girls and women a sin or taboo?

Possible Impact

- Gender sensitization can contribute to women empowerment and gender mainstreaming by hastening the process of both horizontal and vertical flow of ideas, knowledge, information and technology.
- Gender sensitization can enhance women's access to available resources such as land, ponds, technology by overcoming socio-cultural barriers and foster better and more effective integration of women into development process.
- It reduces the chances of gender conflict and promotes gender harmony thereby creating a social climate wherein both men and women can perceive and play their role in right spirit and share the benefits equitably.
- By triggering restructure of gender roles, it can also contribute to rational and effective use of resources including time. Importantly, both men and women can be seen working together in mutually supportive role rather than in individualistic mode.
- Lack of sensitization at different levels, i.e. household, project and programme levels, is an important reason for poor implementation and poor outcome of development interventions. Gender sensitization, therefore, can lead to better impact on women of different projects, programmes and policies.

GENDER DISAGGREGATED DATA - ANALYSIS AND IMPORTANCE

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Gender-disaggregated data means every data that is cross-classified by gender, presenting information separately for women and men, boys and girls. Gender-disaggregated data reflect roles, real situations, general conditions of women and men in every aspects of the society. For instance, the literacy rate, education levels, business ownership, employment, wage differences, dependants, house and land ownership, loans and credit, and debts are all included. Without gender-disaggregated data, it will be more difficult for us to identify the real and potential contributions of half of the population to our country, and could hinder the development of effective policies. Statistical analytical procedures remain same for analysis of gender disaggregated data. The only important part is to consider gender as one component which must be incorporated in the whole procedure during analysis and such analysis helps not only to know the current status of involvement of gender component in projects, programmes, plans, policies etc. and the current development pattern of the nation but also it helps in developing appropriate gender mainstreaming strategies and there by policy making and development process.

Gender-disaggregated data can be applied to

- Find out the different conditions of women and men, including changes over time;
- Consider and track the impacts of national activities on women and men;
- Find out and further define the problems, and then develop options and choose the most effective and beneficial one for both gender;
- Allocate resources and work in a fairer way;
- Evaluate and monitor outcomes and conclusions by gender;
- Present the progress or lack of women by indicators and regular data publications

There is a need to generate gender-disaggregated information/ data and performance indicators for monitoring purposes. Knowledge of appropriate tools for data collection and analysis is therefore required for proper interpretation from the collected information. This chapter briefly describes concept of scales of measurements, data types, sampling procedures, measures of central tendency and dispersions. The scope of describing the statistical tools for analyzing data is beyond the scope of the chapter. Therefore, proper analytical tools along with the situations when it should be used

during analyzing experimental/ observational/ secondary data are listed. Further, concept of gender disaggregated data is introduced and a pre test evaluation schedule is used to describe how to bring the gender disaggregated data in a proper format for further analysis. The data is tabulated and described using MS Excel Software. All the statistical procedures enlisted in this chapter are described briefly. The details on all statistical procedures may be obtained from any standard statistics book.

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.

Sources of Gender Disaggregated Data: 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 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

The above procedures are useful for collection of data. The next step is to understand the data using descriptive and exploratory analysis. A list of measures of central tendency and measures of dispersion are as follows:

Measures of Central Tendency

Mean: The mean of a data set is the average of all the data values. The sample mean (\bar{x}) is the point estimator of the population mean (μ).

Sample mean $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$; n is the sample size, x_i is a random variable

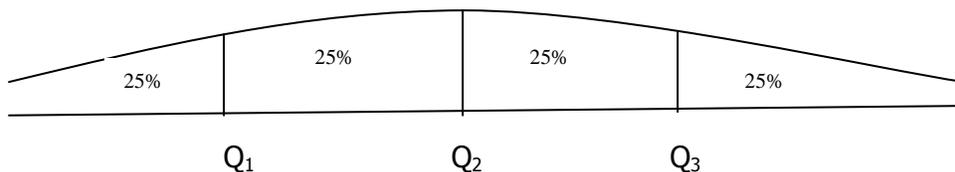
Population mean $\mu = \frac{1}{N} \sum_{i=1}^N x_i$; N is the population size, x_i is a random variable

Median: The median of a data set is the value in the middle when the data items are arranged in ascending order. With an odd number of observations, the median is the middle value. An even number of observations has no single middle value.

Mode: The mode is the value that occurs with greatest frequency. Situations can arise for which the greatest frequency occurs at two or more different values. In these instances more than one mode exists. If the data contain exactly two modes, we say that the data are bimodal. If data contain more than two modes, we say that the data are multimodal. In multimodal cases the mode is almost never reported because listing three or more modes would not be particularly helpful in describing a location for data. The mode is an important measure of location for qualitative data.

Percentile: A percentile provides information about how the data are spread over the interval from the smallest value to the largest value. For data that do not contain numerous repeated values, the p^{th} percentile divides the data into two parts. *The p^{th} percentile is a value such that at least p percent of the observations are less than or equal to this value and at least $(100-p)$ percent of the observations are great than or equal to this value.* Colleges and universities frequently report admission test scores in terms of percentiles.

Quartile: It is often desirable to divide data into four parts, with each part containing approximately one fourth, or 25% of the observations.



Q₁ = first quartile, or 25th percentile

Q₂ = second quartile, or 50th percentile (also the median)

Q₃ = third quartile, or 75th percentile

Measures of Dispersion

Range: The simplest measure of variability is the **range**. Although the range is the easier of the measures of variability to compute, it is seldom used as the only measure. The reason is that the range is based on only two of the observations and thus is highly influenced by extreme values.

$$\text{Range} = \text{Largest value} - \text{Smallest value}$$

Interquartile Range: A measure of variability that overcomes the dependency on extreme values is the interquartile range (IQR). This measure of variability is simply the difference between the third quartile, Q_3 , and the first quartile, Q_1 . In other words, the interquartile range is the range for the middle 50% of the data.

$$\text{Interquartile Range (IQR)} = Q_3 - Q_1$$

Variance: The variance is a measure of variability that utilizes all the data. If the data are for a population, the average of the squared deviations about population mean is called the population variance (σ^2). For a population of N observations and with μ denoting the population mean, the definition of the population variance is

$$\text{Population Variance } \sigma^2 = \frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2$$

When we compute a sample variance, we are often interested in using it to estimate the population variance. It can be shown that if the sum of the squared deviations about the sample mean is divided by $n-1$, and not n , the resulting sample variance provides an unbiased estimate of the population variance. Therefore, the sample variance is

$$\text{Sample Variance } s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

The units associated with the sample variance often cause confusion. Because the values being summed in the variance calculation are squared, the units associated with the sample variance are also squared. The squared units associated with variance make it difficult to obtain an intuitive understanding and interpretation of the numerical value of the variance.

Standard Deviation: The Standard Deviation is defined to be the positive square root of the variance. s is used to denote the sample standard deviation and σ to denote the population standard deviation. The sample standard deviation s is the point estimator of the population standard deviation σ .

$$\text{Sample standard deviation} = s = \sqrt{s^2}$$

$$\text{Population standard deviation} = \sigma = \sqrt{\sigma^2}$$

The standard deviation is measured in the same units as the original data. So the standard deviation is more easily compared to the mean and other statistics that are measured in the same units as the original data.

Coefficient of Variation: The coefficient of variation is a relative measure of variability; it measures the standard deviation relative to the mean. The coefficient of variation is usually expressed as a percent.

$$\text{Population Coefficient of Variation} = \frac{\sigma}{\mu} \times 100\%$$

$$\text{Sample Coefficient of Variation} = \frac{s}{\bar{x}} \times 100\%$$

In general, the coefficient of variation is a useful statistic for comparing the variability of variables that have different standard deviations and different means.

For descriptive and exploratory data analysis along with the usual measures of central tendency and measures of dispersion the graphical tools also play an important role to describe the gender disaggregated data. Many times the data must be visually observed using proper graphical tools to understand the behaviour of the data or interrelationship between/among the variables. Bar chart and pie charts are mostly used for qualitative data where as histogram, dot plot, ogive, scatter plot, box plot, stem and leaf display are mostly used for quantitative data.

Type of statistical analysis of gender disaggregated data depend on: number of populations; number of variables; type of variables; parameter types; sample size; sampling methods, assumptions, auxiliary information etc.

- Number of populations – one /two/more than 2
- Number of variables – one/two/more than 2
- Type of variables – nominal/ordinal/interval/ ratio
- Parameter types – mean, variance, median (mostly)
- Sample size – small; large. Sampling – with/without replacement
- Assumptions – distribution assumption (normal); continuous/discrete; independent observations; constant variance etc.

A collection of statistical tests/ procedures for analyzing gender disaggregated data based on above criteria can be found in <http://bama.ua.edu/~jleeper/627/choosestat.html> (developed by Dr. James D. Leeper).

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GENDER SENSITIVE EXTENSION

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Women are vital in nourishing the world. Their contribution in food production is 60-80% in developing countries and in Asia up to 90% involvement in rice fields. Women compose one-half of the world's population and perform two thirds of the world's work hours, yet are poorer in resources and poorly represented in positions of power. These inequalities are seen in all parts of the world. According to the 1995 UNDP Human Development Report on the status of women indicated that:

- 70% of 1.3 billion people living in poverty are women
- Among the world's 900 million illiterate people, women outnumber men two to one
- More women than men are malnourished
- Wages of women are 30-40% lower than men for comparable work
- Women constitute less than 1/7th of administrators and managers in developing countries
- 10% seats in world's parliaments and 6% in national cabinets are held by women
- Women own less than one hundredth of the world's property
- Women earn one tenth of world's income

Farm women in agriculture scenario in India and abroad :

According to FAO, contribution of women in food production is 80% but they receive extension support only 2 to 10%. Agriculture contributes 25% of GDP which is a female dominated activity. Agriculture also employs 4/5th of all economically active women and out of self employed farmers, 40% are women. In dairy sector, 75 million women and only 15 million men are involved where as in animal husbandry, 20million women and 1.5 million men are there. Other than this, 51% work done by women is remaining unpaid. In Turkey, raising of dairy cows is the sole responsibility of women, in Indonesia and West Java, women also raise silk worms and responsible for 90% of its production, in Papua New Guinea, women are primarily responsible for crocodile farming, in Abidjan and Lome, women run poultry farms of 1000-5000 birds. Women are highly involved in processing of the NTFP particularly in small-scale enterprises to generate income. But, most of their work like collection of fuel, fetching water, cooking care of children and elderly is unpaid and not considered as "work".

Extension issues:

There are so many issues out of which extension issues are very important for the development of women in agriculture. Some of the issues are as follows:

(i) Over burden of women :

Women perform the triple roles like production, re-production and community roles. Research on time utilization pattern of women revealed that on an average women work for 15-16 hours a day, out of which 7–8 hours in peak and 5 – 6 hours in lean period are spent in farm work which are labour intensive, monotonous, repetitive and drudgery prone and leads to mental and physical exhaustion.

(ii) Socio-economic and cultural background :

The stereo type perception of our society is that women's works are "inside" home and not "outside". The general trend is that the women with larger land holding are not allowed to work in the field where as small land holders or landless women spent much time for wages in agriculture. Restrictions are there for women in the field of mobility, communication, interaction etc. So it is difficult for a male extension worker to deliver extension services to a woman.

(iii) Invisibility of women :

Women play various roles in agriculture starting from farm managers to labourers. In case of male migration they also head their families. But still the extension services are not facilitating such women rather them with a feeling that "farmers" means "men".

(iv) Livelihood integration :

Farm women play a crucial role in production of field crops, fruits, vegetable and its storage and processing in most of the societies. Women face several hardships in taking care of livestock, in culturing fishes, looking after family nutrition and health. But the extension service given to women is very limited and not in an integrated manner. Therefore, integrated service of all developmental agencies with a holistic approach should be planned for farm women.

(v) Location specific extension :

Indian has diversified cultures, customs, religions and languages as per the regions. One extension agent can easily serves his / her local community with a

particular local language but it is difficult to speak his / her own language in different places. Therefore, development of location specific and need based extension model may be developed which can work for gender mainstreaming in extension.

(vi) Extension management:

Extension service for farm women is very much required because they are highly illiterate and discriminated. For effective extension service, more number of change agents, training programmes, infrastructural facilities, allocation of gender budgets, sensitization of extension functionaries, etc. should be made. Then only gender balancing extension systems can be managed to meet the gender needs of extension and training.

(vii) Components of extension services:

It is observed that services, co-operatives and credit support are less available for women household heads than for men. They have unequal access to extension inputs and credit. Agricultural development programmes are usually planned by men and aimed at men. Therefore, free supply of inputs, subsidized inputs, credit from banks and marketing facilities should be included under extension services for women for mainstreaming.

Possible areas of Mainstreaming in Extension:

There is scope and opportunities of gender mainstreaming in extension by minimizing the issues. Those are:

- (i) Engendering the agricultural curriculum:** At college level the curriculum should be engendered to go a long way towards gender sensitivity.
- (ii) Involvement of women in Panchayats/ Local bodies:** The women in local bodies should represent in controlling the decisions at all the planning, coordination and evaluation mechanism at all levels to recognize women specific needs, abilities and contributions as key stakeholders.
- (iii) Delivery system through mass media, publications etc.:** The access of farm women to this channel is found to be very limited due to their illiteracy and pressure of household chores or both. But it can carry messages to a large number of farm women. However, we should examine how different media support and extension model can contribute to the empowerment of farm women. According to Mohapatra and Panda (2001), there is no doubt that empowerment of women with information can lead to a better world. Mass media can sustain a hope for socio-economic betterment of people where as media have an invaluable role in promoting social awareness (Lopoyetum, 2001).

- (iv) Credit and technical support:** Technical support should be provided to farm women which is appropriate for women's multiple tasks. Credit facility should be given to WSHGs to increase income by way of developing micro-enterprises.
- (v) More women extension workers:** Expanding the sphere of women extension workers is required who can better identify the women's needs and constraints, priorities and opportunities to meet their requirements. Adequate funds need to be provided to women extension functionaries for field activities and its recognition.
- (vi) Capacity building and skill upgrading of women:** Through different training programmes in different areas will largely improve the access to agricultural knowledge and information among farm women and communities. Therefore, gender relevant extension training materials should be developed.
- (vii) Reorientation of extension and research priorities:** Extension should be reoriented and research priorities should be given on women farmers who are from backward caste, backward class and mostly weaker sections.
- (viii) Developing linkage between extension and research:** Linkage should be developed among ICAR, SAU, NGOs, Private sectors, etc. to bring a strong collaborative programme between extension and research to provide feedback on needs of the women.
- (ix) Developing and popularizing gender sensitive training modules:** To sensitize the stakeholders at all levels of planning and implementation, modules should be used by the trainers.
- (x) Conducting gender sensitive workshop, seminars, etc.:** It is needed to recommend some policies and approaches from a gender equity perspective to policy makers and planners.
- (xi) Training of extension functionaries on gender analysis:** Gender analysis acts as a planning tool. So, the male extension workers should be sensitized to the needs of the women farmers. Through gender analysis, they will be able to critically examine the roles, responsibilities, constraints, opportunities, costs and corresponding benefits and then to draw an intervening plan for bringing the farm women into mainstreaming.

Multifaceted approach for Gender Mainstreaming:

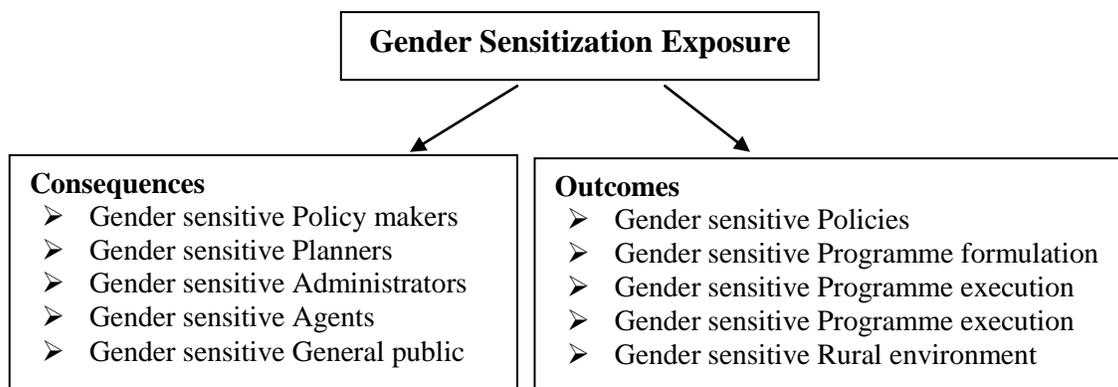
To promote and support for gender mainstreaming, the gender focal persons need a multi-faceted approach as following:

- Participatory gender policy formulation
- Review of existing policy and planning documents
- Gender sensitization workshops, seminars, etc.

