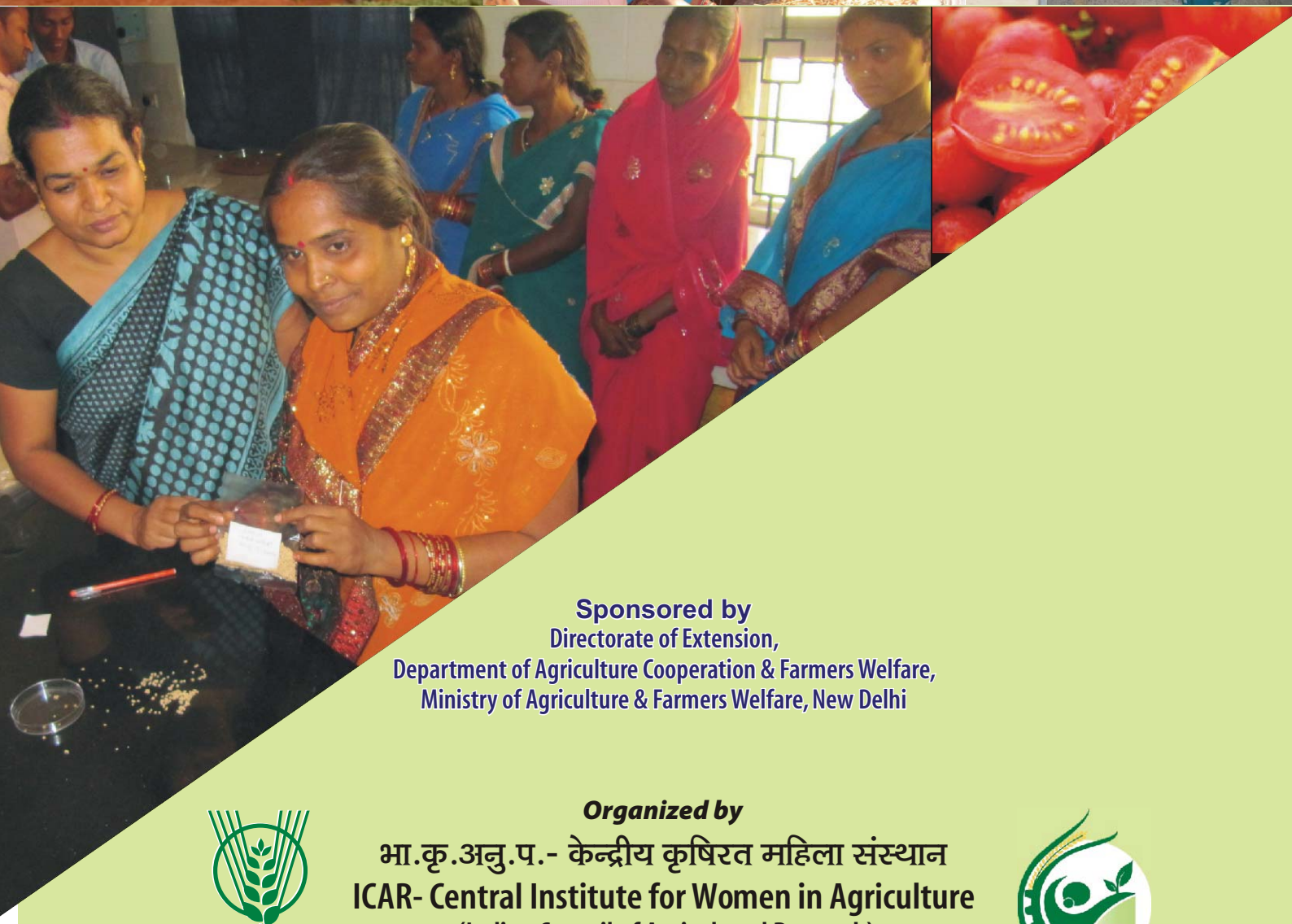
COMPENDIUM

Model Training Course
"Strengthening Farm Women Perspective in Quality Seed Production"
(11-18 January, 2017)



Sponsored by
Directorate of Extension,
Department of Agriculture Cooperation & Farmers Welfare,
Ministry of Agriculture & Farmers Welfare, New Delhi

Organized by
भा.कृ.अनु.प.- केन्द्रीय कृषिरत महिला संस्थान
ICAR- Central Institute for Women in Agriculture
(Indian Council of Agricultural Research)
Bhubaneswar-751 003, Odisha

COMPENDIUM

Model Training Course

On

Strengthening Farm Women Perspective in Quality Seed Production

(11-18 January, 2017)

Dr. Jatinder Kishtwaria
Director, ICAR-CIWA

Course Team

Laxmipriya Sahoo, Course Director
Tanuja S., Course Coordinator
Shivaji Dadabhau Argade, Course Coordinator

ICAR- Central Institute for Women in Agriculture
Bhubaneswar- 751003, Odisha

Compendium

Strengthening Farm Women Perspective in Quality Seed Production

January, 2017

Compiled & Edited by

Laxmipriya Sahoo
Tanuja S.
Shivaji Dadabhau Argade

Citation

Sahoo, L. P., Tanuja, S. and Argade, S. D. 2017. Strengthening farm women perspective in quality seed production. ICAR- Central Institute for Women in Agriculture, Bhubaneswar, pp.....

Published by

Dr. Jatinder Kishtwaria
Director
ICAR- Central Institute for Women in Agriculture
Plot No. 50-51, Mouza-Jokalandi, Post- Baramunda,
Bhubaneswar- 751 003, Odisha, India.
Phone: 0674-2386241
Fax: 0674-2386242
E-mail: director.ciwa@icar.org.in;
Website: http://www.icar-ciwa.org.in

Printed at:
AB Imaging & Prints Pvt. Ltd.,
62 & 63, Ganga Nagar, Unit-6, Bhubaneswar

Preface

Agriculture and allied activities support livelihoods of nearly 70 per cent of India's rural population resided in over 638000 Indian villages. Seed is basic catalyst for the success of agricultural production. The practice of seed saving has been a corner stone of Indian farming traditions that has made agriculture, a way of our life. In recent times, it has also drawn the attention of the world community as a means of technological intervention in agriculture for commercial interest on one hand and on the other, the imminent need to conserve the diversity which is on the threat of extinction. Seeds are critical in the food chain and women's role as seed savers and breeders have been largely responsible for keeping the diversity alive. So the need of the hour is to encourage women's inherent capabilities in seed multiplication and management and establish their dominance in the fast growing seed sector. Development of new models of seed production for women enabling their access to land, skill, technology and critical inputs will go a long way in making them potential seed producers for fulfilling the seed need of the villages. Combined with this, a systematic seed production plan, involving farmwomen for locally adoptable cultivars, will help in the conservation of these rich germplasm. This holds the key to food and livelihood security of the people especially in the wake of climatic changes. Knowledge on labelling, packing, testing and marketing techniques will empower them in quality seed production .

In this model training course, the lectures were kept in such a way that it could give overall picture on the importance of seed in agriculture and the role of women in seed sector. All the faculties of Model Training Course have immensely contributed their knowledge, skill and experience to the success of the course. Their contribution has helped in compiling a vast pool of scientific information in the field of quality seed production with participation of farmwomen.

The support of Directorate of Extension, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India is greatly acknowledged for sanctioning the Model Training Course. It is indeed a great pleasure to thank the state governments and Director of Agriculture of Arunachal Pradesh, Bihar, Chhatisgarh, Himachal Pradesh, Odisha, Tripura, Uttar Pradesh and West Bengal, for nominating the officials for this course. The sincere and active participation of all the participants in the Model training Course are greatly appreciated.

Dr. (Mrs) Jatinder Kishtwaria, Director, ICAR-CIWA has extended wholehearted support, guidance and encouragement in all stages for organizing the Model Training Course. Authors are highly indebted to the outside speakers for sparing valuable time and sharing their experience with the participants. All the scientific, technical and administrative staff of ICAR-CIWA was behind the success of the Course.

Course Team

Contents

Strengthening Farmwomen Perspective in Quality Seed Production

Jatinder Kishtwaria & Laxmipriya Sahoo

ICAR-Central Institute for Women in Agriculture, Bhubaneswar

Role of farmwomen is crucial in all sectors of agriculture and agro processing which contribute to the household economy. Farm household derives its total sustenance either from crops or livestock, in which women contribute substantially to either one or both. However associated with their contribution in farm sector, different issues also emerge which retard their working attitude, renders severe monotony and sometime exposes to undesirable occupational health hazards. These gender issues differ in nature and magnitude with respect to the working area, occupation, social structure, economic condition and educational status. Farmwomen's access to resources, inputs, services, information, produces, benefits and extend of control, level of participation in decision making, scope for skill up gradation, development of entrepreneurship skill are the important areas of gender study.

Studies indicated that participation of farmwomen in different agricultural operations is quite significant in Odisha. Their role became more crucial recently with response to massive male migration and increase in female headed households. So there is urgent need for capacity building of farmwoman in crop husbandry, marketing management. Equally important is to improve their access to seeds and planting materials, fertilizers, pesticides, crop weather information and knowledge on farming.

In our country extension information dissemination is male centric. Woman could get the information as secondary source. Same situation prevails with seeds. Farmwomen have always less access to quality seeds and planting materials of desirable varieties. Success of government promoted agriculture schemes very often becomes unsustainable due to lack or less access to quality seeds. So access to quality seeds is the key for achieving quality participation of women in agriculture.

Quality seed

Seed refers to any botanical seeds, tubers, cuttings, suckers, implants etc. which are used for producing a new plant. Quality seed is the seed, which has good germination or regeneration ability, desirable moisture content, true to mother population, uniform, free from disease causing organisms and insect pests.

Importance of farm saved seed

As per farmer's right of PPV & FR (Protection of plant varieties and farmer's rights act-2003) farmers can produce, sell and exchange their produced seed. So the seed saved and produced by the farmer is called farmer saved seed. In India we have an organized seed production and distribution system organized by National Seed Corporation, state seed corporations and state seed certifying agencies. Parallel to this public owned system, private companies of all sizes operate largely in production of HYVs, Hybrids and Genetically modified seeds of high value crops and occupy a major market share. Besides these two systems farmers produce their own seed and farm saved seed occupy minimum of 50% share in Indian seed industry. So farm saved seed is very important and there is a need to improve the quality of farm saved seed.

Present involvement of farmwomen in seed production

From beginning of agriculture in ancient times, farmwomen played an important role in seed collection, conservation and maintenance. However in the post green revolution era, their importance diminished due to the use of more HYVs and

hybrids. Men took control over seed procurement and management. So access of farmwomen reduced to the main farmland and seed and women dominated in other operations like transplanting and weeding, which are more drudgery prone activities.

Need for more access of women to quality seed

Small and marginal women farmers, who are desirous of cultivating crops and to maintain homestead nutrition garden, face acute shortage of quality seeds. Though seeds available they cannot access it in the village and depend on male members for its procurement. Due to discontinuance of seed production and maintenance activities, they did not develop much skill in it.

Strategies to Strengthening Farmwomen Perspectives in Quality Seed Production

Improvement in access of farmwomen to quality seed necessitates involvement of women in seed production activities. Besides skill development in practices like seed production, processing and storage it is essential to strengthen the following aspects with farmwomen perspectives like-

1. Awareness Generation

Often farmwomen of Odisha hesitate to express the difficulties faced by them in farming and quality seed need is taken less seriously. Arrangement of seeds usually becomes more difficult and farming is delayed and compromised. So awareness generation becomes imperative to document their perceived need for quality seed and their concerns for less participation in agriculture due to lack of seed. This step leads to formulation of programmes to address their seed needs

2. Capacity Building

Seed production and distribution system in India takes care of all released and notified location specific high yielding varieties for seed production. At times it happens that seeds of few promising varieties are multiplied and distributed to farmers. So many promising local varieties with good adaptability to climatic fluctuations, insect pest resistance, indeterminate fruiting type remains out of seed multiplication chain. So capacity building of farmwomen in production and management of both high yielding varieties and local varieties will definitely improve their access to quality seed and conservation of these local races.

3. Working Knowledge

For involving farmwomen in seed and planting material production of crops, vegetables, flowers medicinal plants etc. Working knowledge is essential in their part. So step by step training on soil and climate requirement of crop, sowing, transplanting, rouging, isolation requirement, off types, supplementary pollination, fruit and seed set, time of harvesting, threshing, processing and storage will help in developing skill in farmwomen. Proper seed labelling and packing will add value to the produced seed.

4. Community Involvement

Community involvement will prove beneficial. In a community farmwomen will be more confident in learning skills and sharing of responsibilities. This will help in effective penetration of knowledge. The community can be a unit involving all the village households or a farmers' interest group, a SHG, a group of few likeminded people or a joint family. Seed production in a community can be characterized in three ways:

- Seed production individually but with a common goal
- Seed production in a common land with equal benefit sharing

- Seed procurement by a community or SHG from all producers and handling distribution

In this model of seed production farmwomen can enjoy easy and immediate access to quality seed and can have exchange option in absence of working capital. Then both essential seeds of food crops and prized crops like vegetables and flowers will be equally available to the rural farmers. Certified seed production of notified varieties can also be taken up in a community with collaboration of state seed corporations for marketing dealership for easy access at the village level.

5. Orgainzahianal Participation

For enhancing the quality and quantity of farm saved seeds and improving access of farmwomen to quality seed by involving them in seed production and management activities, organizational support is necessary. Participatory evaluation of scope and opportunities, provision of source seeds, quality control, maintenance of threatened local races, marketing assistance, entrepreneurship development etc. has to be done in participatory mode with farmwomen. For sustainable development of agriculture much stress has to be given on seed and planting material production. Bulk seeds having heavy transport requirement like potato, tuber crops, sugarcane, plantation crops like coconut, banana etc. can be produced in their vicinity or in their field, thereby saving in the investment and maximizing benefit. Impact of one successful area can be multiplied by organizational participation by producing more number of skilled manpower from the locality.

6. Contract Production

Contract production of seeds and planting materials by farmwomen by private companies, Krishi Vigyan Kendras, State farms, Seed Corporations can be very convenient. Contract production is a package which comes with source seed, proven technology and assured procurement and marketing. The major challenge in contract growing is cancellation of contracts, if quality parameters are not met. So contract production should follow organizational support and handholding for development of adequate skill of farmwomen in specialized production methods.

7. Policy Support

With advent of green revolution, high input dependant High Yielding Varieties (HYVs), and hybrid varieties, rural agriculture became corporate dependant. Farmers became dependant for everything on corporate sector and public distribution system. Local varieties which are suited to the local climate and have the capability of giving good return by using family resources are being replaced by few HYVs due to lack of organised seed multiplication system for them and gradually being out from the scenario. This made agriculture highly risk prone as investment has gone high. Along with this it leads to erosion of precious germplasm which are source for future development of HYVs. So the gene pool is becoming very narrow which will affect effective plant breeding.

So suitable programmes and policies for creating inventory of the local varieties still being cultivated, determination of their yield potential, quality analysis, documentation of specific advantages, and conferring the local people the legal rights of these cultivars on seed production and distribution is necessary. This will involve more women in seed multiplication.

So in addition to quantity of this farm saved seed, qualitative improvement is necessary by skill training. Maintenance of carryover seeds, proper storage environment provision, making seed activities mandatory, inclusion of farmwomen in large numbers will be quite helpful. Proper conservation of surplus seeds for enabling quick resowing at times of disaster, when, first sowing is damaged is quite logical for

quick recovery of disaster damage. Inclusion of women SHGs as contract growers of seed corporations by relaxing the minimum land size requirements, involving them more in vegetable seed production can help them grow as seed growers.

8. Lesser quality standards for farm saved seed

Development of lesser seed standards for labelling of these seeds and development of authorized mini seed testing laboratories in every block or panchayat for this farmer notified varieties will be useful for giving a boost to women involvement in seed production and increasing their access to quality seed.

8. Promotion of women seed distributors

Promoting farmwomen or women SHGs as seed distributors and retailers of both certified seed and farmsaved seed is an important step in increasing seed access of farmwomen. The seed requirements of the local people will be better assessed by women and seed procurement from local growers will be faster.

Conclusion

Farmwomen's problems are many, and, limited access to quality seed is the major challenge in a disaster prone state like Odisha. Seed security is essential for sustaining rural farming for minimizing migration from rural areas. Combining effort by farming community, developmental workers, researchers and policymakers can convert the seed problem of farmwomen to an opportunity for them to emerge as major seed producers and distributors.

****

Present Policy Environment and Access of Farm Women to Seed

Dr. L. P. Sahoo, Dr. S. Tanuja and Dr. Shivaji Argade
ICAR-Central Institute for Women in Agriculture, Bhubaneswar

INTRODUCTION

Seed as a core entity for life transformed the ancient human life and was the basis for settling civilizations. It can be considered as the greatest discovery like fire. Women's observations on plant multiplication lead to collection of seeds and inception of agriculture. Hence seed and knowledge on seed continued to be a heritage for farm household and rather considered as a natural resource or gift of nature. Seed selection, collection and preservation were attached to the pride of communities and women. There was a lot of variation in plant resources to fetch for all good, bad or moderate patch of mother earth. It passed from one place to other in the virtue of marriages, rituals and trading. Ethno cultural values of species rendered deep knowledge within the farming community for conservation of priceless germplasm. A basket of seed could describe a civilization. Seed was never a matter of perplexity for them. However advancement of systematic agriculture witnessed development of high yielding varieties and increased production. These high yielding varieties promised more production and replaced most of the traditional cultivars. Certified seeds offered more opportunities for breeders and government seed producing organizations in establishing a systematic seed network which in turn increased our total food production.

Farmer's capability of seed management could not keep pace with large scale introduction of improved varieties of food and cash crops. This necessitated a separate framework for dealing with seed. Seed production and distribution was taken in a centralized manner by the state. As a result seed conservation by farmers and state managed seed system were flown apart and became two different things. This weakened the relation between seed and farmer particularly farmwomen. They failed to relink themselves with the seed. Hence Production and distribution of high yielding varieties seeds became the main agenda for transforming agriculture from deficiency to sufficiency, and rendered seed the status of an external input rather than a natural resource. Less focus was given in preparing farmers for internalizing the improved seed. Hence detachment of farmer from the seed management was so fast that they could not own the seed, thus cultivation and seed conservation became two different aspects and gap was widened.

Lack of inclusive and careful transition from traditional to modern farming via improved cultivars is creating difficulty among the agrarian community particularly farmwomen. Very few studies were done on the impact of these seed factors on women headed families. Major issues affecting her efficiency in managing farming are less inherited knowledge from mother or mother in law on seed conservation, limited access to the seed distribution and procurement network, denial to institutional credit in absence of land rights for investing in agricultural inputs like seed etc. Scarce knowledge on plant protection and fertilizer issues needed for hybrids, their pollination and fruit setting behavior and seed renewal induces skepticism in their mind. Less exposure to seed generation system ends up in either purchasing fresh seed every year or allowing compromised genetic purity. Seed availability is a major determinant for their involvement in farming. Being unable to choose the right crop or variety, climatic vagaries can play more havoc on women, affecting her nutritional and livelihood security. Corporatization of agricultural inputs is decreasing their access to good seeds as seeds are gradually becoming costlier.

Development of hybrids and genetically modified varieties is taking out seeds from farmers hand by imposing Genetic material utilization restriction technology (GURT).

B. PRESENT POLICY ENVIRONMENT FOR FARMER'S RIGHTS ON SEEDS

"Farmers' rights" is a core component of the International Treaty on Plant Genetic Resources for Food and Agriculture (hereafter referred to as "the Treaty"), and as such its full implementation is a prerequisite for achieving the Treaty objectives. However, there is much concern that the activities of UPOV and WIPO are not supportive of farmers' rights, and even undermine those rights, thereby hindering implementation of the Treaty provisions. At the fifth session of the Governing Body of the International Treaty on Plant Genetic Resources, which was held in September 2013 in Oman, Resolution 8/2013 was adopted. It requested the Secretary of the Treaty, among other things, "to invite UPOV and WIPO to jointly identify possible areas of interrelations among their respective international instruments." Thus the work on Resolution 8/2013 and any follow-up Resolution should question the way in which UPOV and WIPO support or hinder implementation of Article 9 of the Treaty.

International Treaty on Plant Genetic Resources for Food and Agriculture

Article 9.1 states that Parties to the Treaty "recognize the enormous contribution that the local and indigenous communities and farmers of all regions of the world, particularly those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic resources which constitute the basis of food and agriculture production throughout the world."

Article 9.1 is essentially recognition of the important past contributions of farmers, as well as an acknowledgement of the important role they will play not only in the conservation but also in the "development of plant genetic resources" that constitute the foundation for food and agriculture globally. Existing literature provides irrefutable evidence of the contribution of farmers – particularly small-scale farmers – to the development of plant genetic resources for food and agriculture (PGRFA) as well as to food security.2

Article 9.2 places the responsibility of realizing farmers' rights in the hands of national governments. It further states that each party should, **"as appropriate" and "subject to national legislation," "take** measures to protect and promote farmers' rights including":

a) Protection of traditional knowledge relevant to plant genetic resources for food and agriculture;
b) The right to equitably participate in sharing benefits arising from the utilization of plant genetic resources for food and agriculture; and
c) The right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture.

The importance of this fundamental aspect is reinforced by Article 9.3, which states: "Nothing in this Article shall be interpreted to limit any rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law and as appropriate." Thus, the right to freely save, use, exchange and sell farm-saved seed and other propagating material should be considered to be an important right of farmers.

There are various aspects throughout the Treaty that are important with regard to the implementation of farmers' rights, such as: –

Article 6.1(a): pursuing fair agricultural policies that promote, as appropriate, the development and maintenance of diverse farming systems that enhance the sustainable use of agricultural biological diversity and other natural resources

Article 6.1(c): promoting, as appropriate, plant breeding efforts which, with the participation of farmers, particularly in developing countries, strengthen the capacity to develop varieties particularly adapted to social, economic and ecological conditions, including in marginal areas

Article 6.1(d): broadening the genetic base of crops and increasing the range of genetic diversity available to farmers

Article 6.1(e): promoting, as appropriate, the expanded use of local and locally adapted crops, varieties and underutilized species

Article 6.1(f): supporting, as appropriate, the wider use of diversity of varieties and species in on-farm management, conservation and sustainable use of crops, and creating strong links to plant breeding and agricultural development, in order to reduce crop vulnerability and genetic erosion, and promote increased world food production compatible with sustainable development

Article 6.1(g): reviewing, and, as appropriate, adjusting breeding strategies and regulations concerning variety release and seed distribution. Implementation of these elements is fundamental to the realization of farmers' rights.

UPOV 1978

Article 5 of UPOV 1978 provides for breeders' rights, but it is limited to "production for purposes of commercial marketing, the offering for sale and the marketing of the reproductive or vegetative propagating material, as such, of the variety."

It is generally accepted that farmers using the protected varieties have the freedom to save and exchange farm-saved seed/propagating material. However, the sale of the protected variety's propagating material requires the authorization of the right holder.