- Development of gender checklists and guidelines
- Incentives for staff
- Forming internal as well as external gender networks
- Promoting management support for gender mainstreaming

Gender Sensitization

Sensitization can play a key role to bring gender mainstreaming in all developmental programmes. So among all categories of all functionaries starting from programme planners to grass root level sensitization exposure is needed. The following figure explains the consequences and outcomes of gender sensitization exposure.



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DIFFERENT HORTICULTURE BASED CROPPING MODELS AND THEIR BENEFITS FOR WOMEN AND FAMILY

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Horticultural crops play an important role in revitalizing rural economy as this system provides more employment and contributes to nutritional security particularly for micronutrients and vitamins. Horticultural crop production is more labour intensive and hence marginal and land less farmers also get opportunities for income generation. Subsistence farmers who often face famine condition would like to adopt a technology which would produce at least some yield to run livelihood even in the worst year of agriculture. Fruit based cropping system is one of such types of technologies which can provide the farmers an appreciable amount of economic return even under unfavourable agro climatic conditions. This is very difficult to achieve by growing only seasonal crops which often fail under abnormality of weather but fruit trees are efficient to be productive even such conditions. An integrated system with several crop combinations to maximize production of nutrient rich-food, and fodder along with enhance income and employment generation for farm family. However, with the traditional cropping system, small and marginal farmers are finding it difficult to produce adequate food to feed their families. The only way to convert these holdings in to profit- making ones is through the intensive use of land through diversification of crops. For that purpose mango-based, guava-based, minor fruits-based, coconut-based, cashew nut -based multi- storey cropping model in coconut and Resource efficient horticulture models were developed at DRWA. More than 25 intercrops including vegetables, short-duration fruit crops, flowers, aromatic plants, fodder crops and root crops were planted among these crops. Crop combinations were selected in such a manner that they could fulfill food, fuel, fodder, financial needs of a farm family. These models help in generating '6Fs' of sustainability-food, fodder, fuel, feed, fiber and finance. The fertility of the soil is maintained by biomass recycling and nutrient conservation.

Why horticulture based cropping models?

1. Fruit trees are efficient enough in providing higher economic return even under stressed growing conditions prevailing under the upland situations than the other annual crops.

2. The approach aims at improving productivity by effective utilization of air, light and soil which are not utilized in single tier system.
3. Higher labour requirement per unit area of multitier system contribute towards creation of job opportunities at site.
4. High return per unit area under upland conditions is the ultimate result of horticulture based cropping models.

Concept of horticulture based cropping models

The horticulture based cropping models is a self-sustainable system where solar energy can be harvested at different heights, soil resources can be efficiently used and cropping intensity is increased. The system consists of three main components viz. main crop, filler crop and inter crops which occupy three different tiers in space of the production system.

1. Guava based cropping model

Plants of guava (*Psidium guajava* L.) var. Allahabad Safeda, were planted at a spacing of 5m x 5m plant to plant and row to row accommodating 400 plants in a hectare in the year 2006. Four intercrops such as okra (*Abelmoschus esculentus* L. Moench), cowpea (*Vigna unguiculata* L. Walp.), turmeric (*Curcuma longa* L.) and pineapple (*Ananas comosus* L. Merr.) were planted during 2007 and 2008 between interspaced of guava plants under rain-fed condition. Okra variety 'Arka Anamika' was sown at a spacing of 60cm x 30 cm row-to-row and plant-to-plant during 2nd week of June and harvested during August and September. Before sowing the seeds were soaked in water for 8-10 hours and dried in shade for quick and uniform germination. The seeds were covered with mulch after sowing to conserve temperature and moisture. However, the mulch removed after germination to avoid damage by termite, ants to germinating seedlings Okra can be raised in a small scale in kitchen gardens by women for household consumption. Cow pea (*Vigna unguiculata*) var. 'Utkal Manik' was sown at a spacing of 60cm x 30 cm from row-to-row and plant-to-plant during 2nd week of July and harvested during October. Green pods as well as seeds were collected and rest of the plant was added to the soil. Fresh pods were utilized by farmers for culinary purpose and seeds were used for pulse as well as stored for sowing in next season crop. Turmeric (*Curcuma longa* L.) var. Local was planted during June month at a spacing of 60cm x 25 cm in furrow during July. The seed rhizomes were treated with Dithane M -45 @ 0.2 % for 20 minutes before planting. The crop was harvested during December. The green leaves of turmeric were utilized by women during festive occasions for preparation of sweet dish locally called *petha*. During festival time a lot of market demand for turmeric green leaves has been

observed in Odisha. Suckers of pineapple (*Ananas comosus*) variety 'Kew' were planted at a spacing of 60cm x 30 cm from row –to- row and plant- to- plant during July month and harvested from May- July. The yield of intercrops was significantly influenced by guava plantation. Among different intercropping, highest yield was obtained from pineapple (150.53q/ha) followed by turmeric (64.58q/ha). Results revealed maximum plant height (3.86 m), plant girth (9.67cm), plant circumference (16.54cm) and plant spread from E-W (5.04 m) were recorded by guava cv. Allahabad Safeda with intercrop of cowpea while minimum value of these parameters were recorded turmeric during three years of cropping period. Maximum yield was recorded in cv. Allahabad Safeda (26kg plant) with cowpea intercropping. The fodder generation was higher in cowpea. Among all intercropping combinations highest income of Rs 166485/ha was recorded under guava + pineapple intercropping system. Guava + turmeric was found next profitable with net income of Rs. 135438/ha.

2. Mango based cropping models

Mango (*Mangifera indica* Linn) is one of the popular fruits in the country due to its delicious taste and excellent nutritional properties. Flowers/ panicle of mango are used by women in Odisha for worship purpose during a festival locally called *Bakuda Amavasya* for higher production. Five intercrops i.e. cowpea, radish (*Raphanus sativus* L.) , okra, tube rose (*Polianthes tuberosa* L.) and French bean (*Phaseolus vulgaris* L.) were evaluated for yield, income generation and fodder production in 4 years old mango orchard. There was no effect of intercrops on the plant height of different mango varieties. Yield of cowpea and French bean increased continuously. Maximum yield of cowpea variety Utkal Manika was recorded 87.45 q/ha followed by French bean variety Pusa Phalguni 74.20 q/ha. Highest net return of Rs 59500/ha and B: C ratio of 2.03 was recorded under cowpea. Production of French bean var. Pusa Phalguni was found next profitable intercrop with a net profit of Rs 42300/ ha. Maximum employment generation (277 and 320 mandays/ha/year) was recorded under mango + okra cropping system. Mango based cropping system involves more employment opportunity and can supplement family nutrition. Farmwomen used the profit for meeting their very urgent needs like children's education and procurement of other essential items. Women took active part in operations such as sowing of seeds, manuring, mixture preparation, filling of polybags, nursery management, thinning, weeding, harvesting, cleaning, grading and sale of produce.

3. Minor fruit based cropping models

Minor fruits including custard apple (*Annona squamosa* L.), bael (*Aegle marmelos* (L.) Corr.Serr.), aonla (*Emblica officinalis* Gaertn.), sapota (*Manilkara achras* Jacq.),

lemon (*Citrus spp.* L.) share a good proportion of total fruit production in the country and grown by the resource poor farmers in their homestead for family consumption. In the recent years, the production of these fruits has increased sharply due to popularity in our diet for health purpose and local market demand. These fruits are taken by family members as a fresh, pickle, chutney, murrabba juice, etc. and women play very important role in the preparation of these items. Minor fruits viz. custard apple, bael, aonla, sapota, lemon was planted in the month of September 2008 at a spacing of 5mx5m. Intercrops namely marigold, cowpea, tube rose, fodder grasses namely *Stylosanthes*, *Bracaria humidicola* and congo grass were planted between the crops of 2009 and 2010. Results revealed that yield was 4.20 4.6 kg/plant in lemon during 2010 and 2011. Higher yield was recorded in cowpea followed by marigold. Among the fodder crops the yield of congo grass was higher than *Stylosanthes* and *B. humidicola* . Highest income Rs. 112200 and 125440/ ha and employment generation 248 and 232 days/ ha /year were recorded by lemon+ marigold cropping system during 2010 and 2011, respectively.

4. Coconut based cropping model

The five varieties of coconut (*Cocos nucifera* L.) namely SSG, Guam, British Solomon Island, Philippines Ordinary and Saint Vincent were planted to initiate coconut nut based cropping system in the month of September 2008. Five intercrops such as turmeric (*Curcuma longa* L.), colocasia (*Colocasia esculenta* L. Schott.), elephant foot yam (*Amorphophallus paeoniifolius* Dennst.), cassava (*Manihot esculenta* Crantz), cowpea (*Vigna unguiculata* L. Walp.), were planted in Kharif 2009. Tropical tuber crops, including cassava, yams, sweet potato and aroids like elephant foot yam and taro hold great promise in addressing food security and income generating opportunity for rural women as these can be grown with less inputs drudgery and simple technologies that can also be considered as women friendly. The observations on growth of coconut varieties revealed that there was no significant difference in the palm height, palm girth, palm canopy and palm spread of different coconut varieties. There was no effect of intercrops on the growth of coconut. Similarly there was no effect of coconut varieties on growth and yield of intercrops. Among the different intercropping combinations, highest yield (150.60 q/ha) was recorded in tapioca followed by elephant foot yam (84.60 q/ha). Highest total income was obtained under coconut +turmeric cropping system (Rs 60000 /ha) followed by coconut + tapioca (Rs 49500 /ha). Women are engaged extensively in weeding and basin cleaning of plantation crop. Mulching is done in coconut basin to conserve moisture, check weed growth and increase organic content in the soil. Women carry out in mulching in coconut basins with dried and cut coconut leaves. It has been observed that they collect the dried grasses from the nearby fields and mulch in coconut basins. Coconut provides has plenty of horizontal and vertical space during first three years of planting

and hence intercropping is taken up by farmers for family consumption and for income. Women are engaged in 95 percent of work activities pertaining to intercropping viz., sowing/ planting, manure application, weeding and harvesting etc. After harvesting of produce its cleaning, curing, grading and other operations are also performed by farm women. Majority of cleaning and grading of vegetables and spices at farmer's level is done by women.

5. Cashew nut based cropping model

The six varieties of cashew nut viz. H-2-16, H-303, BH-6 (Jagannath), BH-85 (Balbhadra), BH-1608, NRCC Selection-1 were planted to initiate cashew nut based cropping system in 2008. Intercrops such as pineapple, tapioca, okra, lemon grass, congo grass, *styro* were planted in 2009. It has been observed that there was no significant difference in plant height, plant canopy, plant girth, plant spread of different varieties. Maximum yield (6kg /plant) were recorded by BH-6 (Jagannath) variety. Highest yield was recorded in tapioca (120.00 and 175.60 q/ha). Fuel yield was highest in cashew nut + tapioca cropping model. Total income was highest (Rs. 56000 /ha) in cashew nut + tapioca cropping system while employment generation was highest in cashew nut + pineapple. In India women are involved in majority of cashew (*Anacardium occidentale* L.) plantation for the collection of raw cashew nuts. Women engaged in this task harvest mature nuts by way of collecting fallen nuts and shaking the tree branches. About 90-95 per cent of total work force is constituted by women in cashew processing industries irrespective of the size of the processing facility or mode of operation or location of the industry. Cashew nut processing system followed in Chintamani region of Karnataka reveals that after drying the kernels in cabinet type tray driers, manual peeling of kernels were taken up by women at home level. Mostly women folks were employed in shelling peeling, grading and packaging activities of cashew.

Multi storey cropping model in coconut

Cultivating of intercrops in coconut produces more food and agricultural products which provide food security for the people in both the rural and urban areas. At the same time, the practice generates jobs and livelihood, likewise enhancing farm income which helps alleviating poverty in farming communities. Coconut is the most important fruit crop grown in coastal area of Odisha. However, with the traditional cropping system, small and marginal farmers are finding it difficult to produce adequate food to feed their families. The only way to convert these holdings into profit-making ones is through the intensive use of land through diversification of crops. Thus an integrated system with several crop combinations to maximize the production along with more income and employment generation would ensure a sustainable

development of farm families and additional opportunities to farmwomen. Therefore, in order to improve the productivity and income of these targeted groups of farming community, the effort was made to standardize suitable intercrops in coconut based multistorey cropping model with banana, papaya and guava as second storey crops. Different ground storey intercrops like cowpea, turmeric, elephant foot yam and pineapple were taken in the interspaces of the main crop. Observation revealed that intercropping did not show any adverse effect on increment in the height of plant, girth of trunk and area of canopy spread of main crop as well as second storey crops. Growth of second storey crops was also not influenced by intercropping. Among the different intercropping combinations, highest yield were recorded by turmeric (180.46 q/ha) followed by elephant foot yam (150. 20q/ha). Yield of cowpea was recorded 52.30 q/ha from July to September. The income per year Rs 60000/- obtained from coconut single crop at the age of six years old with average nut yield 20 nut/ plant while income increased with intercropping and highest income (Rs 462000) were recorded with the combination of coconut+ banana + turmeric. The care of ground storey crops is taken by the farmwomen.

Resource Efficient Horticulture Model

Different component of the resource efficient model consisting of various component like high density planting of banana, meadow orcharding of guava, high density planting of papaya, pineapple, lime, growing of vegetable crops in open field and protective condition, tuber crops, intercrops, mulching, drip irrigation , raised bed method, nutrient management in banana etc. were evaluated. The main of the model is to increased crop productivity and profitability per unit area with increased resource use efficiency.

Benefits

- Models provide food security as well as nutritional security for women and family
- Models provide more employment for the women and their family members.
- It should provide food grains, pulses, oilseed etc. to family and roughages, fodder to cattle.
- It should be so arranged to make for economy in production. There is over all increase in yield of crops mainly due to maintaining physical - chemical properties of soil.
- It helps in controlling insects, pests and soil borne diseases.
- It facilitates even distribution of labour. Following crop make proper utilization of all resources and inputs. Family and farm labour, power, equipment and machines are well employed though the year.

- Farmers get a better price for his produce due to higher demand in local market. So there is regular flow of income over year.
- Diversification of crops reduces risk of financial loss due unfavorable conditions. Diversification of crops means variety of crops can be grown for meeting the domestic needs of farmers and livestock, to reduce risk of market fluctuations, mechanism of farming, growing expensive crops. So all variety of crops are grown in rotation for more benefit.
- The family needs of feed, food, fuel, fiber, spices, sugar etc. are fulfilled and also fulfill needs of livestock.

Conclusion

From the above results it can be concluded that horticulture models with diversification by incorporating different vegetables, fruit crops and other cash crops in a scientific cropping pattern can play an important role in increasing farm incomes and employment to achieve nutritional security. Further, as the average family land holdings at the national level have come down, interventions are further needed to convert such uneconomic landholdings into profitable one. Such studies can make a difference to the livelihood as well as food & nutritional security to the people. As such, the focus of extension functionaries should shift to farming system diversification.