In contrast to UPOV 1991, UPOV 1978 offered greater leeway to implement farmers' rights. It is worth noting that though UPOV 1978 provided more flexibility, there are limitations to the implementation of farmers' rights.

Section 39(1)(iv) of the Indian PVP Law states: "a farmer shall be deemed to be entitled to save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a variety protected under this Act in the same manner as he was entitled before the coming into force of this Act: Provided that the farmer shall not be entitled to sell branded seed of a variety protected under this Act."

UPOV 1991

UPOV 1991 greatly expands the scope of breeders' rights and severely limits farmers' rights. Breeders' rights are expanded to "producing, conditioning, offering for sale, selling or other marketing, exporting, importing or stocking for purposes of propagating material of the variety."

These rights also extend to acts in relation to harvested material if obtained through an unauthorized use of propagating material, unless the breeder has had reasonable opportunity to exercise his/her right in relation to the propagating material.5 An optional exception to breeders' rights is provided under

Article 15.2 of UPOV 1991, which states: "to be de- fined in national law, within reasonable limits and subject to the safeguarding of the legitimate interests of the breeder, […] in order to permit farmers to use for propagating purposes, on their own holdings, the product of the harvest which they have obtained by planting, on their own holdings, the protected variety."

UPOV advocates the following interpretation for this article: "The Diplomatic Conference recommendation indicates that the optional exception was aimed at those crops where, for the member of the Union concerned, there was a common practice of farmers saving harvested material for further propagation. The wording 'product of the harvest' indicates that the optional exception may be considered to relate to selected crops where the product of the harvest is used for propagating purposes, for example small-grained cereals where the harvested grain can equally be used as seed i.e. propagating material.

Factors which might be used to establish reasonable limits and to safeguard the legitimate interests of the breeder are the size of the farmer's holding, the area of crop concerned grown by the farmer, or the value of the harvested crop. Thus, 'small farmers' with small holdings might be permitted to use farm-saved seed to a different extent and with a different level of remuneration to breeders than 'large farmers'. For those crops where the optional exception is introduced, a requirement to provide remuneration to breeders might be considered as a means of safeguarding the legitimate interests of the breeders."

Increasingly, developed countries (particularly the US, EU and Japan) and institutions such as UPOV, WIPO and the Community Plant Variety Office (CPVO) employ different methods and means to pressure developing countries to adopt strengthened breeders' rights at the expense of farmers' rights, including the right to use, save, exchange and sell farm-saved seed/propagating material. This limits the flexibility of Treaty members to take the necessary steps to implement the Treaty obligations, including farmers' rights. Article 9 of the Treaty stipulates "that the responsibility for realizing farmers' rights, as they relate to plant genetic resources for food and agriculture, rests with national governments." However, the implementation of Article 9 is not possible due to the incoherence of the international legal system. Thus, it is imperative to interpret and revise the UPOV Convention to make it compatible with the recognition of farmers' rights. UPOV's instruments and activities fail to give due recognition to the contribution of farmers and local and indigenous communities, or acknowledge their continuing important role in the development of plant genetic resources. While safeguarding the interests of commercial breeders, its instruments (especially UPOV 1991) are detrimental to the interests of farmers and local and indigenous communities. To facilitate implementation of Article 9 of the Treaty, it would be important to revise UPOV 1991 and provide greater flexibility to governments to implement the right to freely use, save, exchange and sell farm-saved seed/propagating material.

Patents

The TRIPS Agreement allows WTO members to exclude "plants" from patentability. However many countries limit such exclusion to "plant varieties," thereby allowing for the patenting of plants and their parts and components.

In addition, even in countries where the legislation excludes plants and plant varieties from patent protection, patents have been sought and granted on genetic constructs, cells and other parts and components of plants.

Exclusive rights granted by patents prevent farming practices that freely use, save, exchange and sell seeds, as well as preventing the option of using protected material as a source for further improvement of a plant variety.

There is a need for clarity about WIPO's technical assistance on plant genetic resources, particularly what specifically is advocated by WIPO with regard to patenting of plant genetic resources. There would then be a need to assess the impact of this assistance on the implementation of farmers' rights and the Treaty objectives.

Alternative Sui Generis PVP Legislation

Several countries (e.g. India, Malaysia, Thailand, Ethiopia) have opted to depart significantly from the "one size fits all" model of UPOV 1991 and adopt innovative national PVP laws that balance the different interests (public interests, interests of commercial breeders, and the interests of small-scale farmers), as well as implement the requirements and obligations of the Treaty, the Convention on Biological Diversity (CBD) and the Nagoya Protocol on Access and Benefit Sharing.

Farmers' rights under PPV&FR Legislation

1. Farmer who has bred or developed a new variety shall be entitled for registration and other protection under PPV&FR Act, 2001 in the same manner as a breeder of a variety.
2. Farmer who is engaged in the conservation of genetic resources of land races and wild relatives of economic plants and their improvement through selection and preservation shall be entitled in the prescribed manner for recognition and reward from the Gene Fund provided that material so selected and preserved has been used as donors of genes in varieties registered under this act.
3. Farmer shall be entitle to save, use, sow, re-sow, exchange and share or sell his farm produce including seed of a variety protected under this act in the same manner as he was entitled before the coming into force of this act provided that the farmer shall not be entitled to sell branded seed of a variety protected under this act.

AGROBIODIVERSITY AND ABS (ACCESS AND BENEFIT SHARING)

Agricultural (agro) biodiversity is the diversity found amongst the many life forms in agriculture. It includes seed varieties, animal breeds, fish types, living soils, micro-organisms and their habitats. The most commonly understood imagery of agrobiodiversity is cultivated ecosystems with a range of crops and cropping systems, evolved and adapted over generations. Uncultivated sources and non-harvested species also play a significant role in the food and nutritional security of local communities. However, now the very existence of all these is under threat either from overuse or misappropriation by a range of players, both public and private. This is contributing, in lesser or more degree, not only to the loss of resources and erosion of knowledges, but also to a decrease in diversity itself.

ACCESS AND BENEFIT SHARING (ABS) 'Access' implies obtaining genetic or biological material or resources (GBMR) or people's pre-existing knowledge of their qualities, for purposes of formal research and development (R&D) as well as commercialisation.

Benefit Sharing This is a specific concept to be brought to life whenever access takes place. It requires the accessor of GBMR or traditional knowledge (TK) to share the benefits derived from the use of those resources, with the communities in the country of origin of the resources, in fair and equitable measure.

Historically, in agriculture, biological resources were accessed by the people in a community or geography for their own subsistence and local exchange, or in some cases sale outside.

Growers and cultivators from within the local communities in an area do not need to intimate any government body, i.e. the State Biodiversity Board (SBB), to access resources, as domestic companies (whether small firms or large corporations) need to do before such access.

[Section 7] However, foreign nationals, institutes or companies will need to get permission from the National Biodiversity Authority (NBA) under the domestic access and benefit sharing (ABS) regime for access to any Indian GR or TK.

Public sector institutions have been and continue to access resources through bio-prospecting and bio-surveys of soil, plant and animal germplasm.

This remains a controversial issue in implementation. For, some governments feel that these activities are in exercise of national sovereignty and therefore do not require NBA scrutiny. Yet there are other interpretations that such access by the public sector too should be regulated under the BD Act, with the NBA, the apex governmental agency, approving or restricting such access. [Chapter II of the Act]

C. Women and biodiversity Conservation

Bio diversity definition is broad, spanning diversity between ecosystems and species, and also within species (genetic diversity). Agro-biodiversity encompasses all components of biological diversity of relevance to food, agriculture and the sustainability of agro-ecosystems.

Loss of biodiversity

The two great ecological challenges of our times are biodiversity erosion and climate change. And both are interconnected, in their causes and their solutions. Industrial agiculture is the biggest contributor to biodiversity erosion, as well as to climate change. According to the United Nations, 93 percent of all plant variety has disappeared over the last 80 years. Monocultures based on chemical inputs do not merely destroy plant biodiversity, they have destroyed soil biodiversity, which leads to the emergence of pathogens, new diseases, and more chemical use.

Biodiversity may be the basis of human well-being but human habits threaten to deplete it.

Unfortunately, the loss of biodiversity is accelerating at an unprecedented rate. According to the World Conservation Union's 2002 Red List of Threatened Species, over 11,167 species face extinction. The most important drivers of biodiversity loss are unsustainable production and consumption, inequities in distribution of wealth and resources, demographic developments, international conflict, and international trade and agricultural policies. These result in land conversion, climate change, pollution, atmospheric nitrogen deposition and unsustainable harvesting of natural resources. As ecosystems falter, threats to food and water security, health care and economies grow.

Role of women

The Convention on Biological Diversity in its preamble recognizes "the vital role that women play in the conservation and sustainable use of biological diversity" and affirms "the need for the full participation of women at all levels of policymaking and implementation for biological diversity conservation".

A specific framework for the participation of indigenous women is found in the programme of work on the implementation of article 8 (j) and related provisions of the Convention on Biological Diversity regarding participatory mechanisms for indigenous and local communities. In this regard, task of the first phase of the programme of work urged:

Parties to develop, as appropriate, mechanisms for promoting the full and effective participation of indigenous and local communities with specific provisions for the full,

active and effective participation of women in all elements of the programme of work, taking into account the need to:

- ✓ Build on the basis of their knowledge
- ✓ Strengthen their access to biological diversity
- ✓ Strengthen their capacity on matters pertaining to the conservation, maintenance and protection of biological diversity
- ✓ Promote the exchange of experiences and knowledge
- ✓ Promote culturally appropriate and gender-specific ways in which to document and preserve women's knowledge of biological diversity

In order to ensure the full involvement and participation of indigenous women in the work being carried out under the Convention on Biological Diversity with regard to traditional knowledge, the Secretariat takes into account gender considerations when selecting participants for meetings, when undertaking research work, when creating experts groups and, in general, when engaging in all activities related to policy-creation and implementation of the provisions of the Convention. In addition, given that traditional knowledge is a cross-cutting issue within the Convention, the promotion of the participation of indigenous women is applicable to meetings regarding each work programme and decision of the Conference of the Parties to the Convention.

In light of the recognition of the role of women in the Convention of Biological Diversity and, in particular, in the work programme on the implementation of article 8 (j), the Secretariat is pleased to participate in events related to indigenous women and biodiversity. In this regard, for instance, the Secretariat delivered a presentation at a workshop for indigenous women on biodiversity and traditional knowledge held in New York, on 6 May 2004. The workshop was organized by the Indigenous Women's Biodiversity Network (IWBN), an open network of indigenous women interested in environmental issues, initiated in May 1998 at the fourth meeting of the Conference of the Parties, held in Bratislava. Finally, the Secretariat of the Convention on Biological Diversity continues to cooperate with the secretariat of the Permanent Forum on Indigenous Issues, among other relevant organizations, and with women representatives of indigenous and local communities, to ensure that the perspectives and strategies of indigenous women in biodiversity-related issues are taken into account in the work being done under the Convention with regard to traditional knowledge.

Gender makes the difference

Across the globe, women predominate as wild plant gatherers, home gardeners and plant domesticators, herbalists and seed custodians. Research on 60 home gardens in Thailand revealed 230 different species, many of which had been rescued by women from neighboring forests before being cleared. Women in different regions of Latin America, Asia and Africa manage the interface between wild and domesticated species of edible plants. This role dates back to 15,000-19,000 B.C.

Women and men often have different knowledge about, and preferences for, plants and animals. For example, women's criteria for choosing certain food crop seeds may include cooking time, meal quality, taste, resistance to bird damage and ease of collection, processing, preservation and storage. Men are more likely to consider yield, suitability for a range of soil types and ease of storage. Both are essential for human welfare. In a study in Sierra Leone, women could name 31 uses of trees on fallow land and in the forest, while men named eight different uses. This

shows how men and women have distinct realms of knowledge and application for natural resource management, both of which are necessary for sustainable use and conservation.

Women provide close to 80% of the total wild vegetable food collected in 135 different subsistence-based societies. Women often have specialized knowledge about "neglected" species. The majority of plant biodiversity research is not gender sensitive. This has led to incomplete or erroneous scientific results with respect to the diversity, characteristics and uses of plants, and the causes and potential responses to genetic erosion. Integrating women's traditional knowledge into botanical and ethno-botanical research, and protecting all informants' rights, are critical for improved knowledge and management. The language used by the Convention on Biological Diversity and the Bonn Guidelines to address subjects related to indigenous and local communities is not gender-sensitive. In spite of the fact that an increasing number of experiences are highlighting the sustainable manner in which women use biological diversity, it is often true that women do so without equitable participation in the access and control of such resources. There is a tendency to ignore the natural spaces predominantly used by women in favor of those used by men, and to undervalue non-commercial (mostly female) production spaces in favor of commercial (mostly male) production spaces.

Therefore, it is necessary to make visible the gender-differentiated practices and knowledge of women and men in their relations with biodiversity resources. Despite considerable efforts over the past fifteen years at national and international fora, such as the Convention on Biological Diversity, very little progress has been made in understanding the fundamental roles that women play in managing and conserving biodiversity. It is essential to recognize that women and men have particular needs, interests and aspirations, and that they make different contributions to the conservation and sustainable management of biodiversity. Making visible the various roles women play in biodiversity conservation, sustainable use of resources and survival of the human species is only the beginning.

How to address gender and agro-biodiversity (FAO initiative)

According to the FAO, the promotion of a long-term strategy of conservation, utilization, improvement and management of genetic resources diversity for food and agriculture requires:

- ✓ Recognition and consideration of the gender-differentiated roles, responsibilities and contributions of different socio-economic groups
- ✓ Recognition and valuing of men and women farmers' knowledge, skills and practices and farmers'rights
- ✓ Sound and equitable agricultural policies to provide incentives for the sustainable use of genetic resources, especially through "in-situ" conservation and improved linkages with "ex-situ"conservation
- ✓ Appropriate national legislation to protect "threatened" genetic resources for food and agriculture, guarantee their continued use and management by local communities, indigenous peoples, men and women, and ensure the fair and equitable sharing of benefits from their use
- ✓ Enhanced access of women farmers to land and water resources, to education, extension, training, credit and appropriate technology

- ✓ The active participation by women, as partners, decision-makers and beneficiaries

Adherence to the above points will facilitate the provision of appropriate support to the different actors, protect local men and women's interests, enhance food security and enable the development and implementation of sustainable, effective and equitable agro-biodiversity programmes. The challenge for the next generation is the safeguarding of agro-biodiversity by paying greater attention to diverse and integrated agricultural systems, especially those managed by women that provide food and livelihood security. The maintenance of plant and animal diversity will protect the ability of men and women farmers to respond to changing conditions, to alleviate risk and to maintain and enhance crop and livestock production, productivity and sustainable agriculture.

D. OPEN SEED SYSTEM INITIATIVE- An alternative for improving seed access

- ✓ Open Source Seeds System for us means 'arrangements that facilitate and preserve freedom of access and use of plant genetic material, prohibit exclusive rights, and apply to any subsequent derivatives of those materials
- ✓ Freedom of access: Any one committing to OSS agreement receives freedom of access and use for the material under Material Transfer Agreements (MTAs)
- ✓ Freedom of use: Open source seeds would be available for farmers and breeders with freedom to use
- ✓ Farmers have freedom to use, reuse, sell
- ✓ In case of Selections and Breeding of derivatives
- ✓ Clear acknowledgement of the source of breeding material
- ✓ The derivatives can only be distributed under open source arrangement
- ✓ Genetic Modification not allowed
- ✓ Commercial Seed Production (Farmers and Farmers Cooperatives)
- ✓ Benefit sharing with the open source seed network for continuing the initiative
- ✓ Have to use the same varietal name but can brand differently

E. CONCLUSION

Consequences of the present policy environment on seed will only be helpful in completely swiping away seed from farmer's basket. Every seed company is attracting farmers in the name of hybrid and GM seed. What about environment? What about agro biodiversity? Ethnic communities possessing most of the agro biodiversity know less about plant breeder's right and gene fund. The present situation is only seeding perplexity or confusion evolved from complex farmer- seed relations, emerging peculiar issues. Careful and cautious steps are the need of the hour, if we are interested to help not only agriculture but also the agrarian community. Addressing these sensitive issues of seed can solve half of agricultural problems. Strengthening the seed value chain of location specific crops with more accessibility to farm women and farmers through implementable strategies will motivate them in tackling challenges of agriculture.

Seed Management for Commercial Horticulture

H. S. Singh and Meenu Kumari
ICAR-IIHR: Central Horticultural Experiment Station, Bhubaneswar

Availability of quality seed is the foundation for food production and productivity and a precursor to crop and food diversification. A true seed is defined as a fertilized mature ovule consisting of embryo, stored food material and protective coats. However, any planting material used for propagation of a crop is known as seed. Quality seeds of improved or high yielding varieties have played a key role in green revolution and has made the country self sufficient in food grains. There is a need to safeguard the farmers with the supply of genetically & physically pure, free from seed-borne diseases and quality seeds for horticultural crops also. There is marked difference between grain and seed that it is always certified and viable on the other hand grain does not require any of these specifications.

Rural women play key roles in horticulture sector production by working with full passion in production of crops right from the soil preparation till post harvest activities. They are more involved in most of farm operation activities of seed management but their competence in decision making has been questioned still. Therefore, awareness should be created for the community for the benefits of rural women to participate in seed production and making decisions in all aspects of seed management activities also. There have been many interventions by community-based organisations and NGOs to conserve the available biodiversity through initiating community seed banks which is a system in the process of community agriculture that includes village level facilities, a garden or field where traditional varieties are safeguarded.

The quality seed is prerequisite for enhancing the horticultural production in the country as the cost of seed is usually 10-20% of total cost of inputs and it is short sighted to compromise the seed management. The demand for high-value horticultural commodities is increasing faster than food grains. For most of the high-value food commodities, demand is expected to increase by more than 100% from 2000 to 2030. Therefore, to achieve this target, it is most essential to integrate the various technologies for seed production and its management. Horticultural crop refers to fruits, vegetables, ornamentals, plantation and spices but seedlings of fruit and plantation crops have long phase of juvenility and the first crop is obtained very late that limits multiplication of fruit plants by true seed. Papaya, phalsa and mangosteen are still being propagated by true seed. In vegetable crops, commercial growers recognize quality seed of improved varieties or hybrids of tomato, brinjal, chilli, okra *etc*. as the most strategic resource for higher and better yield.

Sources of Seed Material

- Own seed
- Neighbour
- Progressive farmers
- Local seed traders
- Seed company
- Agricultural University
- ICAR institutes
- KVKs
- ATMA
- NGOs

- National Seed corporation
- State Government departments

A Sustainable Model:

It need attention for proper vegetable crop husbandry management, seed processing, treatment of seeds with fungicides and packing in bags that can be done at village level by using available technologies and human resources involving women. Village-based seed production could come about by establishing small-scale farms which can produce sufficient improved seeds to satisfy the needs of the local community. Such farms could also be managed privately by groups of better-off farmers or under community control to meet the market need. The decentralised seed farms could be supplied annually with foundation seed from the research stations/seed industry, and could concentrate their activities on seed multiplication and marketing to the community. To strengthen this model, also **seed village scheme** concept exist which provide financial assistance for distribution of foundation/certified seed at 50% cost for production of certified or quality seeds.

Important Steps for Quality Seed Production:

1. Seed crop husbandry
2. Post harvest technology

1. Seed Crop Husbandry: In general, the principles and practices to establish the seed crop are the same as for the production of vegetables. But as the final objectives is to obtain seeds to be used for the production of further crop generations, it is important to apply best possible agronomic practices for raising the healthy seed crop. Selection of varieties (Table 1) and agroclimatic conditions, timely seed sowing, optimum plant population, irrigation on critical growth stages, weeding, nutrient and plant protection measures are some of the agronomic practices that needs to be taken into care for obtaining higher yield and better quality of seeds. The agronomic practices required for seed production may vary with the crop. On the other hand technical knowledge for isolation distance and rouging- off is most important for quality seed production.

Isolation distance: One major factor during the course of seed production is to ensure that the possibility of cross-pollination between different cross-compatible plots or field is minimized. It depends on nature of crop *i.e.* self pollinated crops require less isolation distance in compare to cross pollinated crops (Table 2). Adequate isolation also assists in avoiding admixture during harvesting and the transmission of pests and pathogens from alternative host crops.

Rouging: The existence of off-type plants in the seed crop is a potential source of genetic contamination. The removal of such plants is termed as roguing. Not only the off-types but the diseased and abnormal plants are also to be removed. The number of roguing required for the seed crop will vary with the kind of vegetables, purity of the seeds sown, nature of the previous crop etc. Rouging may be done at the following stages as soon as the off-types are recognizable:

(i) Vegetative or pre-flowering stage : Inspection at stage is done to watch and rogue out plants differing in height, growth habit and leaf shape etc.

(ii) Flowering stage: This stage is very important phase.Inspection at this stage is helpful to remove loose smut/diseased and off type plants not conforming to varietal purity requirements.

(iii) Maturity or post-flowering stage: During this inspection it is confirmed that roughing of all off- types, objectionable weed plants is complete. Off type plants on the basis of colour, shape and size of flower are removed.

In the seed crop, off-type plants should be rouged out at different times of the day by walking in different directions of the plot. In general the cross-pollinated vegetable crop for seed production should be thoroughly rouged before flowering. Regular supervision by trained manpower is important.

Harvesting and seed extraction: Harvest the seed plot at proper stage and moisture level so as to maintain good germination and seed quality including lustre. One variety should be handled at one time. In tomato, the extraction of seed from ripe fruit is done by fermenting the crushed fruits for 1-2 days and then putting it in water, so that the seeds settle down and pulp and skin float which are easily separated. It can also be done by using commercial HCl. It takes only about 30 minutes time, after which the seeds are cleaned up and dried. In brinjal, the ripe and yellow fruits are crushed and stored for overnight and the seeds are thereafter are washed, sieved and dried. An axial flow vegetable seed extracting machine can alternatively be used for extraction from tomato, brinjal and chilli fruits. In case of okra, seeds are dried after threshing.

2. **Post Harvest Technology:** It refers to techniques of seed processing, seed storage, seed testing, packaging & labelling, seed certification and seed marketing.

Seed Processing: Seed processing is to narrow down the level of heterogeneity of the lot by using suitable processing methods. This heterogeneity can be narrowed down in the processing of seeds by eliminating the undersized, shrivelled, immature, ill filled seeds using appropriate sieve size. The germinability and vigour of the seed lot can be upgraded by grading the seeds according to size, specific gravity, length and density of the seeds. The inherent qualities such as germinability and vigour are exemplified by certain physical characteristics of the seed such as large size, a denser seed, optimum length etc.