GENDER ISSUES IN LIVESTOCK PRODUCTION

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Livestock sector in India has shown an impressive growth in the last decade especially in the dairy and commercial poultry sector. It contributes 4.1 percent of the total GDP (2012-13). The livestock sector alone contributes nearly 25.6% of Value of Output at current prices of total value of output in Agriculture, Fishing & Forestry sector. The milk production now stands at 132.43 million tonnes (2012-13) and it is an important secondary source of income for 7- million households engaged in dairying and for the 70 percent of the workforce that comprised women. The per capita availability of milk is 295 g per day in India which is higher than the world average. Poultry sector has also shown an impressive growth because of the conducive government policies for commercial poultry production and the focus on family poultry system which addresses livelihood issues. The egg production in India was 69.73 billion in 2013, while the poultry meat production was 2.68 mt. The per capita availability of egg in India is 55 eggs per year.

The livestock sector has the potential to provide income and employment and nutritional security to millions of farmers which is yet to be fully tapped. The growth witnessed in the dairy and the commercial poultry sector can be spread horizontally provided it encompasses other livestock species like goats, pigs and backyard poultry which are less capital intensive but have greater impact on the health and well being of the farm families. Although the contribution of women in making the operation flood programme has been immense because they have been shouldering most of the activities related to rearing and management of dairy animals, their abilities and expertise with respect to other livestock species is yet to be fully appreciated especially in the field of small ruminants and backyard poultry.

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 • Organise training programme on-site (village) 	<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

	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Improve access of women's to common pool resources through 	<ul style="list-style-type: none"> • Improvement in the productivity of CPR • Enhance women's' right to

production and other micro-enterprises income generation	community participation and management <ul style="list-style-type: none"> • Develop mechanism at village level for provision of water and fodder during scarcity period 	control and manage CPR and livestock <ul style="list-style-type: none"> • 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 organisation; 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, utilise 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 Vanraja 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 recognised.

In Uttar Pradesh 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, organisation 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.)

Livestock in Uttar Pradesh:

The livestock population in UP in 2003, 2007 and 2012 is given in table below. The total livestock population in UP in 2012 was 68.7 million, of which there were 28% cattle, 44% buffaloes and 22% goats. The livestock population in UP has increased by 14.01% in 2012 as compared to 2007. The rich livestock population provides an important source of livelihood to people.

Table. Livestock population in UP in 2003, 2007 and 2012.

	Livestock population (,000)		
	2003	2007	2012
Cattle- Exotic/Crossbred	1634	1945	3579
Cattle- Indigenous	16917	16938	15978
Cattle - total	18551	18883	19557
Buffalo	22914	23812	30625
Sheep	1437	1188	1354
Goat	12941	14793	15586
Pigs	2284	1350	1334
Total livestock	58531	60272	68715
Total Poultry	11718	8754	18668

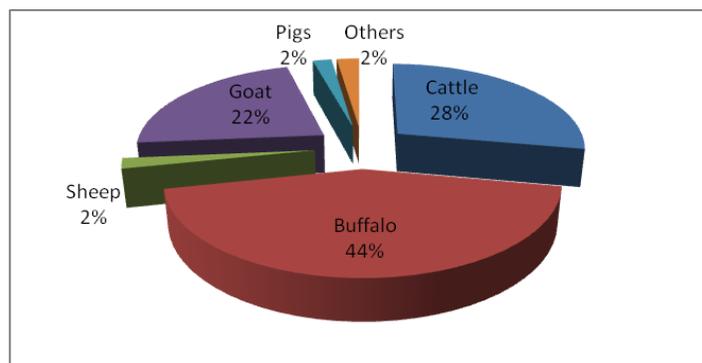


Fig. Distribution of livestock species in UP (Livestock census 2012)

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

TECHNOLOGICAL EMPOWERMENT OF WOMEN IN AGRICULTURE

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What is Technology

Technology is a purposeful practical activity that involves the application of scientific knowledge by human beings for solutions to development. It is argued that all problems of humanity can be solved through technology. It has been understood as process, a set of mind, and instrument for national development. It refers to the transformation of scientific laws into machines, tools, mechanical devices, instruments, innovations, procedures and techniques to attain tangible ends or manipulate environment for practical purposes.

Appropriate Technology

- Knowledge about technology has two components. Know how and know why? Knowing how something works and knowing why it works. This will enable the people to adapt a technology to local conditions. Knowledge of social, cultural and economic contents is also important for any interventions that are intended to benefit the poor. The advanced or modern technology ignores this factor totally. The people learn by 'doing' and enhance their technological capability.
- Participatory Technology Development is a process of developing appropriate technology. This process of developing appropriate technology. This process shall enable the rural artisans and craftsmen to interact with science and technology experts and to develop appropriate technologies that suit to the local culture, materials and skills.

The criteria of Technology Appropriateness

The criteria of technology appropriateness can be determined by taking into consideration the following factors:

- Technology should be compatible with local cultural and economic conditions.
- The tools and processes should be accessible to people.
- Should use locally available resources
- Use of local energy sources
- Ecologically and environmentally sound

- Should minimize cultural disruptions
- Should improve gender relations
- Should be flexible
- Should encourage participation of local community
- Should be labour intensive, energy reducing and cost effective.

Technology for Gender

A technology may be appropriate for women if it reduces their drudgery, improves their environment, their skill and enhances their comforts. A lack of sensitivity, total ignorance and apathy to the general problems of rural women are the basic reasons due to which not even a simple technology package for rural women has been formulated so far. Basically, the technology generators have been the 'males' who have failed to give a real 'feminine' sense to their technology packages for the women.

Impact of Technology on Women

The East Asian experience has demonstrated that women excel at new technologies, as they are more disciplined; less unionized, and, can easily master new skills useful in such key industries as computers, electronics and value-added fashion garments.

- It has recently begun a scheme to provide mobile phones to women in every village. This shows that women can easily adapt themselves to the new communication technologies and use them for their family and economic survival.
- The Self-Employed Women Association (SEWA) has shown the way by the using video technology for articulating grievances of women construction workers, vegetable sellers and other such self employed women who had no forum for collective social action. It has gone a long way in innovating several self-help programmes like opening bank accounts for the illiterate women account holders. These women workers also learnt to operate and handle video camera and other audio-visual equipment.

Components of Technology Transfer for Women

We have many technologies that can be gainfully practiced but still there is something lacking when it comes to technology diffusion and TOT especially at the rural level. The problems of rural technology are as follows:

- 1. Rural Technology Needs:** Very often rural technology needs are perceived by scientists, technologists, economists, planners, elected representatives, etc. Strictly speaking rural technology needs must come from the village women. These then

must be channelized and reach the agencies that has competence to transform them into technology packages.

- 2. Technology development vis-à-vis technology transfer:** Rural technologies are developed by institutions and voluntary organizations. Individuals are also generators of technology. Unfortunately not every technology generator knows the mechanism or the methodology of TOT to reach the women in agriculture.
- 3. Knowledge Information:** Technology user may be knowing his needs but he has to first seek information about the availability of the "need technology" and then link it to the needs. Technology information collection therefore is a task by itself. More the information, wider is the choice.
- 4. Technology selection and assessment:** While cost is an important parameter, proper selection followed by assessment of technology is a crucial factor in relation to needs, expectations, and acceptability of the women. One has to keep in mind the human skills available or to be developed for operation, maintenance and future improvements. Certain technologies can last for a long time whereas some others get obsolete sooner. Care has to be taken at the time of selection of technology as (a) whether too much labour is going to be dispensed (b) environmental pollution (c) eco-friendliness, (d) energy consumption (e) energy source and (f) bi-products/ waste products generation.
- 5. Implanting the technology:** A scientist develops a technology on a laboratory scale which is invariably less than the commercial scale. He has very limited idea about the techno commercial parameters. For any transfer to take place scale of production is first decided on economic and commercial considerations. This is a crucial decision because successful TOT often depends on it. In the field of agriculture frontline demonstration should be done. The next step is project report preparation including (a) details of capital and working capital requirements, (b) manpower requirement, (c) the general lay out of the unit
- 6. Understanding among Policy making agency and R&D Scientists:** For a successful TOT, the R&D scientist, policy/ promotional agency and the technology adopters must have a forum and a channel for communicating each other's problems and arriving at practicable solutions. It is for this reason that technology-user (farm women) needs are to be assessed before technology is developed (new, improved or upgraded).
- 7. Entrepreneur and entrepreneurial ability:** The choice of an entrepreneur is one of the key elements of successful TOT. A sincere, competent, and committed entrepreneur can understand and absorb the technology and make TOT a success story. Many training programmes include selection of technology and a practical training in development of skills needed to use the technology for production or societal mission which an entrepreneur should undergo.

8. Market and market forces: The one indicator for the success of technology and TOT is selling the product or services for a profit. If the product is new, marketing ability lies in creating the market. If the product is conventional, the ability lies in penetrating the market and competing with others. Without a minimum assured market, the best of technology, the best of entrepreneurial talent, and the best of TOT support mechanism, the enterprise/ industry will have an uncertain future. Hence for any enterprise, a market potential survey, elaborate or otherwise, and an effective marketing are a must. For certain rural technology products, we can think of Rural Marketing Centres (RMCs) with clear marketing functions for local market, national market, and export market depending upon the nature of products.

Areas of Technological empowerment for women in Agriculture

1. Crop farming
2. Fruit & vegetable farming
3. Dairy farming
4. Poultry farming
5. Sheep/goat rearing
6. Rabbit rearing
7. Mushroom production
8. Pisciculture
9. Bee keeping
10. Seed production
11. Nursery raising
12. Agro-forestry
13. Sericulture
14. Fruit & vegetable preservation
15. Rural art & craft
16. Appliqué work/tailoring
17. Vermin-composting

Conclusion

To bring the rural women into the fold of technological development, there is need to identify location-specific profitable enterprises and train them to increase their efficiency. Their awareness about different enterprises, development programmes and opportunities created for them has to be increased. The pin pointed facilities required to help village women are technical advise through training, inputs and marketing which can push them into the world of entrepreneurship with new hopes and aspirations.

WOMEN IN HOUSEHOLD FOOD AND NUTRITION SECURITY

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Household food security is defined as availability and accessibility of adequate food in terms of quality and quantity that is safe, nutritious and acceptable to all household members throughout the year. The food nutrients should meet the individual body requirement. This may also refer to economic and physical accessibility to food. Food security is determined by what that particular household is able to purchase, produce, store, process, prepare and consume. In turn these are determined by purchasing power, agricultural productive resources available to that particular household such as amount and quality of land, the amount and division of labour, the availability of production assets, the level and type of technology as well as climate and ecology. Food insecurity and malnutrition are quite common but the relationship between the two differs according to ecological setting, which in turn, is differentiated by sources of income, living conditions, ownership of assets, and habitual diet. Food security is not guaranteed by adequate food grain production or even food availability. It is more fundamentally linked to both physical and economic access to food. Food security has three components," The first is food availability, which depends on food production and imports. The second is food access, which depends on purchasing power. The third, food absorption, is a function of safe drinking water, environmental hygiene, primary health care and education. The International Food Policy Research Institute (IFPRI) disaggregates food security into three pillars; food production, food access and food utilization (IFPRI, 1995)).

The concept of food security refers to the ability of a household to assure all its members sustained access to sufficient quantity and quality of food to live active healthy lives. Such access is likely to be most threatened in times of economic deterioration. Maximizing household income is not always sufficient to maximize the food security of all its members for the same reasons that national food availability does not necessarily translate into household food security. In both regions there is evidence that women appear to take a much greater role in assuring the food requirements of their dependents in situations of economic deterioration. So that situations where women produce and/or control the resources by which their own nutritional needs and those of their families are met are likely to be associated with enhanced food security of all members.

The manifestation of food insecurity can be categorized as (1) Chronic food insecurity, (2) nutritional insecurity, (3) insecurity caused by lack of food absorption and (4) transitory food insecurity. There are both supply side and demand side factors that may lead to chronic food insecurity. On the supply sides are: (a) food production, (b) imports and (c) distribution (Public distribution system). The demand side depends on: (i) population growth (ii) purchasing power (iii) product price/subsidy and (iv) support of social system support such as the Integrated Child Development Services Scheme, Food for Work Programme, National Rural Employment Guarantee Scheme, etc. There are some groups of people who are more at risk than the chronically food insecure people for not getting sufficient and adequate food. The most vulnerable under this category are the pregnant and nursing mothers, unborn babies, as well as children under five, as they are in critical period of their lives where they have special nutritional needs.

A large proportion of malnutrition occurs on account of poverty, lack of knowledge and ignorance. Many of the nutritional imbalances and associated health problems can be prevented provided the people have adequate knowledge and appropriate skills in this regard. The ability of a household to command sufficient nutrition is largely depend upon its social, material and economic conditions. It is conclusively demonstrated that under nutrition is associated with low income, low assets, morbidity, unemployment, low household expenditure, and low education of the mother, weak social networks, poor housing and unhygienic condition. Other factors are household size, birth order and female gender. Malnutrition is generally associated with diets of poor quality, but often disease is a major factor as well. Inadequacy in the quantity of food, particularly energy supplies leads to under nutrition. Under nutrition may not result only from a lack of food but also from the skewed distribution of the food that is available. This skew results because some people are too poor to purchase food from available stock.

Nutrition security

Nutrition security is defined as the “appropriate quantity and combination of inputs such as food, nutrition and health services, and time needed to ensure an active and healthy life” (Haddad, Kennedy, and Sullivan 1994). Nutrition depends not only on suitable food but also on good basic health services and, particularly for children and the elderly, adequate care. Food security is one component of nutrition security, together with health security and care security. Nutrition security, in turn, is one component of the broader concept of livelihood security. A poor combination of economic, social, ecological, and institutional factors contributes to food insecurity. A high level of income poverty, poor connectivity, and periodic recurrence of droughts and floods give rise to a situation of chronic and endemic food insecurity.

Food security and nutrition security are different. The FAO's Sixth World Food Survey (Food and Agriculture Organization, 1997) showed that while food inadequacy is more prevalent in sub-Saharan Africa than in South Asia, the incidence of malnutrition based on anthropometric measures is higher in South Asia. Apparently, the discrepancy is largely due to differences in disease patterns. Most life-threatening malnutrition occurs among children, but children do not require very large amounts of food. There can be widespread malnutrition in a population even while food security measures indicate the food situation is relatively good. Millions of children worldwide die each year as a result of diarrhea, for example, but this has little to do with the level of food supply in their communities or even in their households. By this understanding, security refers to anticipated conditions. It is different from status, which is about current conditions.

Improving nutrition security would require introducing some sort of change in the local social and institutional arrangements or training or tools or some other resources that could change things over the long run. Nutrition interventions should be assessed not so much on the basis of their immediate impact but on the impacts they are likely to have over the long run, long after the interventions have ended.

Food availability

Food availability is one of the major factors that determine the nutrition status. However, nutrition status, as an outcome, results not only from the quality of food but also from the qualities of care and health services. Thus, we can say that nutrition status depends on food status, care status and health status. And similarly, we can also say that nutrition security depends on food security, care security and health security. Food is the basic need of human beings. The cultural influence of food preferences depends on the properties of food, taboos and social role of food in the family (Atkinson 1992). The natural resources in an ecosystem are the basic energy base for the human beings and they exploit these resources with the help of suitable technology. Technology is a means to explore and exploit the resources. For most households, the food produced on their land does not feed the family for the entire year. The magnitude of food shortage varies from family to family in a given year and from year to year for a given family. In addition, there are significant expenditures to meet the social and cultural obligations. Improvement in food consumption is a necessity but there are insufficient conditions for overcoming the problem of malnutrition in India especially in the vulnerable section of the society like children, pregnant and lactating mothers and tribal population living in the remote areas. Hence, it is necessary to build capacity of vulnerable section to enable them to come out of the poverty trap, through proper livelihood sustaining measures (Rajkishore, 2007).