Basic processing steps are:

receiving seeds → drying → shelling → air cleaning → separation by separators (gravity/spiral separator) → treatment → bagging

Seed drying: The process of elimination of moisture from the seed is called drying. Elimination of moisture from the seed depends upon the relative humidity and temperature of the environment surrounding the seed. Greater the seed moisture content lesser should be the drying temperature and vice versa. Basic methods of drying are:

i. Physical drying or sun drying and
ii. Mechanical or artificial drying

Seed treatment: Based on the purpose of seed treatments it can be classified in to two groups:

Pre-storage seed treatment: Before distribution of seeds, the seeds should be treated with suitable fungicides and insecticides and packed in suitable containers of prescribed size. These treatments are given to the seeds to improve and maintain the health condition of the seeds.

Pre-sowing seed treatment: It is the treatments given to the seeds before sowing to improve the germination and vigour potential and as well as to improve the health of the seed. Pre sowing seed treatments includes the following:

i) Dormancy breaking: Scarification, stratification, hot water treatment etc.

ii) Improve germination and vigour potential: KCl, ZnSO4, MnSO4 etc.

iii) Insecticidal and fungicidal treatment: Mercuric chloride, Mercuric oxide, Agrason etc.

iv) Accelerating the speed of germination (other special treatments): Seed pelleting, seed infusion and seed hardening.

Seed storage: The storage of seeds may be short term (3-9 or upto 18 months), medium term (18 months to 5 or 6 years) and long term (upto 10 years or more). The purpose of seed storage is to maintain the seed in good physical and physiological condition from the time of harvesting till their planting. The seeds should be treated with Captan or Thiram 75%WDP at 2g/Kg seed before storage. Depending on the longevity of seeds, it can be classified as orthodox and recalcitrant seeds. Orthodox seeds are long-lived seeds *e.g*. annual temperate species. They can be successfully dried to moisture contents as low as 5% without injury however, later one cannot tolerate drying to such a low level of moisture content and difficult to store for a long period e.g. coffee, coconut, cocoa, citrus *etc*.

Seed packaging: It is important to package seed in dry containers for proper storage. For small quantities of seed, these containers may be tin cans, jars, or pots that are glazed on the inside; even reinforced boxes or bags can be suitable. Metal or plastic jar cans, or drums are often used to package large quantities of seed.

Seed labelling: Each container of seed offered for sale for planting purposes must have attached to the container in a visible place a label or tag with the following information: name or kind of variety, lot number or identifying trade mark, germination %, inert matter %, name and complete address of selling agency.

Seed testing:

Purity test: As a measure of the cleanness of seed, pure seed is separated from impure seed, and then separately weighed. Seed is considered pure if it appears normal in terms of size, shape, and general outward appearance. Conversely, seed that is too small, has been partly eaten by insects, or exhibits

fungal stains is regarded as impure. A sample for a purity test may consist of 100 to 1,000 seeds.

Purity percentage is calculated as: weight of pure seed/ total weight of sample x100

Viability test: Seed viability testing uses a chemical called tetrazolium and aims to determine which seed tissues are alive and have the potential to germinate under optimum conditions. Tetrazolium is a colourless chemical that reacts with living cells and stains them red. In this way, living tissue in seed embryos can be distinguished from non-living tissue.

Germination test: Seeds are germinated under optimum environmental conditions for an optimum period of time according to species. Dormancy breaking measures are used. Distinctions are made between normally and abnormally germinated and dead seed.

Seed marketing: It is one of the most vital components of seed technology. Seed marketing refers to the actual acquisition and selling of packed seeds, intermediate storage, delivery and sales promotional activities. The simplest and most efficient system is to establish a central marketing cell and regional offices in end-use areas. The retail sale could be organized either by appointing distributors/dealers such as private dealers, cooperatives, agro-sales service centres, etc., or by opening seed company/corporation-owned sales points, or both.

Seed Certification: The object of the Seed Certification is to maintain and make available to the public through certification high quality propagating material of notified kind / varieties so grown and distributed as to ensure genetic identity and genetic purity. There are three categories: Breeder seed, Foundation seed and Certified Seed.

Breeder seed is directly controlled by the breeder. This should be genetically pure. It does not come under the preview of seed certification as it is not meant for public sale. Breeder seed should be packed and supplied with breeder's golden yellow tag as per the guideline given in Indian Minimum Seed Certification standards. It is also the fact no standard for breeder seed have been prescribed. Foundation class of seed and certified class of seed are to be certified by the Certification Agencies as per the Indian Minimum Seed Certification Standards. Tag colour for foundation seed is white and for certified seed it is blue.

Concept of Seed bank: The establishment & maintenance of seed bank is a central sector scheme implemented through the National Seed Corporation, State Farms Corporation of India and State Seed Corporations. The objective of the scheme is to meet requirement of seeds during natural calamities and unforeseen conditions. Under the scheme for maintenance of certified and foundation seeds of identified crops, grants are provided for meeting revolving funds, maintenance cost and price differential for left over seeds as non seed. Financial assistance is also provided for development of necessary infrastructure for storage as well as setting up of a data bank and information system for facilitating faster flow of information on the availability of seeds.

Annexure-I

Table 1: Important Varieties/Hybrids of Vegetable Crops

Crop	Varieties	Hybrids
Okra	Parbhani Kranti, P-7, Arka Anamika, HRB-55, HRB-9-2, GO-2, VRO-6	CO-3 (Hybrid-8), DVR-1, DVR-2, GOH-1
Brinjal	Doli-5, GBL-1, GOB-1, JBGR-1, PLR-1, PPC, PPL	ABH-1, ABH-2, Pusa Hybrid-5, Pusa Hybrid-9, NDBH-1, MHB-10, MHB-39
Chilli	G-4, S-49, Jwala, GVC-101, GVC-111, GVC-121, AVNPC-131, Pusa Sadabahar, LAC-206B	CH-1, CH-3
Tomato	GT-1, GT-2, Junagadh Ruby, Pusa Ruby, CO-3, Pant T-3, Arka Vikas, Arka Saurbh, Sel-7, Sel-32, DT-10	Pusa Hybid-2, Pusa Hybrid-4, MTH-6, ARTH-3, NA-601, BSS-20, Avinash-2, Arka Rashak
Cauliflower	Early Kunwari, Pusa Early Synthetic, Pusa Deepali, Pusa Snowball	Pusa Hybrid-2
Onion	GWO-1, Junagadh Local, Agri Found Dark Red, N-53, Agri Found Light Red, Arka Kalyan, Arka Niketan, PBR-5	
Cucurbits		
Bottle gourd	Pusa Naveen, PSPL, ABG-1, Arka Bahar, Punjab Komal	Pusa Hyb-3, Pusa Meghdoot, NDBGH-7
Ridge gourd	Pusa Nasdar, CO-1, CO-2	
Spine gourd	Arka Neelachal Shree	
Teasel gourd	Arka Neelachal Gaurav	Arka Neelachal Shanti
Pointed gourd	Swarn Alukik	
Bitter gourd	Priya, CO-1, Pusa Visesh, Arka Harit, Pusa Do Mausami	Pusa Hybrid-1
Watermelon	Sugar Baby, Arka Manik	Arka Jyoti, NS 295
Muskmelon	GMM-3, Hara Madhuras, Pusa Madhuras, Durgapura Madhu, Punjab Sunehari	Punjab Hybrid-1
Cucumber	GC-1, Pointsette	Pusa Sanyog
Carrot	Punjab Kesar, Nantes, Ooty-1, Pusa Meghali	
Cowpea	AVCP-1, Pusa Phalguni, Pusa Komal	
Cluster bean	Pusa Navbahar	

Annexure-II

Table-2: Seed sowing guide for vegetables

Crop	Spacing		No. of plants/acre	No. of seeds/ gm	Seed rate/ acre (gm)
	R&R	P&P			
Baby corn	60	10	66,667	4	20,000
Bitter gourd	150	60	4,356	6	900
Bottle gourd	250	60	2723	7	500
Broccoli	60	45	14520	250	100
Cabbage	45	30	29,630	250	130
Carrot	30	5	2,61,360	500	1000
Cauliflower	60	45	14,250	225	100
Cucumber	120	45	7,407	33	269
Brinjal	90	60	7,260	275	40
Melon	180	60	3,630	30	200
Bhindi	60	30	22,222	15	1,852
Onion	18	8	3,33,333	375	1,333
Pea	45	10	88,889	5	22,222
Chilly	90	60	7,260	200	100
Pumpkin	250	60	2,667	10	320
Radish	30	15	88,889	100	1,156
Ridge gourd	180	60	3,630	10	500
Sweet corn	60	30	22,222	9	2,963
Tomato	75	60	8,700	300	40
Water melon	180	60	3,704	15	325

Annexure-III

Table 3: Isolation distance and permitted off types for foundation and certified seeds of varieties of important vegetable crops

Crop	Minimum isolation distance		Off-type	
	F	C	F	C
Cowpea	10	5	0.10*	0.20**
Garden pea	10	5		
Chilly and capsicum	400	200	0.10*	0.20*
Cauliflower	1600	1000	0.10*	0.20**
Lettuce	50	25	0.10*	0.20*
Carrot	1000	80	0.10*	0.20**
Onion	1000	500	0.10*	0.20**
Radish and turnip	1600	1000	0.10*	0.20**
Okra	400	200	0.10*	0.20**
Tomato	50	25	0.10*	0.20**
Cucurbits	1000	500	0.10*	0.20**

*maximum permitted at final inspection; **maximum permitted at end after flowering

Seed standards for vegetables; F- Foundation seed; C- Certified seed

Seed Management for Sustainable Agricultural Systems

Amar KJR Nayak, Professor, XIMB, Bhubaneswar

Objectives:

1. Understand the actual practice of sustainable agriculture systems
2. Assess the optimal land holding and crop combinations that make a small family farmer self reliant.

Initiative of Sustainable Agriculture Systems in CEDEC-NIWASS

National Round Table Discussion on Sustainable Agriculture Systems was held on 18th January 2016 at Xavier Institute of Management Bhubaneswar. Some of the NISWASS faculty are part of the NRTD. After the discussion was over, it was decided to have a demonstration farm. Dr. R.K. Nayak, the founder of NISWASS and CEDEC was requested to have a demonstration farm in CEDEC. He agreed on the proposal because a sustainable agriculture system is an effective social action for students and as well as for the community.

This initiative of sustainable agriculture systems also accomplishes the vision and mission of National Institute of Social Work and Social Sciences (NISWASS) & Centre for Development Educational & Communication (CEDEC).

The main aim of the SAS is to disseminate natural farming methods to the small farm practitioners by which the principle of agriculture could be sustained and theoretical as well as first hand practical knowledge could be delivered to the master of social work students.

Principle of Sustainable Agriculture Systems

Principle – 1: To care the soil health without using any chemicals or fertilizers. To enhance the soil health, green manures were used. The ingredients were used for leguminous plants (Dhaincha, Barbati, Til, Biri, and Jawar) that have helped to enhance the soil health. The leguminous plants were mulched after two months of time. The soil is a living system for each and every living being. But it was gradually forgotten to care. So in this model of organic farming, soil would be safe.

Principle – 2: Indigenous seed protection. Rather using Genetically Modified (GM) seeds, hybrid seeds we used local or indigenous seeds. Local seeds do not require fertilizer.

Principle – 3: To preserve and converse moisture/water. To converse water we made trenches round the land and it has specific measurement according to size of the land. In the cultivated land itself we had micro water locking system by means of contour that automatically recharge water.

Principle – 4: To care the diversity of the cultivated area by the means of mix cropping, cultivating verities of crops at a time will reduce their susceptibility for pest attack, enhance the soil fertility and enrich the moisture retention capacity.

Principle – 5: To balance and protect the ecology by planting varieties of plants and crops, making no harm to any living being. To strengthen both micro and macro ecology by helping the food chain is strong enough to be self sustainable.

Ingredients and methods

Aulakik khat is made up of Cow dung, soil, Jaggery, and sun flower oil. It was kept for 50 days and watering was done on regular interval. This is natural fertiliser and which helps to grow plant as well as accommodate earthworm and other micro organism. The whole organic system depends on the five principles.

Seed Management in Home Garden for Family Nutrition

Abha Singh and Laxmipriya Sahoo
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Nutrition garden in homesteads

Malnutrition is a serious public health problem among women and children in developing countries, especially in middle and low income group. Micronutrient deficiency is more common than macro nutrients deficiency in rural area. Indian diets are mainly cereals based depending upon single food grain and very low intake of low cost protective foods such as fruits and vegetables. Low purchasing power, unavailability and ignorance are the major cause of malnutrition and under nutrition. Macro and micro malnutrition have lasting and devastating consequences for individual health and national development, as malnutrition early in life often leads to stunted growth, poor cognitive and physical development and is associated with increased episode of infection throughout an individual's lifetime. In addition, during pregnancy, reduction in micronutrient content can have a significant impact on foetal growth and development which will later affect the child's growth potential and adult height. Many reports indicate qualitative and quantitative gap in terms of foods for the individual and population. This gap is major in the case of pulses, oilseeds, vegetables, fruits and animal protein compared to common cereal food. This gap can be bridged in a phased manner through increased production, nutrition education and health sector.

Several extensive studies done by the ICMR and other agencies on the nutritional profile of our diet indicates that

- Calorie gap of our diet to the extent of 15-20 per cent in adults and children
- Consumption of protective foods like fruits and vegetable is very low
- Intake of vitamin A is very low
- Intakes of vitamin B-complex are marginal
- Intake of minerals such as calcium and iron are low

Recent developments have provided encouraging results in bridging the gap of major food crops, especially cereals which provide the major substance of our population. Efforts are already in progress to increase the production of pulses and oilseeds, milk and milk products, and poultry products. There is need to give similar approach in regard to the production of fruits and vegetables (horticultural crops) and nutrition garden is the best option at small scale. Horticultural crops provide important essential nutrients, such as calorie (tuber crops), protein (leguminous vegetables), minerals as calcium and iron (green leafy vegetables), precursor of vitamin A (green leafy vegetables, yellow and orange vegetable and fruits), vitamin B-complex (common vegetables), and vitamin C (citrus and other fruits). The intake of these categories of foods in our diet is far from satisfaction especially in the low income group. Perhaps the most important reason in regard to protective foods is the lack of nutritional awareness about the low-cost but nutritive value of fruits and vegetables. So nutrition education and establishing the nutrition gardens in the rural area are two important aspects for increasing the consumption of protective foods.

Fruits and vegetables play an important role in the balanced diet of human beings by providing not only the energy rich food but also promise vital protective nutrients. The daily requirements of some of the essential nutrients like proteins, minerals and vitamins can be very well met, if a man, woman or child consumes about 85g fruits, 75-125g green leafy vegetables, 85g other vegetables, 85g root and tubers everyday on a balanced diet pattern. Fruits and vegetables are good sources of carbohydrates (banana, jack fruit, beans and fenugreek), minerals like calcium and iron (dates, almond, green leafy vegetables), β carotene (mango, papaya, green leafy vegetables, sweet gourd), vitamin B complex (apple, apricot, grape fruit, bael, banana) and vitamin C (aonla, guava, citrus, bitter gourd).

Nutrition gardening is one of the world's most ancient food production practices and is commonly practiced throughout the world. Homesteads are the resources that provide major share of livelihood especially for poor farmers. Home gardens generally refer the garden which is located near the residence, contains a high diversity of plants; production is a supplement rather than a main source of family consumption or income. Nutrition garden should be a feature of every farm family whether one live in a village or town if there is some space. Every family, even landless labourers, can grow nutritious vegetables. It is easy and very rewarding: you will save money, improve your diet, and avoid eating pesticide-tainted vegetables often sold in the market.

Types of home gardens

Large gardens (at least 500 sq m)

Almost all types of vegetables can be grown in a large garden, including one or two large fruit plants, such as papaya, guava, lemon, grape, or dwarf mango.

Medium-size gardens (150 to 200 sq m)

Choose from tomato, eggplant, fenugreek, chilli, French bean, bitter gourd, cucumber, spinach, amaranth, radish, turnip, carrot, lettuce, cauliflower, cabbage, summer squash, okra, cowpea, or cluster bean.

Small gardens (less than 100 sq m)

Choose from amaranth, spinach, fenugreek, radish, turnip, tomato, eggplant, chilli, lettuce, mint, or coriander.

Container gardens

Some vegetables grow well in pots or containers placed on sunny terraces, window ledges, balconies, verandas, or on the roof. Fill containers with a mix of sand, soil, and manure. Choose from chilli, tomato, coriander, mint, amaranth, spinach, table radish, kulfa, lettuce, knol-khol, French bean, okra, fenugreek, cluster bean, green onion, garlic, leek, parsley, broccoli, and tomato.

The layout of the nutrition garden of a farm family in village differs from town and extensive method of cultivation is followed. The nutrition garden, if large enough, has the potential to supply most of the non-staple foods and some of the staple foods (e.g. roots and tubers and some pulses) that a family needs each day of the year. In every village there are examples of nutrition gardens which are managed well. These

nutrition gardens produce a wide variety of food crops which supply the family throughout the year with fresh fruits and vegetables, roots and tubers, legumes, spices, medicines, etc. The link between nutrition garden and nutrition seems obvious and the promotion of nutrition garden is often undertaken on nutritional ground. In fact most of the workers advocating nutrition gardens use the need for improved nutrition and income as a major part of their arguments. There should be proper layout of the garden in order to meet daily supply of fresh fruits and vegetables for the family.

Importance of homestead nutrition garden

1. Improves nutritional status as a whole
2. Additional source of household income
3. Improve the nutritional status of women as it is primarily a female activity
4. A way to conserve biodiversity
5. Improves the natural environmental status through recycling
6. Good platform to utilize family labour
7. Best way to utilize leisure time
8. Easy availability of fresh and nutritious fruits and vegetables

Important tips for better nutritional status through nutrition garden

- Establish a nutrition garden in your backyard.
- Grow creeper vegetables on your house roofs.
- Eat at least one green leafy vegetable daily.
- Consume seasonal low cost fruit daily.
- Consume raw vegetables (in the form of salad) daily.
- Prepare snacks with green leafy vegetables.
- Preserve seasonal vegetables by simple techniques such as drying, salting, pickling etc.
- Preserve fruits by preparing jam, jelly, squash etc.
- Feed infants (6 months to 18 months) with boiled and mashed potato, sweet potato, banana, papaya which are rich in micronutrients.
- Aonla is very rich in Vitamin C, during season consume one aonla daily. This will keep our gums healthy.
- Papaya, mango, carrot and spinach are rich in Vitamin A, so protect our eyes.
- Eat green leafy vegetables for iron and vitamin A for anaemia protection.

Table 1: Essential nutrients, deficiency diseases and their fruits and vegetables sources

Nutrient	Consequences of deficiency	Fruit and vegetable source
Calories and proteins	Retarded growth in children,, irritability, apathy and possibly retarded mental development, discoloration of skin and hair, swelling of the face and lower part of legs and feet, fatty liver and extreme emaciation	Calories: Tapioca, sweet potato, yams, colocasia, potato, banana, jack fruit Protein: Peas, winged bean, cow pea, amaranthus, drumstick leaves
Vitamin A	Night blindness, immune impairment	Carrot, spinach, palak, amaranth, sweet potato, sweet gourd, pumpkin, mango, papaya, tomato
Vitamin B complex	Beriberi, cracks at corners of the mouth, raw red cracked lips,	Peas, broad bean, garlic, tomato, apple, banana, bael

	pellagra	
Vitamin C	Bleeding gums, depression, impaired wound healing, loose teeth, tiredness	Green chilli, amaranth, coriander, drumstick leaves, bitter gourd, cauliflower, papaya, guava, lemon, orange, aonla
Calcium	Osteoporosis, tooth decay	Curry leaves, amaranth, drumstick leaves, coriander, palak, custard apple
Iron	Anemia, spoon shaped nails, pale lips	Drumstick leaves, amaranth, coriander, palak, raisins, guava, dates, pomegranate

Nutrition garden management

- Sow or transplant seedlings in rows or lines with proper spacing.
- Remove some seedlings if plants are crowded.
- If many seedlings die, plant more to take their place.
- Irrigate after transplanting.
- Remove weeds between the rows and between plants.
- Vegetables need regular watering for good growth and yield.
- On larger plots, irrigate lightly every third or fourth day during summer and once every one or two weeks in winter.
- Farm yard manure, vermi-compost and compost are great fertilizers for vegetable gardens. Mix them in the soil about a week before sowing or transplanting.
- Apply a nitrogenous fertilizer, such as urea, in small quantities in standing crops for higher plant growth and yield. Apply urea only when the soil is moist; otherwise, give a light irrigation after application.
- A few tools can be very useful: spade, hand hoe, watering can, sickle, knife, basket, small hand sprayer, twine, and bamboo stakes.

Planning of a homestead garden

Careful planning is important for a successful nutrition garden. There are a number of factors to be considered.

Location

It is usually located at the backyard of the house. It enables the members of the family to give constant care to the vegetables during leisure hours. The vegetable plots should be located away from trees so that they are not under shade and there is no competition from the wide-spreading roots of trees.

Size

The size of nutrition/kitchen garden depends on the availability of land, the number of persons for whom vegetables are to be provided and time available for its care. For an average family size of two adults and three children, 250 sqm of land is sufficient to supply adequate vegetables.

Space

The space available around the house will determine what techniques and how many vegetables can be produced. However, even houses having small space around can also build homestead garden. With careful planning, a garden can maximize the efficient use of the space available.

Shade Vs full sun

All plants need sunlight to grow, but too much sun and heat can dry out the soil and burn plants. Trees are good for adding shade to a garden, cooling hot summer temperatures and helping to prevent moisture evaporating from the soil especially in dry areas. However, too much shade prevents sunlight from reaching the plants and obstructs their growth. Tree crops like mango, papaya, banana, drumstick, curry leaf, jack have to be planted in homesteads boundary in such a way that their shade does not affect the growth of annual vegetables. Some crops like partial shade and some crops like full sun. Most of the vegetables like radish, amaranth, cabbage, cauliflower, brinjal, tomato etc. require open sunny space especially morning sun for better growth and therefore the vegetable plots should be prepared in eastern side. The partially shady area or intercrops in between perennial fruit trees can be used to grow shade loving crops such as elephant foot yam, pineapple, ginger and turmeric.

Access to water

Plants need to be watered regularly, especially in dry areas. Therefore access to water must be considered when planning a homestead garden. The waste water from kitchen can also be routed through the perennial plot.

Household labour capacity

The area of nutrition garden may be decided on the basis of availability of household labour and their capacity to do the work.

Layout

The layout of nutrition garden is especially important. A sample layout for preparing a small homestead garden is given in the figure-1. Each plot in the garden should be numbered and should follow crop rotations. By planning ahead, farmers can better utilize the limited space around a house and maximize the production of vegetables and other food crops.

The perennial plants should be located on one side of the garden, so that they may not shade other crops and compete for nutrition with annual vegetables. After establishment of nutrition garden, little care is needed for constant supply of vegetables year after year with little additional cost of labour. Economic utilization of space should be obtained by use of fence on three sides for training cucurbits during the summer and rainy seasons and peas in winter.