Women in food, nutrition and livelihood security

In India around 70% of the population earns their livelihood from agriculture (EIU, 1997). The Indian agricultural production area is delineated to 15 regions based on water resources, irrigation pattern, rainfall distribution, soil characteristics and cropping pattern. Characteristics and potentials of agriculture strongly vary across the regions. Each region has distinct characteristics and potentials for agricultural production. Rural Indian women are extensively involved in agricultural activities. However, the nature and extent of their involvement differs with the variations in agro-production systems. The mode of female participation in agricultural production varies with the land-owning status of farm households. Their roles range from managers to landless labourers. In overall farm production, women's average contribution is estimated at 55% to 66% of the total labour with percentages much higher in certain regions (Venkateswaran, 1992). In the Indian Himalayas a pair of bullocks works 1064 hours, a man 1212 hours and a woman 3485 hours in a year on a one-hectare farm, a figure which illustrates women's significant contribution to agricultural production (Singh and Shiva, 1988).

Farmers may be unaware that they have food losses where significant amount of the grains and pulses grown in the field never leave the farm. Food storage is the only part of the system or interim phase through which food passes from the farm to processing and consumption. However, there are also some post harvest losses of food that occur during improper storage due to pests and poor storage conditions. To achieve sustainable reductions in under-nutrition and other forms of malnutrition, national policies and programmes must be complemented by effective community-based actions. These actions must address and remove local causes of malnutrition, for example, chronic or seasonal shortages, lack of dietary diversity, or inadequate feeding practices. Member Nations, as well as institutions and communities, require methodological support and technical advice to formulate and implement solutions. To contribute to food security at household level guidance on how to minimize these losses. Specifically advice on packaging and post harvest technology, development and improvement of traditional storage structures, and extension services. These activities aims at improving household food and nutrition security by minimizing losses which occur during harvesting and post harvest handling of food. Some of the options are:

I. Product Development

This aims at improving the nutritional quality of homemade food products as well as ensuring quality of commercially available food products and diets some of which are:

- Amylase enriched flour
- Local complementary recipes
- Improved complementary foods
- Jams and marmalades
- Confectionaries and bakery products

- Micronutrient enriched beverages.

II. Food Preservation

The principles involved in food preservation are those based on knowledge of the conditions under which micro organism, insect and rodents can destroy foods. Perishable food products such as fruits, vegetables, meet and fish often require preservation treatment before they are stored for later use in order to ensure their availability during times of shortage.

Food preservation is done by removing water hence helping to inactivate pathogenic micro organisms or bacterial growth and stop enzyme activity. Some preservation techniques include heat treatment, freezing, chilling, drying and addition of chemical preservatives such as sodium meta-bisulphate, sugar, salt and vinegar. In food preservation the following aspects have been worked out.

- Solar drying of green vegetables and fruits.
- Low cost fresh cassava storage.
- Long term storage of sweet potatoes.
- Traditional food preservation techniques (salting and lactic acid use).
- Modification of traditional storage structures.

III Food Processing Technology

Food processing is used to increase the shelf lives and quality of foods. Also it is done so as to avoid drudgery and to remove toxins. In this area the following are the options:

- Germination
- Fermentation
- Cereal de-hulling and milling
- Improved sweet potato and cassava processing by grating, chipping and pressing

Conclusion

A key dimension of household food and nutrition security strategy is enabling households to maximise food security and nutrition with existing household resources, while also striving to increase such resources. This requires a process of effectively mobilising women/communities and shifting from a centralised to a more decentralised approach, with wider participation on the part of the women/community. Community-centred nutrition programmes should aim at building capacities and empowering women to create a demand for their own household food security and nutrition improvement. This involves enlisting in them a strong sense of ownership for

developmental programmes, which in essence, become community investments for promoting their own nutritional well-being and development.

Food safety, bio-safety, health safety, nutrition safety, gene safety and environmental safety have become major issues in international trade and role of women is very important in all these safety issues. Women's key role in the production of major grains and minor millets illustrates their invaluable contribution to the food and nutrition security. In addition, women play a crucial role in ensuring supply of food as food vendors and post-harvest processors of livestock and fishery products. As major buyers of family food and meal-makers, women ensure adequate food security. As primary providers of nutrition to the young child women are the major decision-makers in ensuring nutrition to the next generation. In this way we can say women are the ultimate contributor of food, nutrition and livelihood security. It is concluded that food, nutrition security and livelihood are fragile in case of vulnerable section of the society and therefore, need massive support and interventions from government, non-government and public organizations.

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EMPOWERING WOMEN IN PRODUCTION AND MANAGEMENT OF QUALITY SEEDS

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Since enactment of seed law 1996 it was realized by scientists and policymakers of all sectors that seed is the basic input and quality seed is indispensable for realizing the yield potential of the nation. National Seed Corporation, state seed corporations, state seed farms produce sizable amount of quality seeds to meet the national and local demand. However availability of quality seeds is not uniform and farmers in remote villages are deprived from seeds of good quality high yielding varieties. Certified seeds supplied from dept. of Agriculture comprises of limited no of varieties and lot of time in procurement and distribution through different tiers. Lack of standard recommended seed godowns affect the seed substantially in terms of insect / pest infestation and reduction in viability and vigour. The benefits which would have been reaped by the ultimate consumers by use of certified seeds is somewhat diluted in some cases. Problems become more intense in case of oilseed crops like groundnut and soybean.

Field workers, extension functionaries, state owned agriculture departments, scientists engaged in boost in agriculture production have achieved a remarkable target. The portion of target not achieved to reach the goal can only be achieved by looking to seed factor in a more retrospective manner. As long this key to life factor is not addressed by involving farmers participation and dealt in an integrated manner, the situation is not going to improve. Improvement in crop production is not realized by isolating farmers, and then why not seeds? The ignored lot in the crop production scenario, the farm women can be a worthy asset in enhancing the seed sector by better capacity building in seed management and seed enhancement.

Though seed production does not significantly differ from crop production except few crops, farmers still take it lightly to be self sufficient in seeds and always look forward to external source of seed , hence agriculture becomes dependant and prone to many disturbing factors. Under the prevailing circumstance if we want to make more profit oriented agriculture by introducing improved varieties and hybrids preserving the valuable germplasm, then we have to make every farmer responsible for seed.

Agriculture development programmes should integrate seed production by motivating workers to go one step forward beyond crop production up to seed collection. At the present scenario farm women being more organized due to self help groups have more motivational energy and can handle more challenging tasks. A woman who is a mother having experience in rearing a child, a calf, a chick, a seedling can handle a seed, a life entity in a more careful manner.

The science and technology of seed has done tremendous development. Now we can produce transgenic seed with sufficient protection against misuse by use of germination termination technology. We can value add the produced seed by adding artificial color. Pelleted seed is a common technology, where seed comes packed with all necessary planting requirements like nutrients, seed protectants, and growth regulators by modifying its shape, size ensuring uniformity. We have standardized packaging and storage technology also. Where, these modern technologies of making seeds, a more valuable and salable commodity for private companies, decreased the scope for the poor farmers to access it.

India being a land of natural calamities and crop insurance programmes being in still evolving stage, money lenders being the major financier, agriculture became riskier. So in this case where the state government still takes it granted to arrange seeds from other states to meet the cropping season demand, private companies dump hybrids and improved varieties with luring promises, the farmer is trapped and ventures into challenging location specificity, new unknown problems associated with new varieties by ignoring the locally suitable varieties and threatening the biodiversity. What could be a possible escape from these seed associated problems.

India has witnessed promising entrepreneurs in agriculture and allied sectors. One case study can be of mushroom cultivation, floriculture and aquaculture. In all these cases farmwomen played a vital role. They have not emerged overnight. This is the result of continuous attempts and programme implementation. Similar models can be applicable to seed production also. Educating farmwomen at village level and turning them into entrepreneurs is possible. Unlike other sectors seed sector needs little more care.

To start with different areas/ villages/ cluster of villages should be identified within an agro climatic zone having prospect in agriculture. At present due to high male migration most of the farm management activities are coming on the in arranging

seeds for their field's shoulders of farm women. Most of these women being less skillful, agriculture is becoming a burden for them. Having no alternate livelihood option they are bound to adopt it. They are in real need of appropriate technology. Nobody other than these farmwomen can perceive the difficulty they are facing in arranging seeds for their fields. So these farmwomen are the perfect clients to bring a change in the seed scenario of this country.

Farmwomen have natural inclination towards local varieties in addition to improved ones. So biodiversity conservation can be better ensured also. Most of the women in these days are somewhat educated except tribal areas. So technology diffusion will be easier than yesteryears. For ensuring women involvement in seed production Seed Corporation should come forward to enroll women or self-help groups for seed production of crops, vegetables and flowers.

Studies revealed that farm women have the capability of being good seed producers if properly motivated and capacity building is done sincerely. They should be trained at each and every step of seed production, harvesting, threshing etc. Seed management is the perfect area for enhancing women involvement. Among these seed treatment, drying, pelleting, coloring, invigoration and moreover packaging is the need of the hour towards ensuring quality seed sufficiency and can be a better income generation activity. Men and women farmers can work together. Men can produce seed and rest seed management can be done by women. Packaging and labeling is a potential area. Like seed production planting material production is a growing area and equally important for agriculture.

Productivity and quality of horticultural crops depends to a large extent on the availability and quality of planting material and rootstocks. With a view to boost the availability and quality of planting material, establishment of strong nursery infrastructure for mass multiplication of varieties/rootstocks in commercial fruit crops, establishment of mother blocks of improved varieties for mass multiplications of disease free quality planting material and establishment of rootstocks bank to mitigate problems related to biotic and a biotic stressis important .So women can be efficient entrepreneurs in this area. Moreover quality control can never be undermined. So presence of mini seed testing laboratory will be very useful in self assessment of seed quality.

GENDER ISSUES AND OPPORTUNITIES FOR WOMEN IN AQUACULTURE AND FISH PROCESSING

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Women are involved in all activities of fisheries in all continents although the degree and type of participation is quite variable depending on local cultural conditions. In some continents fishing is the domain of men, in various other places women are the active participants. Male–female relations in the fisheries sector vary greatly and are based on economic status, power relations and access to resources.

Gender issues in harvest and post harvest fisheries

In an Indian fisher's family, the responsibility of household management of food, childcare, education, health, sanitation, financial management and the responsibility of getting and repaying debts mostly rests on the women's shoulders. They share their family's financial burden by indulging in shore based activities. Women's most prominent role in small-scale and industrial fisheries is in post-harvest, processing and marketing. In India, approximately 1.8 million people are employed through net mending, marketing fish, peeling, curing, preservation, trading, purchasing, handling, drying, filleting, displaying, and fish-selling activities, with women forming 48% of this total labor force (Nag *et al*, 2012). The women of coastal states of India, except West Bengal are involved in net mending, prawn peeling, fish curing, drying and trading, value addition etc. In Maharashtra, the entire fishing economy revolving around Mumbai are controlled by women. In the Minicoy islands of Lakshadweep, the famous tuna Masmin and Riha Akru are produced by women (Immanuel and Srinath, 2000). In Tamilnadu, seaweed collection is carried out by fisherwomen.

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. There also exist families, where women are the only bread earners. (Sahoo *et al*, 2011). While these examples draw the picture of a highly empowered fisherwoman, with status equal to those of men, there are many different arenas where comparatively low value is attached to the work done by them. For example, motorization and mechanization of fishing vessels has resulted in takeover of fish trade by fish merchants [who were men]. This process displaced

many women from the retailing of fish. As a result majority of fisherwomen have become wage earners in the processing industry. They 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. Moreover they 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. Thus, despite their pervasive involvement in fisheries activities, women's invaluable contribution is often overlooked and undocumented, such that women do not benefit from adequate working conditions, facilities, training and access to information.

Gender issues in aquaculture

Aquaculture is one of the livelihood options which can provide employment in the rural areas. Women's participation in aquaculture is pronounced in many of the Asian countries. In Vietnam, women were found to be very active collaborators in various aquaculture activities including post stocking activities. In Cambodian small scale aquaculture women have been found to contribute more than men in all activities like pond digging, preparation of pond, seed procurement, fertilization and feeding. The role of Indian women in aquaculture is relatively low when compared to many other Asian countries. Here women have to limit their activities to subsistence aquaculture. The low level of participation is due to age old social, cultural and ideological barriers imposed on them. While men are actively engaged in the activities like pond preparation and repairing of hedges, the production, maintenance and management of feed are usually done by women. There exists considerable scope for active participation of women. Several factors that weigh positively for women are ready availability of different low cost production technologies of varying production range, compact production area requiring very little mobility on part of women, proximity of these ponds to their houses etc. Women along the Kerala and Tamil Nadu coast are involved in prawn seed collection and women also participate partially in stocking, feeding, management and harvesting of the prawn. In the case of oyster and mussel culture women are involved in spat collection, seeding and binding of ropes. Increased participation of women in aquaculture activities is required for their self employment and nutritional security. Factors which influence the possibility of women to become and continue to be involved in aquaculture include geographic location, local traditions and outlook, the historical mobility of women, family support and interest, community and peer group support, the age of the women and the effectiveness of the institutional support. Aquaculture is ideal for meeting the protein requirements and fish consumption needs of the population; if it is successful, it can contribute significantly to the livelihood security of rural households and the economic status of the family.

Gender mainstreaming in aquaculture and fish processing

Recognising the potential of aquaculture in bringing socio economic empowerment of rural women in the coastal tracts of Orissa, DRWA has taken several initiatives to empower the rural women in different aquaculture technologies. The aquaculture technologies like fry production, composite fish culture, integrated fish farming and ornamental fish culture has been studied in women perspective. Rural women have also been trained in induced breeding of carps, nursery raising, happa breeding, prawn culture etc. Fry production was found to be a good proposition for farm women as the demand for good quality seed is always high. Inability of women to procure fry from long distance, inconvenience in transporting large numbers of fry over long distance, high mortality of fry during transportation, high cost of transportation and packing, unavailability of fry of desired species at the right time were some of the constraints faced by the rural women prior to the implementation of the project. The beneficiaries were thoroughly trained on the package of practices for carp seed rearing. Onfarm demonstrations were conducted for practical orientation of the beneficiaries. One of the modifications made to the recommended packages of practices was harvesting of early fry from 20th day onwards to reduce the rate of mortality. Continued fry harvesting at different stages resulted in thinning out of density and in 45-50 days good fingerlings were harvested. From the study it was concluded that a pond size of 0.02-0.03 Ha is found to be favourable with respect to ease of management and profitability. As an outcome of the project the fry production increased from 0.2 lakh in the first year to 4.9 lakhs in the 3rd year with increase in area under production from 0.21 ha to 0.54ha.

Women were highly enthusiastic in adoption of the technology as they could utilise their backyard ponds for fry production. The project not only helped the rural women in production of quality seed for fish farming but also served as an additional income source where in an income of Rs 3270/- per pond was obtained (Sahoo *et al*, 2009). DRWA has also trained many farm women on the different management practices in composite farming practices so that they will become competent in taking up aquaculture as a livelihood option. Refinement in the recommended practice for carp polyculture and IMC fry rearing was done taking into consideration the poor economic conditions of women farmers. The farmers were advised to use locally available feed ingredients to reduce the cost. The evident gain in yield has encouraged women farmers to take up the low cost technology. DRWA's suggestion that *Puntius gonionotus* can be taken as a short period crop in shallow ponds or can be grown along with IMC in polyculture was wholeheartedly accepted by the farmers. We could demonstrate that the growth performance of *P.gonionotus* is similar to or even better than mrigal. Thus they could increase the fish yield by manipulating the stocking

density of IMC when *P.gonionotus* was introduced as a short period crop. The species was rated high because of its good taste and smaller head size and they could obtain higher market price for the fish when compared to IMC of 200-300g size.

DRWA has also taken steps to popularise the integrated fish farming techniques by giving priority to farmer's choice and resource availability. Women SHG's were given off farm trainings on the different integration systems by experts from Central Avian Research Institute (CARI), Central Institute of Fresh Water Aquaculture (CIFA) and Directorate of Research on Women in Agriculture (DRWA). Women were eager to adopt poultry cum fish farming as they could utilize the kitchen waste as feed for poultry as well as fish. The location of the poultry shed and pond near to their household helped them to keep watch and ward of the resources thus reducing the cost of labour. The continued sale of eggs and meat decreased the economic burden of their family and ensured their nutritional security. Even though the yield of fish and meat from fish cum duck integration was better than fish cum poultry, the farmers still showed a preference for integration with poultry. The low preference for duck meat and egg, risk of poaching, death of ducks due to consumption of crops sprayed with pesticides are some of the reasons attributed to this. Other integration with vegetables and mushroom showed great promise. Through mushroom cultivation each women farmer could gain Rs175/- per 2 weeks (Sahoo *et al*, 2010). Practices for Semi intensive carp culture was also demonstrated to the rural women with a stocking density of 15000/ha. The beneficiaries could attain an yield of 5 t/ha with minor refinements in the recommended practices like reduced use of cow dung so that the water can be used for domestic purposes too. Hand to hand practice on netting of back yard ponds was imparted to women so that their dependence on men for harvesting the ponds can be reduced.

Demonstration of low cost indigenous technology for ornamental fish production has been given to rural women and efforts were made to facilitate marketing of ornamental fishes produced by women managed production units. The locally available earthen pots which the farmers used for rice parboiling were used for breeding and rearing of ornamental fishes (Jyotsnarani and P.K.Sahoo, 2010).. This reduced the capital cost that could have been incurred to the farmers. The ornamental fishes produced by the units in cluster were supplied to aquarium shops in Bhubaneswar with whom a marketing linkage was made. The farmer's response to the low risk low cost technology of crab fattening has also been immensely encouraging. Water crabs of 150-200gm were purchased from nearby markets at Rs180-200/- per kg. They were fed with trash fish @10% of their body weight and reared for 3-4 weeks till they reached 700-1000g. The crabs could be sold at a price of Rs 500-800/kg. Rural women

were very receptive to this technology because of the short term of culture. They could take up 3-4 crops a year. DRWA, Bhubaneswar has also made its mark on the field of fish processing and value addition. The biochemical and microbiological evaluation of dry fish available in local markets revealed the extremely poor quality of the dry fish. This points to the unhygienic manufacturing practices. A model fish drying unit has been set up with the facilities like fish salting tanks, raised platforms for drying and storage rooms at Penthakota, Puri, Odisha (funding by NFDB, Hyderabad). This has been created to facilitate fisherwomen in producing clean and high quality dry fish so that they can realize better price for their produce in the local market.

Conclusion

The gender issues in the fisheries and aquaculture sector have seldom been examined, and the important role women that play has often been overlooked and, thus, not taken into account in decision-making processes and outcomes, thereby hindering development. Never the less, the Directorate of research on Women in Agriculture (DRWA), the unique institution under ICAR and the only one of its kind globally, during its journey of 16 years has developed core capacity to address women in fisheries and aquaculture through research and dissemination of knowledge in different sectors of agriculture to meet the goal of gender mainstreaming.

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GENDER FRIENDLY PEST MANAGEMENT PRACTICES FOR SAFE FOOD PRODUCTION

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If policy makers were to look more closely at women's needs and contribution, and take measures to ensure they enjoy all their rights without exception, then many of the world's poor would not be so poor, the hungry would be fewer and vulnerable groups would be less vulnerable. Once women are awakened and given the rights, needed orientation of literacy and skill development in gender friendly pest management practices for safe food production, the rural women will move for accepting the challenges of their decisive role and participation. With them the family, the household and the whole village will move and ultimately the Nation will move to bring desired progress and prosperity in the rural areas. 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. Therefore, improving their economic status has now been recognized as an important component for any developmental activity. Rural women face several risks and problems out of which technical risks is the major one. Creating new opportunities for women it is very important that more focus should be given on capacity building of farm women basing on the type of work they desire. First woman President of India Pratibha Patil in her very first official programme at National Academy of Agricultural Science, New Delhi advocated that our agriculture policy and programme should not be only pro poor and pro environment but it must be pro women.

The greatest impact of green revolution is certainly making the food available for common man within his/her means. Nobody can now imagine what would have happened if the food grain production would not have increased from 50 million tones to 252 million tones in 2011-12 during last six decades. Agriculture has enabled the country to increase food production thus making visible impact on the nation's food and nutritional security. However, well established fact of green revolution which was targeted at maximizing food grain production was unrestricted use of water, fertilizers and pesticides. As a response to higher yield, higher doses of input beyond prescribed and scientific limits created newer problems of ecology and environment. The pesticide consumption has gone up. The lop-sided consumption resulted in to build-up of pesticide-resistance, residues in consumables and persistence in soil, water and environment.

PESTICIDE USE IN CROP PROTECTION V/S HEALTH HAZARDS

Since before 2500 BC, humans have utilized pesticides to protect their crops. The first known pesticide was elemental sulphur dusting used in Sumeria about 4,500 years ago. By the 15th century, toxic chemicals such as arsenic, mercury and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides, pyrethrum which is derived from chrysanthemum and rotenone which is derived from the roots of tropical vegetables. In 1939, Paul Muller discovered DDT as a very effective insecticide. It quickly became the most widely used pesticide in the world. Some sources consider the 1940s and 1950s to have been the start of the "pesticide era". Organochlorine insecticides were commonly used in the past, but many have been removed from the market due to their health and environmental effects and their persistence. In the 1960s, it was discovered that DDT was preventing many fish-eating birds from reproducing, which was a serious threat to biodiversity. An example of a widely misused DDT pesticide, which was brought to public attention by Rachel Carson's book, *Silent Spring* was the reduction of the thickness of the egg shells on predatory birds. The shells sometimes become too thin to be viable, causing reductions in bird populations. This occurs with DDT and a number of related compounds due to the process of bioaccumulation, wherein the chemical, due to its stability and fat solubility, accumulates in organisms' fatty tissues. Also, DDT may biomagnify which causes progressively higher concentrations in the body fat of animals farther up the food chain. DDT is now banned in at least 86 countries, but it is still used in some developing nations to prevent malaria by killing mosquitoes. Short term insecticides are often used in homes and dwellings where children, people and domestic animals might be exposed. Most organophosphate insecticides were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. Some are very poisonous were used in World War II as nerve agents. However, they usually are not persistent in the environment. Organophosphates have an additive toxic effect to wildlife, so multiple exposures to the chemicals amplify the toxicity.

A number of the organochlorine pesticides have been banned from most uses worldwide and globally they are controlled via the Stockholm Convention on persistent organic pollutants (POPs). These include, aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene. 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. Indiscriminate and injudicious use of chemical pesticides in agriculture has resulted in several associated adverse effects such as environmental pollution, ecological imbalances, pesticides residues in food, fruits and vegetables, fodder, soil and water, pest resurgence, human and animal health hazards, destruction of biocontrol agents, development of resistance in pests etc.

Crop protection strategies - the management of pests, diseases, and weeds have changed dramatically over time. The intensification of agriculture alters agricultural practices significantly. For example, in intensive agricultural systems, more traditional and labour intensive physical and biological crop protection measures are superseded by pest resistant varieties and more capital intensive use of pesticides. In marginal areas, the generally small returns to these expensive chemical inputs make them difficult for farmers to use (IFAD 2002). Genetically modified technology in crop protection is still poorly understood in many settings, specially with respect to gender differences. Pesticides can increase agricultural productivity, but when handled improperly, they are toxic to humans and other species. A study by FAO, WHO, and UNEP (2004) broadly estimates that between 1 million to 5 million cases of pesticide poisoning occur each year, resulting in several thousands fatalities. Pesticide fatalities are overwhelmingly a developing country phenomenon.

Although developing countries use just 25 percent of all pesticides produced, 99 percent of deaths from pesticide poisoning occur in developing countries. Children and women are specially at risk. Many farmers in developing countries overuse pesticides and do not take proper safety precautions because they do not understand the risks and fear smaller harvests. Making matters worse because pesticides banned or restricted in industrialized countries are used widely in developing countries. Farmers' perceptions of appropriate pesticide use vary by setting and culture. Additional negative environmental effects and socioeconomic costs include the debt incurred by farmers to purchase these inputs, the loss of local knowledge and practices once used to protect crops, and dependence on external sources of inputs. As with so many capital intensive technologies, the poor, including women and children, are the ones least able to benefit from their use. Recent research in India, for example, shows that small scale and marginal farmers take loans from private finance corporations to purchase inputs and then, unable to pay their debts, become answerable to

moneylenders (Mancini and others 2005). The same study also found marginal farmers to have a 10 times greater risk of severe pesticide poisoning than large scale farmers.

Today we have succeeded in getting poisons into the mouths of millions due to faulty agrochemical based food, fodder and vegetable production. Two major challenges facing our agriculture today are the titanic population explosion, the pressure on land has increased tremendously and the indiscriminate use of pesticides has led to problems of environmental pollution and pesticide residues in food items. People have started realizing the present state of continuous ill health is due to the increasing quantity of poison accumulating in their bones and tissues. Mrs Sunita Narain, Director, Centre for science and environment, reported traces of 6 to 13 pesticides mainly monocrotophos, chlorpyrifos and cocktail of phosphamidon and malathion in blood samples of Punjab farmers (June, 2005), which causes infertility and cancer. Certain organo-chlorine pesticides in blood samples from Punjab were found to be 15 to 60 times higher than those of US population. We are living in an age, where neither the water we drink nor the food we eat can be guaranteed free from pollution. The whole food chain is contaminated. However, the increasing consciousness of safe, healthy and quality food is increasing not alone at global front but India too. 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.

With the growing demand for enhancing food grain production to feed continuously increasing population at one end and increasing yield loss due to pest infestation on the other, the farmers of India till recently, have been relying on chemical fertilizers and pesticides. It is estimated that about thirty percent of the potential of food production is lost due to insect pests, diseases, weeds, rodents and birds. In terms of money, it is estimated that every year crops losses worth Rs. 60, 000 crore due to weeds, insects and other pests, out of this maximum loss due to weeds are up to Rs.20, 000 crore and due to insect pests are up to Rs.12, 000 crore every year. Given the large proportion of agricultural production lost to pests and disease, higher yields might be achieved by reducing these losses through capacity building of farmwomen. India stands on 4th place in World in respect of insecticide production. Every year India exports insecticides of 2800 crore rupees.

In India 70 percent insecticides are used in wheat and rice while in other worlds maximum insecticides are utilized in fruits and vegetables. Use of insecticides in Taiwan is 17 kg/ha, Japan 12 kg/ha, South Korea 6.6 kg/ha, America 7.7 kg/ha and Europe 2.5 kg/ha. Use of insecticides in India is continuously increasing but it is less 0.50 kg/ha in comparison to other countries. In Punjab the consumption of insecticides and pesticides has increased from 624 tonnes during 1960-61 to 6900 tonnes in 2003-04. It is a matter of great concern that existing farming is becoming a major threat for human and environmental health. Increasing and injudicious use of pesticides for the protection of crops and storage of seeds and grains have contributed a lot of the environmental pollution and threatened the health of man and animals by disturbing the eco-system. These environmental pollutants are either distributed in the soil, water and air and deposited in plants and food grains and subsequently in the body tissue or directly consumed by man and animals producing direct and in direct toxic effect on the body systems. 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. The current scenario of agriculture revealed that on an average 80 percent of the developed countries of the world are not containing pesticides residue, whereas in India the situation is so grave that this percentage is as low as 2.5 percent. The pesticides being used in India are of first generation which are highly toxic, hazardous and not easily biodegradable. About 1/3 of the pesticide poisoning cases in world are reported from India only. Some of the vegetables like ladies finger, cauliflower, pointed gourd and brinjal are dipped directly in the pesticide solution to improve their appearance.

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.

Judicious use is very important now. In 1990, we consumed 75033 metric tons of technical grade insecticide without substantial increase in production as a result of loss of factor productivity. With judicious use, we have come down to 45000 metric tons and still getting equal or higher yield. Thus pesticides need to be coupled with botanicals, mechanicals, pheromones and cultural practices to develop precise IPM technologies. 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 safe 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.

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 women friendly IPM technologies to increase safety with reduced drudgery are the need of hour at country level as well as at global level. A growing imbalance exists between women's access to IPM technologies to increase safety with reduced drudgery on the one hand and the demands of production on the other.

Integrated pest management 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. Our poets, philosophers or saints have always emphasized that human beings can find happiness only by living in harmony with nature. But with man's greed power, preparing and prestige man has caused unfold damage to the ecosystem. He has used development as a means to exploit nature to its maximum, not caring a bit for the damage it has done and is doing to humanity.

The following components may be included for gender friendly pest management practices for safe food production.

1. Ecology based pest management..
2. Habit diversification.
3. Host plant resistance.
4. Physical methods of pest management.
5. Mechanical methods of pest management.
6. Use of hormone.
7. Use of insect pheromones.
8. Using farmer's wisdom ITKs.
9. Use of plant products/botanicals and
10. Biological control.

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

Intercropping sorghum with other crops has been shown to reduce *C.partellus* damage on sorghum, urdbean, pigeon pea, cowpea and lablab bean (Mahadevan and Chelliah, 1986). The incidence of groundnut leaf miner, *Aproaerema modicella* was highly reduced when groundnut was intercropped with cowpea of blackgram at the ratio of 3:1 (Logiswaran and Mohanasundara, 1985) and with pearl millet at a 4:1 ratio (Baskaran and Thangavelu, 1990; 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 xyliina*). 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-Rodzynekiewicz 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 obtuse* yellow colour attract cotton whitefly, *Bemesia tabaci*, cotton aphids, *Aphis gossypi* 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 in increase the insect catch. Sticky traps are generally used with pheromones (Mohan *et.al.*, 1994).

6. Use of Hormone

The basic studies of insect physiology have evolved the successful use of insect hormones in minimizing the pest population. The prime candidate for developing hormonal pesticides is the Juvenile hormone that all insects secrete at certain stages in their lives. It is one of the three internal secretions used by insects to regulate growth and metamorphosis from larva to pupa and pupa to adult. The Juvenile hormone is secreted by *corpora allata*, which is in the form of two tiny glands in the head. Besides,

Ecdysone is secreted from thoracic gland, which causes pupation and maturation in insects. These hormones have been shown to alter the course of development in insects abruptly when applied at appropriate time and in turn it may be used as pesticides. Carroll M. Williams was first to synthesize cecropia crude juvenile hormone.

7. USE OF INSECT PHEROMONES

Pheromones are chemical substances released by insects, which attract other individuals of the same species. Pheromone trap catches are highest when wind is from the East. Sex pheromones have 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). Detail has been discussed in chapter 12.

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. Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. An example is the development and increase in use of *Bacillus thuringiensis*, a bacterial disease of *Lepidopterous* and some other insects. It is used as a larvicide against a wide variety of caterpillars. Because it has little effect on other organisms, it is considered more environment friendly as well as gender friendly. The toxin from *Bacillus thuringiensis* (Bt toxin) has been incorporated directly into plants through the use of genetic engineering. Other biological insecticides include products based on entomopathogenic fungi (*Metarrhizium anisopliae*), nematodes (*Steinernema feltiae*) and viruses (*Cydia pomonella* granulovirus). According to an estimate 26 billion dollars are spent on synthetic pesticides worldwide per year while only 300 million is spent on biological pesticides. Biological pesticides are far less potent over the long term. As the market for biological pesticides increases, we will also see more and more farmwomen use these biopesticides, which are ultimately better for the environment and beneficial to reduce pesticidal hazards.

OCCUPATIONAL HEALTH HAZARDS AND RISKS OF WOMEN AND MITIGATION METHODS

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Women continue to make significant contributions to the farming community. Not only do women participate in the traditional roles of homemaker, caregiver and wife, they also work side-by-side with their spouses in keeping the farm viable. More daughters are entering the farming business, either as partners with other family members or as independent operators. It is said that health is wealth. Every person has right to live with a good physical and mental health. Any occupation that creates any health problem that should be taken care so that occupational health hazard will be mitigated. Agricultural occupation impacts small physical health problem for a long time, which leads to an incurable disease. Occupational hazard is something that causes harm to the working man, machine or the environment. The health hazard concerns to the hazard to the working man. Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment or combination of these.