- Cropping pattern in the farm of succession and companion are continuously followed.
- The ridges which separate the beds are utilized for growing seeds.
- Raising climbing type of tomato plants on one side and leafy vegetables on the other side of the footpath.
- The principles of crop rotation are followed.
- The compost pits are placed in the two corners of the garden. They are meant for garden and kitchen wastes including house sweeping and ash is also dumped into them.
- Cucurbitaceous vegetables should be trained over these pits to give them shade and also to cut them off from view.
- All the plants after harvest should be put into the compost pits. This will go a long way in obtaining self-sufficiency in manure for nutrition garden.

Cropping pattern

Vegetables may be sown or planted at different dates preferably short duration crops first and later the long duration crops, so as to ensure regular supply of vegetables. Growing more than one crop in a bed in a year enables judicious utilization of the soil

nutrients and airspace above. Roof of the house can also be very well utilized as support for vegetable crops like bottle gourd. In general vegetables could be grown throughout the year with few exceptions. In each bed, crop rotation has to be followed. For example, shallow rooted vegetable (onion) may be rotated with deep rooted vegetable (brinjal), leguminous vegetable may be rotated with non leguminous vegetable (brinjal, tomato), a tuber forming vegetable (sweet potato) may be rotated with non tuber forming vegetable (Okra) etc. In case of perennial vegetables like pointed gourd, the bed should be rotated with a leguminous vegetable once in 3-4 years.

Seed Management in Homestead Nutrition Garden

Seed management is the most important factor in sustainability of home garden. Seeds of a large number of crops and varieties are required in variable quantity. Managing the seed for home garden is more difficult than managing seeds for commercial cultivation. the constraints can be characterized as

- Required quantity of seed for small plots is less but the farmwomen has to buy seed packets of minimum quantity which is liable to be wasted.
- Multiple planting needs seeds to be available over long period of time posing problem for storage.
- Maintenance of seed germination is difficult
- Liable to be attacked by storage pests
- Hybrid seeds of vegetables sold by big companies may not be suitable for the home garden.
- Seeds may not be procured at right time posing problem in planting sequence
- High cost of seed

Strategies to manage seed efficiently in homestead nutrition garden

Use of local varieties

Locally available promising farmers varieties are climate resilient, less input demanding, locally preferred and easy for seed multiplication. Use of Local farmers varieties maintains or conserves the local crop diversity.

Seed production in homestead nutrition garden

As very less quantity of seed is needed for home garden, improving skills of farmwomen in seed collection and preservation in the home garden itself can address many issues of home gardening. This will save money and wastage of purchased seed. Local varieties can be cultivated due to availability of seed. There will be no problem for multiple planting.

Community involvement

Community involvement will be beneficial for home gardening. Seeds purchased can be shared in the community. Also every member of the community can take responsibility of collecting and preserving seed of one crop and can develop expertise in it. The seeds multiplied by each member can be exchanged within the community.

Skill development of women in seed production and management

Hands on skill on vegetable seed production, nursery raising and planting material production is essential for seed management. So organizational support for capacity building will be beneficial. Training should be imparted on

- Ability to differentiate between crop and seed crop
- Identification of offtypes
- Method of supplementary pollination
- Knowledge of proper time of harvest
- Handling of the harvested seed
- Seed extraction
- Drying and processing
- Seed treatment
- Lebelling
- Storage

Planting material/ nursery preparation

Preparation of nursery on community basisfor raising seedlings and planting materials of vegetables is very much useful for self sufficiency. These can be used for home garden and sold outside the community for utilizing the money in purchase of other inputs.

Conclusion

Nutrition garden is an effective measure for combating family malnutrition and women can play a majour role in its proper management. Seed management for home garden is crucial and strategies can be adopted for addressing seed constraints of homestead nutrition garden

Addressing the Seed Needs of Tribal Women

J. Charles Jeeva
ICAR-Central Institute for Women in Agriculture, Bhubaneswar

Tribal Profile of India

India is a home to almost more than half of the world's tribal population. Over 84 million people belonging to 698 communities are identified as Scheduled Tribes constituting 8.2% of the total Indian population. More than half of the Scheduled Tribe population is concentrated in the States of Madhya Pradesh (14.51), Maharashtra (10.17), Odisha (9.66), Gujarat (8.87), Rajasthan (8.42) and Jharkhand (8.4). Odisha is a tribal dominated State with the largest number of tribal communities (62), representing major linguistic groups like Dravidian, Austro-Asiatic and Indo-Aryan. Almost 44.21% of the total land area in Odisha have been declared as Scheduled area. The total tribal population of the State is 8.15 million, who constitute 22.13%. The tribal villages are backward in scenario of economic development, livelihood enhancement and educational development also. A small land base, low agricultural productivity and low incomes have led to rising indebtedness, trapping tribals into a vicious circle of exploitation. The life of the tribals is increasingly vulnerable due to a persistent lack of assured entitlements to their resource base. By and large the benefits of development programmes are yet to reach the tribal population in general.

At the district level, there are 75 districts where ST population is 50 per cent or more. Out of these 75 districts, 41 districts are in 8 North Eastern States. All the districts in Mizoram, Meghalaya and Nagaland have more than 60% of ST Population. •Out of 13 districts in Arunachal Pradesh, 9 districts have more than 50 % of ST population. •Twenty five districts in the country have more than 90% of ST population. •Out of 6380 CD blocks, 716 blocks have more than 50% of ST population.

Socio-economic Profile of Tribes

Historically, the economy of most of the tribes was subsistence agriculture or hunting and gathering. In the forest based tribal economy, provisions for basic necessities like food, fuel, housing material, etc. are made from the forest produce. In most of the States, more than 60% of the tribal population resides within 5 km distance from the forest. A large percentage of tribals that live close to forest areas constitute the most disadvantaged section of society based on per capita income, literacy rate, health status and lack of access to basic amenities. Out of the total area under operational holdings among STs, the holdings by males account for 91.5 percent while that by females is only 8.5 percent. These holdings comprise 88.36 percent of individual holdings and 11.64 percent of joint holdings. Among various holding sizes, area-wise, maximum holdings are of size 1.0-2.0 hectares. The male female proportion in holding of size 1.0- 2.0 hectares was 90.6 percent for ST males and 9.4 percent for ST females. Among individual holdings, the majority of holdings were found to be below 0.5 hectares in size.

Forest Dependence of Tribal Women

Tribal women live in distant villages located amidst hilly forested regions. Their life is integrally linked to the forest, which has been their source of food, fodder and wood for fuel. Since independence, vast tracts of forest have been ruthlessly damaged and destroyed in the interests of larger development projects. The results have been disastrous, leading to the erosion of a life support system, and the uprooting of a large section of the tribal population from their ancestral lands. Already poor, they then lost control of and access to a wide variety of resources on which they depended. Modernization has led to the disappearance of people-based practices such as agro-forestry and food gathering. This has specifically and adversely affected the lives of women, increasing manifold their daily drudgery. Such displacement, non-access, non-possession, non-entitlement has further thrust these people into mute acceptance. Recent studies conducted in the tribal regions of Bihar, West Bengal and Karnataka showed empirical evidence for the extent of dependence of tribal households on NWFP collection. For example, in two southern districts of Bihar, *41* percent of the families collect mahua flowers *(Madhuca indica); 31* percent collect tendu leaves *(Diospyros melanoxylon)* used in making indigenous cigarettes (or bid)); *23* percent of the families collect mushrooms and mahua seeds; *55* percent of the families collect tamarind *(Tamarindus indica);* and *31* percent of the families depend on the collection of wild brooms. The primary players in the collection, processing, and marketing of NWFPs are women who gather the bulk of forest produce, including seed, food and fuel-related forest products. Similarly, women and children collect 90 percent of the medicinal herbs and 100 percent of the drying is done by women. About 71 percent of medicinal herbs are sold by women and children, and 29 percent by men. A study done in Odisha, reported that women generally walk 3 to 4 hours into the forests and work 15 hours per day, whereas men work 11 hours a day. The studies all indicated that women spend more time and labor in forest-related activities, and depend on forests not only to meet subsistence needs but also for income. Tribals in Andhra Pradesh collect a large variety of NWFPs including tamarind *(Tamarindus indica),* adda leaf *(Bauhinia vahlii),* gum karaya *(Sterculia urens),* myrobalans, mahua flowers and seeds *(Madhuca indica),* wild brooms and soap nuts *(Sapindus emarginatus).* One study estimated that income from the sale of NWFP in Andhra Pradesh constitutes anywhere from 10 to 55 percent of total household income. In comparison to Odisha, Bihar and Madhya Pradesh, all with large tribal populations, tribal households from Andhra Pradesh accrue a very high proportion of their income from the sale of NWFPs.

Women and Seed

Seeds are the first link in the food chain. Yet women seed breeders are invisible in the industrial model of food production and in intellectual property regimes. The roots of food and gender justice lie in keeping seeds in women's hands and recognizing women's knowledge of biodiversity. Health and nutrition begin with food, and food begins with seeds. The seeds of food justice lie in creating food systems where seed is in women's hands, and women's knowledge of biodiversity is

the foundation of food and nutritional security. Women have been seed breeders for centuries and have bred much more diversity and traits than all the industrial breeding systems that are formally recognized. Science and culture merge in women's seed breeding. Seed, which used to be saved and bred by women, is now the 'intellectual property' of the chemical corporations, which are now also the seed corporations controlling 73 % of the world's seed supply. When these corporations patent seed, they collect royalties. Royalties on seed mean higher seed costs. Seed in women's hands is renewable and 'open-source', to be freely shared and saved. Patented seed becomes non-renewable. Saving and exchanging seed becomes an intellectual property crime. When women sow seed, they pray 'may this seed be exhaustless'. Corporations work on the philosophy 'may this seed be terminated so our profits are exhaustless'. High costs of seed means debt. In India 250,000 farmers have committed suicide due to debt, mainly in the cotton belt, since seed monopolies were established through the introduction of Bt cotton. Each farmer who commits suicide leaves behind a widow. Across the world, women have bred more than 7,000 species of crops for taste, nutrition, pest resilience, drought resilience, flood resilience, and salt resistance. In India alone, women have bred 200,000 rice varieties. Navdanya, a network of seed keepers and organic producers that is spread across 16 states in India, values this biodiversity and has so far successfully conserved more than 5,000 crop varieties. This is knowledge.

Agriculture has been commercialised, with promotion of cash crops and the introduction of machines and use of chemicals, which also results in external dependence. Women are encouraged to grow new varieties of nutritious vegetables and fruits at their homes, which will cater to the health needs of the family, and at the same time they can earn money by selling the surplus. Community Nurseries jointly owned by the community and developed on a piece of land offered by the villagers are also being promoted, these will continually supply seed and saplings to the families.

Women and Seed Preservation

Traditionally, seed preservation has been women's role, and their knowledge of seeds has been extensive. Therefore, women play a major role in the conservation of diversity at the farm level. It is women who decide on the amount of seed and selections of varieties to be stored and the various ways of storing them. Much of the seed stored in community seed banks is generative, but vegetative seed such as potato tubers, sweet potato vines, yam stets and cassava stakes are also found. Transferring seed between individuals, households and the seed bank entails a variety of exchange mechanisms. These are mainly informal mechanisms such as seed fairs, in-kind seed loans, barter and transfers based on social obligations, but also through cash sales and purchases.