Women working in agriculture may be exposed to the same hazards and risks as male workers, but in addition face further risks, particularly to reproductive health (e.g. from pesticides and biological agents). Additionally, women may be at greater risk of work related neck and upper limb disorders. Socio-cultural, economic and physical factors may affect women's exposure to injury-producing events and their knowledge and beliefs about injury prevention. Even less is known about the extent to which occupational risks are recognized when women seek medical care. Differences in size and stature, increased physical strain, and low maximal oxygen uptake may predispose women to ergonomic-related injuries.

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 farmwomen put in hard physical labour beyond their capacity. There are some other causes for which the agricultural operation is still known as the most hazardous industry in the society. These are;

- i. Seasonal nature of agricultural activities irrespective of summer, rain or winter
- ii. Traditional methods of work which is time consuming and laborious
- iii. Increase in mechanization without technical knowledge
- iv. Increasing use of pesticides and agro-chemicals irrespective of requirement
- v. Use of non-ergonomic tools and equipment which increases drudgery of work
- vi. Lack of education and information of farm workers on the health hazards

Types of Occupational health hazards in agricultural sector

- i. **Mechanical hazards:** Poorly designed and/or guarded agricultural machinery is a major cause of fatalities and accidents. Injuries from cutting tools are another major risk.
- ii. **Psycho-social hazards:** Low pay, sexual and other harassment, job insecurity, poor promotion mechanisms, delay in payment of salaries.
- iii. **Work organisation hazards:** Badly organised shift work and working hours, excessive overtime, lone working, lack of control over work.
- iv. **Ergonomic hazards:** These hazards can cause permanent injuries and disablement. For example: badly designed machinery, prolonged static working positions, repetitive work, unsuitable tools used by workers, poor seating.
- v. **Biological:** Workers may be exposed to infections and parasitic agents at the workplace. Persons working with animal products and agricultural workers are likely to be exposed to biological hazards.
- vi. **Chemical:** Toxic corrosive, allergenic and carcinogenic chemicals act by local action, inhalation and ingestion on exposure to concentrations beyond the threshold limit value (TLV).

Mitigation methods of occupational health hazards

- i. **Elimination of hazardous material:** If we can do a farm operation avoiding a hazardous material, then that is the best way to control the occupational hazard.

- ii. **Substitution of hazardous material:** Utilization of organic/bio pesticide rather than use of a chemical pesticide. This control measure minimizes environment pollution as well as eliminates health problems associated with chemical pesticides.
- iii. **Engineering controls of hazards:** Engineering controls are physical changes to the work area or process that effectively minimize a worker's exposure to hazards.
 - a. Enclosed Hazard: Rotating parts may be covered by safety guard.
 - b. Isolate Hazard: Isolation of the hazard with interlocks, machine guarding, welding curtains and other mechanisms.
 - c. Remove / Redirect Hazard: Removal or redirection of the hazard such as with local and exhaust ventilation.
 - d. Redesign Workplace: Redesign of workstation to minimize ergonomic injuries.
- iv. **Administrative controls of hazards:** If engineering controls are not feasible then consider implementing administrative controls. Examples of administrative controls include:
 - a. Limited time exposure to hazards like high vibration, sound or dust exposure
 - b. Written operating procedures
 - c. Safety and health rules for employees
 - d. Alarms, signs and warnings
 - e. Buddy/ partner system
 - f. Training to the operators
- v. **Personal Protective Equipment to avoid hazards:** If all the measures for mitigation of occupational health hazard fail then we will go for intensive care of the operator by the use of apron, goggles, mask, shoe, helmet/cap etc which are known as personal protective equipment to avoid hazards.

Effective hazard control is by the application of all the three measures i.e; engineering, administrative and use of personal protective equipment.

Preventive Maintenance

A breakdown of equipment in the workplace may cause a severe hazard. So the equipment should be maintained regularly in a regular interval. A particular interval for maintenance of all equipment should be determined. A written preventive maintenance

program should be implemented, so that everyone will follow the procedure and action can be taken against the faulty workers. Audit against safety of a machine also should be conducted by an external agency.

Manage Change

A management of change program ensures that any modifications or additions to equipment or processes are understood and controlled. The entire working employee should be updated about the changes of the relevant equipment drawings. The safety procedures of the equipment or process should be modified as per the change. Training for employees should be conducted on the changes of the equipment or process.

Occupational Health Program

An occupational health program allows to respond effectively to workplace injuries and illnesses and to monitor potential health problems. Medical services & first aid should be available at the workplace for emergency use. A medical screening should be conducted for all employees, so that a person suffering from asthma will not be recruited in a industry which continuously produces dust. It is beneficial for the employee as well as for the employer. The employer should keep the medical records of all the employees and it should be regularly maintained. The employer should conduct some wellness program with the help of health centers or NGOs for the benefit of the employee.

Emergency Planning

Effective planning for emergencies is another mechanism of controlling hazards and avoiding employee injuries. A standard written emergency plan should have with all the industries or employers and that should be followed. An emergency eyewash and safety showers should be installed where there is a chance of contamination of chemicals. Emergency drills should be conducted with the help of local emergency responders like fire extinguish centre, natural disaster management centre or any NGOs working on these etc. Emergency contacts of the local emergency responders should be written in display board in several places for the knowledge of the employee and these should be regularly updated.

Suggestions

Following suggestions can be given for the mitigation of occupational health hazard for the farm women:

1. Due attention is needed with regard to suitability of already developed equipment for various farm operations to farmwomen too.
2. Farmwomen traditionally and comfortably involved in the farm operation need not to be replaced by introduction of implements.
3. Indian anthropometric data may be utilized for refining/modifying/developing the farm implements.
4. Manually operated improved farm tools and implements suitable for farmwomen need to be popularized in the region for increasing productivity of farmwomen.
5. Women friendly improved farm tools and implements have potential to increase the working efficiency of farmwomen with reduced drudgery.
6. There is also need to focus on power-operated implements using ergonomical considerations to provide more options available with farmwomen.

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EFFICIENT MANAGEMENT OF RESOURCES AT FAMILY AND FARM

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Resource is a widely used term which is seldom defined precisely. Gross et al (1980) defined resources as means which are available and recognized for their potential in meeting demands. They further define means as those things which have "want satisfying power" and which are instrumental in the reaching of desired ends. Resource is also defined as, a person, asset, material, or capital which can be used to accomplish a goal.

A resource means anything which is used for the attainment of goal. Speaking of natural resources, Barnett and Morse (1973) noted that nature imposes particular scarcities rather than an inescapable general scarcity, and that man is therefore able and free to choose among an indefinitely large number of alternatives. They add that it is the criteria of choice and the effectiveness of man's decision making procedures that will determine shape of total welfare over time. The development of the criteria for choice may be very difficult. Making use of abundance where it exists, families can give more attention than in the past to goals concerned with beauty, culture, learning, improved inter personal relations, and meaningful consumption.

Classification of resources

Human Resources: The resources possessed and utilized by persons are called human resources. The amount of human resources available will vary from one person to another. Therefore, they can be acquired and cultivated. Examples of human resources are Health, Energy, Time, Skills, Education and experience, Interpersonal resources, etc.

Non Human resources: Non-human resources are external to individuals, but they can be possessed and utilized by them. These are the resources which are available for everyone to use. They are more easily recognized than human resources. Some of these resources like park, and community facilities are available to all of us. Examples are Community services, Environmental resources, Economic resources, Technological resources, etc.

Characteristics of Resources

The classification of resource will help to identify the useful resources.

1. Usefulness: Usefulness is one of the most important characteristics of all the resources. All resources are useful. e.g. Money is non-human resource or material Resource which has been used in fulfilling each and every want or need of the family. It is a medium of exchange. Human resources like skill, knowledge etc. are very important .Many times we are not aware of these resources. This group of resources is very important to the family , for not only are they the means of accomplishing desired ends , but in using them well the group acts together in such a way that common goals seem more real and attainable and the quality of interpersonal relations can be lifted.

2. Limitedness: Resources are limited. Time has the unique characteristic of being the one resource constant in amount for all. Human Resources are *qualitatively* limited where as Non-human resources are *quantitatively* limited. *Time* is the most completely limited resource, quantitatively speaking, since no day can contain more than 24 hours, nor can any of these hours be 'saved'. *Energy* too, is a limited resource, differing from time in that the amount of energy available varies greatly from person to person. After doing any type of physical or mental work we feel exhausted or tired because while performing any task, various kinds of efforts are used e.g. mental, visual, manual, pedal, torsal effort etc. Non-human resources are limited too.

3)Inter-relatedness: All resources are inter-related. Human as well as human as well as non-human resources are inter-related. The use of one resource depends on the use of other another resource. It is difficult to attain your goal in absence of one, two or combination of resources.

4)Manageable: Resources are used to achieve goals by applying the managerial process to them. Managerial process involves three steps planning, controlling-implementation, and evaluation-evaluative feedback .This process is applicable to human resources like time, energy, and non-human resources such as money, material goods etc.

5) Quality of life is determined by the use of resources: Probably the most important similarity in the use of all resources is that the entire fabric of life is determined by them, whether or not one is conscious of this overall result. Certainly if a person is to be judged by others on the basis of his management of resources, their use should be carefully and thoughtfully determined.

Efficient resource utilization requires 'management'

Resources are available inputs for production. It is for us to make use of them properly and take advantage of their uses. This can be attained through proper management. The meaning of management is working out of a plan in a systematic way. Every day we are carrying out different types of activities so as to meet our demands. Each activity is carried in a systematic way i.e. by means of planning, controlling and evaluating things. In a very simple way **'Management' is defined as 'using what you have in order to get what you want'**. Here, in this definition, 'what you have' means the resources at your disposal and 'what you want' means the goals. Effective use of available resources, human as well as non-human, affects the quality of life.

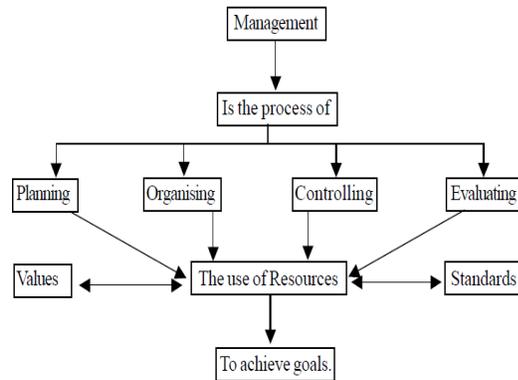


Fig 1: Management process

If we talk about farm households, farm management would be useful to impart knowledge and skill for optimizing the resource use and maximizing the profit. Farm management is concerned with resource allocation. On one hand, a farmer has a set of farm resources such as land, labour, farm buildings, working capital, farm equipments, etc. that are relatively scarce. On the other hand, the farmer has a set of goals or objectives to achieve may be maximum family satisfaction through increasing net farm income and employment generation. In between these two ends, the farmer himself is with a specific degree of ability and awareness. This gap is bridged by taking a series of rational decisions in respect of farm resources having alternative uses and opportunities.

Constraints in efficient utilization of resources

The ability of poor women in developing countries to overcome poverty, enhance productivity, and use resources sustainably is hampered by social and institutional factors that include lack of access to land, to credit, and to education. Women are also often excluded from membership in community organizations that make decisions with respect to production and conservation. In addition, women's multiple economic and household responsibilities impose severe time constraints.

Efficient resource utilization in farm subsystem

In farm households, better use of available resources through adopting strategies for water conservation, storage and other techniques will assist in promoting food security and thus securing their livelihoods. One of the most viable and proven approaches for farm households to effectively use their resources is diversification. *Diversification* can be regarded as the re-allocation of some of a farm's productive resources, such as land, capital, farm equipment and paid labour, into new activities. These can be new crops or livestock products, value-adding activities, provision of services to other farmers, development and promotion of rural handicrafts, etc. Many diversification projects are the result of unusual ideas which have potential for growth. The list of examples below is intended to stimulate thinking.

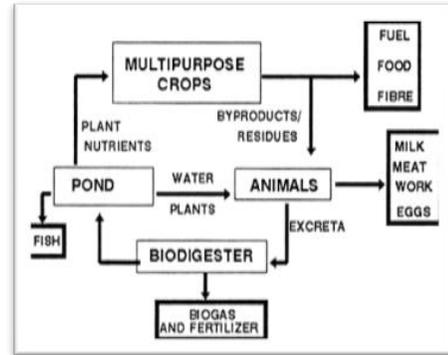


Fig 2 Bio-resource flow in farm household system

1. *Diversification related to agriculture and allied agricultural activities* like cultivating to organic vegetables, flowers, oil seeds and seed production are some of the areas besides taking up mushroom growing and bee-keeping. Some more areas can be like dehydration of fruits and vegetables, canning or bottling of pickles, chutneys, jams, squashes, dairy and other products that are ready to eat.

2. *Diversification related to livestock management activities* like dairy farming, poultry farm, livestock feed production and production of vermi-composting using the animal waste can be an important area in which women can utilize both her technical skills and raw materials from the farm and livestock to earn substantial income and small scale agro-processing units.

3. *Diversification related to household based operations* like knitting, stitching, weaving, embroidery, bakery and flour milling, food preparation and preservation. One's human resources like energy, interest, skill, expertise can be best utilized in this manner.

For efficient utilization of limited resources, *integrated farming system* is the best practice to be adopted. Integrated Farming System may be defined as a set of agricultural activities organized into a functional unit to profitably harness the solar energy while preserving land productivity, environmental quality and maintaining the

desirable level of biological diversity and ecological stability. Integration of different agricultural allied enterprises with crop activity as base would provide ways to reuse and recycle produce/waste material of one component as input in the other linked component and to reduce the cost of production of the economic produce of the component two and finally to enhance the net-income of the farm as a whole.

Efficient utilization of resources in household subsystem

Both human and non-human resources can be utilized efficiently for ensuring livelihood, food and nutritional security of the families thereby enhancing their quality of life. Following are the few examples for efficient utilization of resources.

- **Human resources:** Most of the household tasks require great deal of energy expenditure like mopping, sweeping, cooking, etc and are time consuming too. Labour saving and drudgery reducing devices can be used while performing these tasks. Use of work simplification techniques can cut down the energy cost of these tedious tasks.
- **Household energy resources:** The bio-energy may be used for generating energy for household purposes like cooking, heating water, etc. Various sources of bio-energy are crop residue, cow dung, charcoal, etc can be reused for energy conservation. Briquette for cooking can be prepared from agricultural wastes like bamboo chips, peanut husk, coffee beans, spent fruits, and any type of agroforestry waste. The use of these resources will certainly curb the indiscriminate cutting of trees. Use of renewable energy sources like solar energy, wind energy, tide energy along with energy plantation can also be promoted in rural areas like *neem*, *subabul*, etc. In this line, fuel efficient cook stoves have been designed which consume less cost, are environment friendly and are of low-cost.
- **Food resources:** Many processing and value addition techniques may be used for preparing nutritional foods from the food resources available at households. Eg. Low cost weaning mix for infants, nutritious recipes for children, adolescents, and the whole family etc.
- **Backyard land:** Household land can be used efficiently for nutrition gardening/home gardening. It is a common misconception that home gardens are exclusively subsistence-oriented, whereas in fact home gardens provide households with cash crops as well as food crops (Hoogerbrugge and Fresco 1993). In fact, returns to land and labour are often higher for home gardens than for field agriculture (Marsh 1998). Home gardens can contribute to household income in several ways. The household may sell products produced in the home garden,

including fruits, vegetables, animal products and other valuable materials such as bamboo and wood for construction or fuel. The household may use the home garden site to conduct cottage industries to produce crafts or small manufactures that can be sold (Marsh 1998). In many settings, the home garden plot is the site for important post-harvest activities such as drying and threshing. The plots also typically provide space for storing food, tools and other capital assets. Some livelihood activities like mushroom cultivation, nursery raising and backyard poultry rearing can also be practiced on the household land.

- **Water resources:** Rain water harvesting is a viable and efficient method of conserving rain water. Rainwater harvesting is the accumulation and deposition of rainwater for reuse before it reaches the aquifer. Uses include water for garden, water for livestock, water for irrigation, and indoor heating for houses etc. In many places the water collected is just redirected to a deep pit with percolation. The harvested water can be used as drinking water as well as for storage and other purpose like irrigation.
- **Animal resources:** One of the most common, easily available animal resources is cow dung which is used as a cooking fuel, sanitizing cleanser, construction material, insulation, and waterproofing for walls and floors in rural houses; a cultural symbol in religious worship; the raw-material for producing organic compost and generating electricity. Value added products from milk can be prepared at household level for nutritional and livelihood security. Fibre can be produced from sheep rearing and silkworm rearing.
- **Forest resources:** The forage trees are considered as an important part within the strategy supplying protein, fire wood and also improving the soil fertility as is the case with leguminous trees. Besides this trees and tree products can be used for a wide range of items such as fuelwood, fodder, fibers for clothing and mats, roofing materials, basketry, leaf plates and medicines both to earn income and to meet household needs. Various non-timber forest products (NTFPs) like *tendupatta*, *mahua seeds* etc can be obtained from trees without harvesting them. A value-analysis of the Amazon rainforest in Peru (Peters et al, 1989) found that exploitation of NTFPs could yield higher net revenue per hectare than would timber harvest of the same area, while still conserving vital ecological services. NTFPs can be an important source of income that can supplement farming and/or other activities.

Principles for maximizing utilization of resources

While using resources, we have to ensure that we utilize them in such a way that we get maximum benefit from their use. This way we will be able to get maximum satisfaction. The different ways by which we can achieve this are listed below.

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

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

Reduce: This means less consumption of resources to conserve them for future use. For example, energy- the human resource shall be conserved by use of culturally appropriate, labor-saving technologies that reduce women's time and energy burdens.

Reuse: It means using the resources that have been used earlier. Like crop residues, cow dung, etc.

Recycle: It means considering interaction among resources rather than treating each resource in isolation.

As resources are scarce and limited, there is a need for good planning and management so that resources could be used wisely for maximum gains. Resources shall be consciously selected, organized and controlled and their interactions shall be identified for efficient resource utilization.

Management of resources

For efficient utilization of resources, management is an important aspect. We have to achieve a large number of goals and satisfy our wants. Whether your goals more important or less important, you need resources to achieve it. You are also aware that resources are limited. To achieve our goals with limited resources, we have to follow a systematic method. Management involves the following steps:

- Planning
- Organising

- Controlling
- Evaluating

You will see that everyone follows a particular procedure when they work towards their goal. First you have to think about what to do and how it is to be done, that is, you do the planning. Then you assemble the resources and assign the responsibilities. In other words, you are organizing. After that you perform the actual task, i.e., you put your plans to action or you are controlling your activities so that it is according to your plans. Once the task is over, you check to see whether everything went according to your plan or not. In other words, you are evaluating.

Following is a detailed description of each step of management. These are called the steps in Management. Thus, there are four steps of management:

Step 1: Planning: The first step in management consists of thinking in advance of what needs to be done i.e., planning. A simple way to plan is to make a list of all the things that need to be done. Since certain things have to be done first and others later, arrange them in a proper order or in a sequence.

Thus, planning involves: Listing activities, sequencing activities, and providing flexibility for any adjustments.

In short, during planning think about the following:

- What is to be done?
- Who will do the work?
- How will it be done?
- When will it be done?
- What resources will be used?
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Step 2: Organising: After planning, you have to organize your resources and your work so that the plan is carried out properly. Organizing involves assembling resources and fixing responsibilities.

Step 3: Controlling: Once the plan is ready and the resources are organized, actual work starts. Controlling is necessary at this stage, because activities must move according to the plan. Controlling is also known as putting a plan into action. As the plan is being carried out, you also have to check the progress of your plan. Controlling means carrying out the activities as planned and organized earlier.

Step 4: Evaluating: Evaluating, means checking the progress of your plan and taking corrective measures if needed. For example when you cook a meal for your family, you want to taste whether it is done properly or not. You also see whether everything is made in adequate amounts. Evaluation helps you to check your mistakes and improve your work and product. Thus evaluation helps you to understand your weaknesses and mistakes so that it is checked and will not be repeated in future. This is also called looking back or "feedback". Though you may find that evaluation is listed as the last step, it is done at each stage of management i.e. planning, organizing, and controlling. You have to evaluate at every stage so that you do not regret in the end. Since you are constantly evaluating your work, you come to know the defects of your planning, organizing and controlling. By applying the abovementioned techniques of management, the resources can be used efficiently and utilized optimally for better family living.

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DRUDGERY REDUCING OPTIONS FOR FARMWOMEN INVOLVED IN AGRICULTURE

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The women are the backbone of agricultural workforce but worldwide her hard work has mostly been unpaid. She does the most tedious and back-breaking tasks in agriculture, animal husbandry and households. They don't get any chance to take a nap and work like a machine without any break as compare with the man. Still women are considered as secondary workers in the economic scenario. Rural women who were classified as workers a greater proportion worked in agriculture when compared with men, as comparatively fewer women workers were in the more productive non-farm sector and secondly, women's share in the total number of agricultural workers is increasing overtime leading to their increased involvement in agriculture. As men migrate to urban areas and to non-farm sectors in response to both the distress in agriculture and better job opportunities elsewhere, women's responsibility both as workers and as farm managers has been growing, leading to an increased feminization of agriculture. The proportion of female agricultural workers in the total rural female workforce was 79 per cent in 2009-10, whereas for males this figure was only 63 per cent.

On the whole, women from small farming families and particularly from rain-fed backward areas actively participate almost each and every agricultural activity right from land preparation, weeding, sowing, transplanting to the harvesting and storage of the agricultural produce and secondary agriculture. The majority of these activities, which are full of drudgery, have not been supported by the mechanical advantages of tool and appliances. However, involvement of women from families of rich and big farmers (those with irrigation and machines) is only marginal, partly because of mechanization. It is quite uncommon to see women handling machines such as tractors and threshers. Agricultural development programmes from government are usually planned by men and aimed at men. Mechanization, for example alleviates the burden of tasks that are traditionally men's responsibility, leaving women's burdens unrelieved or even increased. The excess burden of work on women ("the double day" of the farm work plus house work) also acts as a stimulus to have many children so that they, especially female children, can help out with chores from an early age (WTO, 2010). The physical demand of the farm work which range from moderate to heavy, often include climbing, standing, squatting, bending and reaching, carrying

heavy loads and working for long hours is responsible for drudgery and in the long run it may bring certain hazards to a person.

What is Drudgery?

It is the tedious, menial, or unpleasant work, which 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 of farm women in agricultural 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. 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. 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

Participation of women in agriculture include horticulture, aquaculture, animal rearing, household activities etc. at different fields, orchards and also in back yards can't be ignored. Preparation of nursery bed, sowing of seed, shading the bed, up-rooting the nursery plant, transplanting plants, manual irrigation, application of fertilizer, weeding, harvesting, grading & sorting packaging, marketing, storage and post harvest of produces are the common activities where farm women spend their quality time with additional responsibility of families and household work. Most of the activities doing by them manually are drudgery and hazard prone. They use very old tools and equipment which also used by the gents are not suitable for them. There are more drudgery and stress among the farm women found in the field level. They adopt very awkward static posture such as squatting, bending, sitting and performing tasks repetitively for hours which is responsible for musculoskeletal disorders and leads to occupational health hazards. Pain in upper and lower limbs, injuries in finger, nail & palm, allergies & injuries in skin are the major problems one can identify easily. Besides these transportation of harvests from the field to home by the women on head is also an important problem can't be ignored.

Women share abundant responsibilities to perform wide spectrum of duties both in the home and outside but their participation is considered as normal by the society. Women are extensively involved in activities related to production, processing, preparation and marketing and selling of food-grains, fruits, vegetables and fishes, dairy and other animal products. These tasks not only demand considerable time and energy but also are sources of drudgery for rural women which are not yet precisely identified and quantified. The result is that women's needs for comfortable work participation remain neglected. The problem of women relates to physical and mental fatigue, monetary hardship, exploitation, pain, economic stress, malnutrition,

unemployment/ underemployment are very often encountered in the society. Almost all women suffer physical drudgery in various operations, some are given below:

Drudgery in various agricultural operations
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| <ul style="list-style-type: none">➤ Hard physical work in care and management, harvesting, threshing/processing, marketing and bartering of produce.➤ Child bearing and rearing simultaneously.➤ Remain for a long time under rain and scorching sun.➤ Harvesting by bending.➤ Weeding with conventional implements by hand in hot sun, rain and cold for long hours.➤ Dehusking/shelling, pounding, grinding of cereals and pulses by hand, etc➤ Collecting and carrying fuel over long distance.➤ Fetching of water for cooking and drinking from distant places. |
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Drudgery experiences imply-

- **Work is time competitive**
Poor amenities, elaborate work procedures, long distances to travel for meeting basic needs make the women spend more time the survival and productive tasks. Women working in such conditions feel that work is never ending, difficult and time demanding.
- **Work is physically strenuous**
Larger dependence on muscular forces in productive as well as survival activities coupled with nutritional insufficiency and poor physical fit make the worker exhaust very soon at work. This may lead to severe muscular disorders.
- **Work is a complex process and difficult to perform**
The cumbersome work processes due to lack of simplified procedures, more number of tasks remaining unattended at the end of the day make women to feel that work is difficult to perform and work is never ending. Low output efficiency is another result of such processes.
- **Work is causing postural discomfort** and painful leading to muscular disorders. Poor working postures due to work station heights, seating amenities, postures while lifting and handling materials in work cause stress on the skeletal

and joint muscles. Such working postures result in to pains, body disorders, hazards and low out put efficiency.

- **Work is demanding with heavy physical loads to handle**
The manual loads operative in handling materials with the load borne on body muscles such as in lifting, pushing, pulling, and transferring result women to feel that work is heavy and demanding muscular potential.

- **Work is dynamic with force & movements causing stress on respiratory or circulatory system of human body.** The repetitive, forceful and rapid muscular movements while walking with material, climbing, and cutting, pounding etc cause women to feel that work is fatigue. A crop production cycle involves a series of distinct field based operations. These operations are managed by depending on manual power, draught animal power and tractor power or a combination of them. The critical operations of farming namely sowing, transplanted, weeding, harvesting are performed by women depending on laborious manual power leading to drudgery.

Need of Women friendly tools and equipments

Farm women use various traditional tools for different farming, household and animal rearing activities. Sometimes these tools and equipments are not women friendly. Those were developed according to the anthropometry of men workers which is different in case of women workers. Another major factor is that most of the farm tools and equipments for various agricultural operations have been designed mostly for men workers although women are actively engaged in almost all farming activities for long hours in Indian agriculture. The physical structure, physiological conditions, aerobic capacity grip strength etc of men is totally different from women. Due to these women face difficulty while handling the existing tools and equipments and it induce drudgery. Therefore these tools and equipments can be modified or refined suitable to the workplace and to help the farm women in maximizing their activities. Safety aspects can be considered while providing improved tools and equipments. Farm women should get more suitable tools& according to their necessity for performing different activities in agriculture and allied sectors.

Management of Drudgery Reduction Programme

Women have to do jobs that are time and labour intensive such as sowing, transplanting, weeding, intercultural, harvesting, threshing, and post-harvest operations like, shelling, cleaning, grading and processing. They also contribute to decision making processes for crop production, seed production and management,

post-harvest management of agricultural and horticultural produce, biomass utilisation, livestock management, marketing and financial management. In addition, women take up small ventures to generate additional family income. Therefore, the role of women in agriculture and allied occupations, and household activities needs proper recognition. Women constitute a major component of agricultural workforce. They have, however, lagged behind in use of improved crop production and processing tools and machinery. Now, a number of gender neutral and simple devices/equipment for crop production and processing has been developed. Their adoption by women will not only help improving the agricultural production but will also elevate the status of women through better jobs and greater role in the economy of the family. Capacity building of women in technology use is a major action strategy recommended by policy for reducing drudgery. By having good safety management program, one can avoid not only farm injuries, but also unplanned accidents that are costly, time consuming, stressful and inconvenient. Thus there is need for increasing the awareness of the agricultural workers regarding safety while doing farm work and management of health hazards.

Technology Intervention for Drudgery Reduction

Technology intervention means the application of scientific knowledge as solutions to practical problems. In agriculture it means to introduce tools, implements and machinery useful for various agricultural operations. It may comprise of mechanical or motorized power, or a combination of these. A country's development is regarded by its level of technology integration in different domains of human activity. A number of agricultural implements and hand tools suitable for farm women have been developed by various Research & Development organizations under ICAR. These gender friendly tools are being promoted to community through different intervention schemes with specific aim to promote and strengthen agricultural mechanization through training, testing and demonstration and promotion & popularization of gender friendly tools.

Women friendly tools and implements by ICAR-CIWA

There are several researches carried out in DRWA related to ergonomic evaluation, testing, refinement and modification of different farm technologies with women perspective. Certain equipments such as manually operated cleaner-grader, fertilizer broadcaster, seed drill, ridger, hand operated maize dehusker sheller for farmwomen, rice drum seeders, rice transplanters, cono-weeder, improved sickles, pedal operated thresher and winnower were ergonomically evaluated and also modified. But limited work was done on horticultural crops related to women friendly farm equipment and drudgery.

The women friendly farm tools and equipment were refined/ modified/ assessed/ developed by different research organizations. Of which, twenty one manual operated improved farm tools and implements have been found suitable for operation by farm women based on ergonomical data (Singh et al, 2007 and Srinath and Singh, 2009). The improved tools and implements are given below with brief description.

Improved Equipment		Benefits of Improved Equipment
S. No.	Summary of Data	
1	Commercial available seed treatment drum: It was ergonomically evaluated with farm women.	Equipment provides safety to worker as direct contact with chemical is avoided in addition to avoiding bending posture & uniform mixing. The equipment can also be used on custom hiring also to generate income.
	Weight : 26.0 kg	
	Output : 200 kg/h	
	Mean heart rate : 115 beats per min	
	Mean work pulse : 27 beats per min	
	Cost (approx) : Rs. 2000.00	
2	DRWA Hand Ridger: It was modified and ergonomically evaluated with farm women	About 67% saving in physiological cost with equipment in addition to avoiding bending posture that is adopted in traditional practice. Productivity of worker doubles with the equipment than traditional practice.
	Weight : 3.0 kg	
	Area covered : 333 m ² /h	
	Mean heart rate Pulling : 127 beats per min Guiding : 115 beats/min	
	Mean work pulse Pulling : 44 beats per min Guiding : 30 beats per min	
	Cost (approx) : Rs. 500.00	

3	Commercial unit of fertilizer broadcaster: It was refined/modified for farm women and evaluated ergonomically with farm women		About 6% saving in physiological cost with equipment in addition to uniform application of fertilizer apart from their occupational safety. The equipment can also be used on custom hiring also to generate income.
	Weight	: 3.0 kg	
	Area covered	: 1.15 ha/h	
	Mean heart rate	: 134 beats per min	
	Mean work pulse	: 49 beats per min	
	Cost (approx)	: Rs. 1500.00	
4	CIAE Seed drill: It was refined/modified for farm women and evaluated ergonomically with farm women.		About 87% saving in physiological cost with both the equipment than traditional practice in addition to avoiding bending posture that is adopted in traditional practice.
	Weight	: 11.0 kg	
	Area covered	: 430 m ² /h	
	Mean heart rate Pulling	: 135 beats per min	
	Guiding	: 119 beats per min	
	Mean work pulse Pulling	: 46 beats per min	
Guiding	: 28 beats per min		
Cost (approx)	: Rs. 2000.00		
5	PAU seed drill: It was refined/modified for farm women and evaluated ergonomically with farm women.		
	Weight	: 13.0 kg	
	Area covered	: 460 m ² /h	
	Mean heart rate Pulling	: 122 beats per min	
	Guiding	: 127 beats per min	
	Mean work pulse Pulling	: 37 beats per min	
Guiding	: 41 beats per min		
Cost (approx)	: Rs. 2000.00		

6	TNAU four row paddy drum seeder It was ergonomically evaluated with farm women		Being light in weight, easy to transport and handle. Line sowing is done with the equipment that promotes use of mechanical weeders thereby reducing drudgery and cost during weeding operation. The equipment can also be used on custom hiring also to generate income
	Weight	: 8.0 kg	
	Area covered	: 917 m ² /h	
	Mean heart rate	: 144 beats per min	
	Mean work pulse	: 61 beats per min	
	Cost (approx)	: Rs. 5000.00	
7	CIAE naveen dibbler: It was ergonomically evaluated with farm women.		About 13% saving in physiological cost with equipment in addition to avoiding bending posture that is adopted in traditional practice.
	Weight	: 4.0 kg	
	Area covered	: 150 m ² /h	
	Mean heart rate	: 104 beats per min	
	Mean work pulse	: 17 beats per min	
	Cost (approx)	: Rs. 400.00	
8	CRRRI two row rice transplanter was ergonomically evaluated with farm women		In addition to avoiding bending posture that is adopted in traditional practice, CRRRI two and four row rice transplanters save 39 % and 55% cardiac cost/ m ² , respectively. But there is need to refine the float to reduce the frictional load.
	Weight	: 14.0 kg	
	Area covered	: 95 m ² /h	
	Mean heart rate	: 138 beats per min	
	Mean work pulse	: 64 beats per min	
9	CRRRI four row rice transplanter was ergonomically evaluated with farm women		
	Weight	: 23.0 kg	
	Area covered	: 245 m ² /h	
	Mean heart rate	: 148 beats per min	
	Mean work pulse	: 62 beats per min	
	Cost (approx)	: Rs. 7000.00	

10	CIAE Twin wheel hoe: It was ergonomically evaluated with farm women.		About 43% saving in physiological cost of worker per unit of output in addition to avoiding bending/ squatting postures.
	Weight	: 5.0 kg	
	Area covered	: 150 m ² /h	
	Mean heart rate	: 127 beats per min	
	Mean work pulse	: 41 beats per min	
	Cost (approx)	: Rs. 500.00	
11	CIAE IEP Cono-weeder: It was ergonomically evaluated with farm women.		It avoids bending posture as it is operated in standing posture.
	Weight	: 9.0 kg	
	Area covered	: 165 m ² /h	
	Mean heart rate	: 153 beats per min	
	Cost (approx)	: Rs. 2000.00	
12	Improved serrated sickles: Sickles (Vaibhav, Naveen and Gujarat Agro) were ergonomically evaluated with farm women for harvesting wheat, paddy and soybean.		About 15% saving in physiological cost of worker per unit of output during wheat harvesting in addition to the advantage of safety to workers as it does not slip.
	Weight	: 0.2 kg	
	Area covered	: 151 m ² /h in wheat	
	Mean heart rate	: 120 beats per min	
	Mean work pulse	: 27 beats per min	
	Cost (approx)	: Rs. 60.00	
13	OUAT pedal operated paddy thresher: It was ergonomically evaluated with farm women.		It helps to reduce the drudgery involved in paddy threshing as bending posture is avoided and arms are not raised above shoulder height. The equipment can also be used on custom hiring also to generate income.
	Weight	: 39 kg	
	Output	: 77 kg crop/h	
	Mean heart rate	: 136 beats per min	
	Mean work pulse	: 53 beats per min	
	Cost (approx)	: Rs. 5000.00	

14	Octagonal tubular maize sheller: It was ergonomically evaluated with farm women		About 15% saving in physiological cost of worker per unit of output in addition to eliminating the chances of injury to fingers of worker with this.
	Weight	: 0.22 kg	
	Output	: 27 kg cobs/h	
	Mean heart rate	: 93 beats per min	
	Mean work pulse	: 16 beats per min	
	Cost (approx)	: Rs. 60.00	
15	Commercial available rotary maize sheller: It was ergonomically evaluated with farm women.		About 32% saving in physiological cost of worker per unit of output in addition to eliminating the chances of injury to fingers of worker with this.
	Weight	: 80 kg	
	Output	: 73 kg cobs/h	
	Mean heart rate	: 114 beats per min	
	Mean work pulse	: 36 beats per min	
	Cost (approx)	: Rs.5000.00	
16	DRWA Gender friendly hand operated maize dehusker-sheller: It was developed using ergonomics and mechanical considerations.		About 39 per cent saving in physiological cost of worker per unit output as compared to traditional method of dehusking and shelling. About 22 per cent saving in physiological cost of worker per unit output as compared to traditional method of dehusking and shelling with tubular maize sheller. Equipment is gender-friendly. The equipment can also be used on custom hiring also to generate income.
	Weight	: 85 kg	
	Output	: 60 kg grain/h	
	Mean heart rate	: 142 beats per min	
	Mean work pulse	: 42 beats per min	
	Cost (approx)	: Rs.18000.00	

17	DRWA refined sitting type groundnut decorticator: It was refined/modified for women and ergonomically evaluated with farm women.		About 79% saving in physiological cost of worker per unit of output with equipment in addition to eliminating the chances of injury to fingers of worker. The equipment can also be used on custom hiring also to generate income.
	Weight	: 10 kg	
	Output	: 30 kg pods/h	
	Mean heart rate	: 111 beats per min	
	Mean work pulse	: 27 beats per min	
	Cost (approx)	: Rs.1200.00	
18	CIAE Standing type groundnut decorticator: It was also ergonomically evaluated with farm women.		About 74% saving in physiological cost of worker per unit of output with equipment in addition to eliminating the chances of injury to fingers of worker. The equipment can also be used on custom hiring also to generate income.
	Weight	: 15 kg	
	Output	: 33.1 kg pods/h	
	Mean heart rate	: 122 beats per min	
	Mean work pulse	: 42 beats per min	
	Cost (approx)	: Rs.1500.00	
19	Commercial available Jaw type cotton stalk puller: It was ergonomically evaluated with farm women.		Bending posture is avoided thus reducing drudgery and chances of backache to workers in cotton stalk pulling operation.
	Weight	: 5.0 kg	
	Area covered	: 46 m ² /h	
	Mean work pulse	: 25 beats per min	
	Cost (approx)	: Rs. 500.00	
20	CRRI hand operated paddy winnower: It was ergonomically evaluated with farm women		Winnowing can be done at any time in enclosed area, which avoided the environment problems. The equipment can also be used on custom hiring also to generate income.
	Weight	: 36 kg	
	Output	: 242 kg /h	
	Mean heart rate	: 112 beats per min	
	Mean work pulse	: 31 beats per min	
	Cost (approx)	: Rs.7500.00	

21.	CIAE hanging type grain cleaner: It was ergonomically evaluated with farm women		In addition to 63% saving in physiological cost, the productivity of worker increased more than four times with equipment as compared to traditional practice. The equipment can also be used on custom hiring also to generate income.
	Weight	: 17 kg	
	Output	: 225 kg /h	
	Mean heart rate	: 103 beats per min	
	Mean work pulse	: 22 beats per min	
	Cost (approx)	: Rs.3500.00	

The above women friendly equipment are found suitable for various farm operations like, ridge/ furrow making, seed treatment, granular fertilizer broadcasting, sowing in lines, weeding in lines, rice transplanting in line, crop harvesting, fruit harvesting, paddy threshing, paddy winnowing, cleaning/ grading the grains, maize dehusking-shelling, maize shelling, groundnut pods stripping, groundnut decortications, stripping of sugarcane leaves, uprooting of cotton stalks, etc. Of this, there are about seven women friendly farm equipment (Seed treatment drum, Belly mounted Fertilizer broadcaster, four row-paddy drum seeder, Groundnut stripper, Groundnut decorticator, Maize dehusker-sheller and Paddy winnower) which are suitable for custom hiring purpose and introduction of such farm equipment will increase their income and ultimately improvement in livelihood.

It has been realized that the needs of men and women with respect to technologies differ because of the differences in preference, priorities and working environment. Although women are involved in all the agricultural activities but have been using traditional methods/ tools. In agriculture, both men and women perform the farm operations but still the women workers do not use machines as mostly these have been developed male anthropometry in mind. As a result these equipment are not suitable for women as the ergonomical characteristics (aerobic capacity, strength, anthropometry, physiological workload, work preference, wearing of loose clothes/dupatta and safety issues) of farm women differ from that of men. 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. Therefore these tools and equipments can be modified or refined suitable to the workplace and to help the farm women in maximizing their activities. Safety aspects can be considered while providing improved tools and equipments.

Conclusion

Drudgery of farm women in various field operations could be reduced by providing improved farm tools and equipment. The improved tools and equipment are primarily developed keeping men workers in consideration while farm women in the country are also involved in most of the operations. The posture adopted during the operation are also not proper and lead to occupational health problems, if not given due attention. The work in an upright posture is preferred particularly for long duration job in addition of stooped or squat posture. A sitting posture may be better than standing, if job permits. The suitability of equipment to farm women can be judged in better way using ergonomical studies as ergonomics cover all aspects that deal with anthropometry, assessment of workload, working environment and safety features/mechanism to optimize human-machine environment system. This helps in increasing their working efficiency with reduced drudgery by fitting to the capabilities and limit of human operators/workers.

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BACKYARD POULTRY PRODUCTION: THE IDEAL OPTION FOR RURAL WOMEN SELF-EMPLOYMENT

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Participation of women farmers in Indian agricultural production system is significant. Starting from field operation, animal husbandry practice and in food processing sector, they play vital role as the major working force. However, their participation as job creator / provider for self-employment need to be encouraged through different programme. Their dependence on male counterpart will be minimised only when they will be properly guided for doing their own business even it is small. This will empower the rural women in true sense.

Backyard poultry rearing is one of the agricultural practices that suit the un-employed rural women of our country. This is a practice which neither needs more investment nor much difficult technical knowhow to begin with. On the other hand demand for meat and egg is quite high everywhere at any point of time. Again to overcome the malnutrition and protein deficiency in a landless / marginal farm family, backyard poultry production practice will perhaps be the one of the best option. Women by nature are more affectionate to every creature. Their keen association with the poultry birds reared by them is always helpful for better feeding and nourishing in different stages of growth and production. Also the caring nature of rural women towards the birds motivates other members of the family to contribute voluntarily for the better health management of the birds. Thus considering all these advantages, backyard poultry rearing may be treated as one of the suitable animal husbandry practice for rural women.

Before initiation of a backyard poultry unit, one has to be careful about certain critical points which is essential for the success of the farmer. These are:

1. ***Mass vaccination against against Ranikhet disease:*** The biggest threat to the successful backyard poultry production in rural is Ranikhet disease (R.D.). It is a viral disease that spreads very fast with high mortality rate. The only way to control the disease is through vaccination. Therefore, village selected for adoption of the backyard poultry technology must be thoroughly vaccinated against R.D. before introduction of new birds. It is always advisable

to vaccinate all the birds of one village at one time and preferably during evening hour. Vaccination during evening hour facilitates cent-percent vaccination and there is minimal stress to the birds due to low ambient temperature accompanied by night rest in the shed. Vaccination against R.D. at-least once in a year helps eradicating the disease from the village and also protects the farmers from great loss.

2. **Night shelter (Low-cost poultry houses):** Predation is one of the drawback for successful poultry rearing under extensive management practice. Therefore small, hygienic but low-cost poultry houses are to be constructed with locally available materials viz bamboo, mud and straw for thatching. Paddy husk may be used as litter material. Poultry house should be constructed either in the front or by the side of the farmer's dwelling house so that the attention of the whole family will be there on the birds and its safety. Floor space required is 2.5–3.0 sq.ft per bird with a preferred height of 5.0 ft and windows in opposite direction for cross ventilation.
3. **Selection of bird (variety):** For backyard poultry production a suitable variety of chicken for dual purpose needs to be selected. Considering the farmers preference the variety must be of colored plumage, good scavenging ability, faster growth rate, early sexual maturity, moderate egg production potentiality (150-170 eggs in within one year of age) and little fighting ability to protect from predators. Also hens laying brown shelled eggs are more preferred. Healthy chicks of such variety are to be arranged for the farmers through the developmental organisations for a successful programme.
4. **Training / capacity building:** A village farmer needs to be little trained about the backyard poultry production practice. She has to brood the chicks, fed her birds, vaccinate and manage for better laying performance by the bird. Therefore, field demonstration and training is to be extended for the farmers going to start their unit for the first time.

Methods of developing a backyard poultry unit:

Brooding of day old chicks: Day old chicks of improved variety procured from hatchery are brooded first in the farmer's house. Maintaining proper temperature in the brooder house through putting electric bulb is essential. In the absence of electricity conventional source of heat by earthen oven is to be made. Commercial chick mash has to be offered for first 10-12 days as the chicks are not allowed to go outside during this time. Clean drinking water should be provided in chick drinker. Antibiotic (tetracycline powder 2g /lt of water) and multi-vitamin preparations may be

provided to chicks for initial five days which reduced early mortality and help in maintaining the healthy flock. Litter material should be dry and need to be changed as and when required. However, after one wk, the chicks are to be allowed to roam in the house premises in a confined area so that they will acclimatize themselves to the outside environment. During this period broken rice/wheat and other feed from home source may be offered. Chances of predation during this period are to be avoided with care. The first dose of R.D. vaccine i.e. "Lassota" is given to all the chicks through naso-ocular route within five days of age. This will give protection upto three months of age.

Growing management: After brooding the growing birds tried to collect the nutritional requirement from environment through scavenging. Insects, earthworms, food particles, ants, tip of grass etc are the favorite feed resources available to them. However, regular offering of kitchen wastes, vegetable peels, fish scales and left over food of the family to the growing birds will enhance faster gain of body weight and minimize the age of sexual maturity. No commercial feed provision is advised to birds reared under backyard. During this period the shelter house of the adult birds is to be cleaned regularly to keep the floor dry. Second dose of R.D. vaccine i.e. R₂B vaccination (s/c or i/m: 0.5 ml) is to be done between 10-12 wks of age which develops immunity for one year. Also deworming is to be done by four months of age.

Laying management: Dual purpose color birds in backyard used to initiate laying between 20 – 24 wks of age irrespective of any variety. At the beginning they used to lay eggs outside near bushes or straw heaves etc. Therefore, adult hens are to be provided laying nests (bamboo baskets with straw inside or tilted wide-mouthed earthen pots with rice husk inside) before initiation of laying. Hens normally produce a typical crouching sound when age of egg laying approaches. It is advised to put all the hens inside the poultry house before mid day for one hour and laying nests are to be put inside it so that hens will be accustomed to the practice of regularity in egg laying.

For better economic return and for more availability of feeding source to laying hens from surrounding, the adult male birds (cocks) in the flock need to be disposed at the earliest when laying approaches in the unit. The layer hens should be provided with calcium rich diet like fish scale or marble dusts during egg laying period so that farmer can get hard shelled normal sized eggs in a regular manner. Commercially available calcium preparations yield better result in terms of egg production if supplemented in regular interval during laying period.

Sustainability of backyard poultry unit by a farmer: A farmer can generate good earning through a backyard poultry unit. But the income should be continuous over a long period of time so that it will help in improving the livelihood of farmer family. In order to achieve the goal she has to continue the same practice in a regular manner so that quantum of egg production will not be disturbed. The right time to raise next batch of chicks is immediately after disposal of male birds of the first batch. It is because of the reason that after disposal of cocks the flock size is reduced and space will be made available for next batch of birds. Secondly, hens of second batch will initiate laying when egg production in the first batch will start declining. Therefore, the farmer will get productive stock all the time. This will help in maintaining the continuity of the practice and to earn a regular income.

Economics of backyard poultry rearing: Managing a flock of backyard chicken unit by a women farmer is definitely beneficial. Her time of involvement is minimal. Investment is least. Risk is marginal. Taking all these things into account, it is calculated that a successful beneficiary can earn Rs 14,000/- to Rs 16,000/- per annum as net gain for her family besides extending nutritional security to the family to certain extent. This may be treated as a significant income for a landless or marginal farmer which aids to her livelihood in many ways.