Success Stories on Tribal Women's Technological Empowerment

Women farmers in the tribal villages of Odisha, are increasing their yields through the use of hybrid seed varieties, new technologies and better agriculture practices with training and support. Badbil Rengalsahi is a remote, tribal village in the

Mayurbhanj district of Odisha with high poverty and low literacy rates. The village is home to 40 tribal families who mostly farm for a living. They usually grow local varieties of maize in home gardens for household consumption and sell the little surplus as green cobs in the local market. Yields are often low because farmers use unimproved varieties and traditional sowing methods and lack information about good agronomic practices, especially weed and nutrient management. Maize cake is a common breakfast and snack for children in the area, and low maize production often means they receive less food. However, this situation could soon improve thanks to women self-help groups (SHGs) like Johar Jaher Ayo, who learned about new technologies and improved varieties. The farmers bought hybrid maize seed and fertilizer using their collected savings "corpus fund" from the Large-Sized Multipurpose Cooperative Society (LAMP) of the government of Odisha and ploughed the field with tractors instead of the traditional wood plough. The planter — commonly called a "seed drill"— helps achieve optimum plant populations and higher fertilizer efficiency by seeding in lines at a precise depth and spacing and placing fertilizer below the seeds. Trained on better agronomy practices such as nutrient management and timely weed control.

Tribal women of Purulia district in West Bengal have learnt, with the help of several NGOs and SHGs, to implement efficient water management techniques and multi-crop approach and achieved food-sufficiency in a region that was on the 'drought-hit' list in spite of heavy rainfalls. It was ironical that Purulia district often found itself on the West Bengal government's 'drought-hit' list when the average rainfall here is 1100mm-1500mm. The failure to conserve water as well as poor agricultural practices meant that despite back-breaking labour in the fields, farmers could only achieve six months' food sufficiency. Today, however, all that is changing thanks to a water management revolution and seed-banks led by tribal women. In an area where development has been stunted due to a weak government machinery and increasing Maoist influence, SHGs have spearheaded developmental initiatives like the Integrated Natural Resource Management (INRM) and Seed Banks.

Availability of pure seed is a constraint faced by entire agriculture sector in the country. It is necessary to keep a certain distance for isolation between two cultivars of a crop. Cross-pollination between breeds severely affects the quality and purity of a seed. A few centres of research organisations in the country cannot produce enough seed for all the farmers. Traditional practice of farmers to cultivate seed in a corner plot does not succeed, for the quality degenerates over generations of the seed. Production by community groups with perfect technological support from institutions is perhaps the only solution. KVK Nandurbar (M.S.) has successfully shown this by making a Seed production village in the tribal belt of northern Maharashtra. Nandurbar district is located in Northwest of Maharashtra state. Sixty nine percent of the total population of the Nandurbar district belongs to Scheduled Tribes viz., Bhill, Tadavi, Kokani, Pawra, Mavchi etc. KVK selected the Nawapur taluka which was hitherto virgin to onion farming. The tribal farmers hardly used any chemical fertilizers and their farms had abundant natural honey-bees. Presence of honey-bees and no other onion farm in the radius of 1.5 km (isolation distance) made this area an ideal location for onion seed production. The group consisted of 21 tribal

farm women. They took land on lease from a local farmer for 4 months. They bought the seed of Phule Baswant variety. The land had water availability. The KVK clearly told the farmers that they would not receive any financial help or subsidy from the KVK. The onion seed production experiment was going to be self-sustainable from the beginning. Over 80% of the training was on-farm. The training cycle began with soil testing, land preparation, making of furrows, time of application and concentration of fertilizers, pesticides, and irrigation schedule. While the country needs 5000 tonnes of onion seed every year, only 10% of it is available in the pure form. The NRC later signed its first-ever MoU with a community group for seed production. This honour went to three SHGs that are currently producing onion seeds in Nawapur area. Two of these SHGS are composed entirely of tribal women. The KVK was ingenious in working with a group of people that were subsistence farmers. They had no cash crops or huge land holdings. The onion seed production effectively enhanced their livelihood security. They are careful in the production of seeds, for that is their sole secure livelihood. KVK Nandurbar has already succeeded in creating a farmers groundnut crop museum and has plans to initiate seed production of vegetables and wheat. Its projects with UNDP and NAIP have successfully developed livelihood security models for tribal villages. The KVK team is confident that this district can become a seed zone for the country.

Nutrition Gardens and Seed Banks: Women Farmers Adapt To Climate Change

Uttar Pradesh is one of the six severely affected states listed by the World Bank in its study on malnutrition in India. The other states where every second child is underweight – one of the indicators of malnutrition – include Rajasthan, Odisha, Maharashtra, Madhya Pradesh and Bihar. Four states – UP, Rajasthan, Bihar and Madhya Pradesh – account for more than 43 per cent of all underweight children in India. Again, in Odisha, protein consumption is as low as 48 gm per capita, compared to the national average of 57 gm. Not surprisingly, 61 per cent of the women in the state are anaemic, compared to 34 per cent of the men. There is an urgent need to focus on sound adaptation measures, especially those that benefit women directly. Some women-friendly adaptation measures that can be promoted include village-level grain banks, which have proved popular in disaster-prone villages across states, including in Bengal and Odisha. Run and managed by women self help groups, members store and borrow local millets and rice in times of need and repay in kind. Dakshin, a tribal woman farmer in the Kerandimal tribal area in Ganjam district, Odisha, puts it this way, “Grain banks mean our men will not migrate when the crops fail and that we will have enough to eat, too. We women have often starved because we preferred giving the available food to our husbands and our children.” In many tribal areas of the state, grain banks have become the traditional coping mechanism and their recent revival has been welcomed by village women. Grain banks today are supported by government agencies like National Bank for Agriculture and Rural Development (NABARD), UN organisations and other donor agencies as well as by local civil society organisations. Other adaptation measures could include seed banks, fodder banks and inputs for kitchen gardens. The women of Bankra village in 24

North Paraganas district, West Bengal, emphasize that their families survived the worst impacts of cyclone Aila because of their grain/ seed banks and kitchen gardens.

Community Seed Banks in India

With the modernization of agriculture, agricultural practices and cropping patterns changed and genetic diversity started getting lost. As a result, the genetic base of traditional seed varieties reduced considerably and several traditional seed varieties are now facing extinction. These varieties were inherently more compatible with local farming conditions, economically practical and environmentally sustainable than the high yielding varieties being used today. They were also more resistant to pests, diseases, droughts and floods. The availability of the appropriate kind of seed is highly significant for agriculture because without viable seed, the survival of rural households is endangered. The ways that farmers obtain seeds are as old as agriculture, and most small-scale farmers routinely save their seed from one harvest to the next. At one time, India had 200,000 varieties of paddy (rice grown in fields submerged in water), ranging from wetland to dry land to deep water and scented millets were once a popular crop because they are drought-resistant, highly nutritious, and capable of cultivation in poor soil. Nevertheless, these community systems of seed supply are increasingly facing pressure due to: factors such as droughts, crop failure, conflict, difficult storage conditions, and poverty which are eroding both the quantity of seed, and number of plant varieties available to farmers. Agricultural modernization because of which farmers are increasingly purchasing more of their seed requirements. As this bought-in seed replaces older, local varieties, these varieties become increasingly unavailable in many communities. Therefore, interventions to strengthen informal seed supply systems, such as establishing seed banks, and seed breeding and multiplication are gaining popularity among nongovernmental organizations (NGOs) and public sector institutions engaged in the area of seed supply.

Community seed banks usually store seed from a wide range of individuals, informal groups and NGOs who share seed among themselves. Seed is primarily retained from participants' own production with no formal quality control, but individual selection process and handling skills are involved. More recently, some community seed banks have been set up in partnership with the formal sector - chiefly plant breeding research institutes. Seed banks are a form of storage and diversification, and they enhance farmers' ability to buffer environmental and economic stress by planting several crop varieties adapted to a range of environmental conditions. At the same time, seed banks facilitate farmers' access to markets and give farmers more choice over what they grow. Seed banks enable rural tribal villages to become less dependent on engineered high-yield varieties and on expensive inputs such as fertilizers and pesticides.

Issues in Addressing the Seed Needs of Tribal Women

The global commercial seed market is estimated at $27,400 million. The top 10 companies account for 73% of the global market. Just 3 companies control more than half (53%) of the global commercial market for seed. Monsanto, the world's

largest seed company and fourth largest pesticide company, now controls more than one- quarter (27%) of the commercial seed market. The success of any variety depends on two major factors, viz. stringent adaptive trials and the quality of seed being produced and marketed. Since the onset of Green Revolution in 1970s, the distribution of seed has increased from 50 thousand tonnes to above 1100 thousand tonnes in 2007–08. Now the Indian seed market is the sixth largest in the world, growing annually by 12% compared to 5% growth of global seed market. With the adoption of Seed Policy of 1988, wherein foreign direct investment in seed sector was promoted and the import of improved varieties and breeding lines was liberalized, there had been a boom in this sector. At present it is estimated, that private sector accounts for approximately 80% turnover in seed market.

Last year it was worse than the previous year. Even that previous year was worse than the year before. Every year, farmers are facing an increasing problem of access to seeds. Standing in long queues, with cash in hand (procured from private money lenders with great difficulty and high rate of interest), and anxiety writ on their faces, farmers do not know if this method of seed procurement is likely to be permanent or a temporary phenomena. Every year, they hope that the situation might change. Problems with seeds are deep rooted, and extending these roots into new areas. It is not just availability of seeds on time. It is also not just about quality of seeds. Good quality seeds, with good germination potential, are becoming rare, as the number of hybrids are increasing.

The other constraints being, low yield, adaptability of the variety, availability, occurrence/ reports of disease and/ or pests and presence or absence of any special character: in example, presence of basmati characters in rice. On the other hand, prices of seeds are increasing every year. So much so, farmers are now shelling out 10-30 percent of per acre investment on seeds alone. Yet, they are not assured of good quality seeds. There are administrative, economic, management and legal issues here. However, farmers who are forever busy with farming do not have information, knowledge or wherewithal on how to deal with these issues. The traditional systems of selection, saving, improving and production of seeds have been deliberately replaced. Quality is a major issue for farmers, as most seeds, which come in packets and branded, do not germinate, grow, develop leaves, flower or give proper yield. Many farmers, who invest on land preparation, water and electricity, labour, crop protection, land fertilization, etc., find that with low quality seeds, all their efforts go waste – down the drain. This leaves them poorer by so much of investment. Risks due to seeds are increasing, and their worries are multiplying. Other risks include market prices and natural disasters (sudden rains, hailstorms, extreme heat or cold conditions, floods, drought, water shortages, etc.). It is important that prices of seeds are regulated by the government, on an annual basis.

Strategies for Technological Empowerment of Tribal Women in Production of Quality Seeds

Tribal farm women traditionally exchange seeds, usually in an informal fashion. Their varieties necessitate no pesticides because local seeds are naturally hardy. After all they are the progeny of plants that have gone through generations of

constant change in the local environment and bio-cultural practices. Home-saved seeds are at the core, and a living legacy, of the peasant food web. However the number of peasant farmers is diminishing and the reliance on corporate seeds increasing. The seeds and pesticide merchants are trying all they can to capture a bigger share of the market. Sadly many aid and development projects promote this model. They do not necessarily know about or support farmers saving their own seeds. In 1996, FAO's *State of the World Report on Plant Genetic Resources* estimated that 1.4 billion people depend on farm-saved seeds. Locally adapted high quality seeds are a rare commodity and cost nothing but patience. Farmers worldwide keep their seed within a friendly active network, and re-grow them in their fields as a living seed bank evolving within culture, and within climate. Institutionalised seed-banks are inaccessible to farmers. Increasingly even small seed companies are relying on large corporations for their seed supply. To remain independent, an increasing number of farmers are saving their own and gifting and exchanging their seeds with other who also do.

Home-saved seeds are for free- when produce their own seeds they avoid the recurring expense each year. It is easy to produce seeds- a little patience and appreciation for the beauty of plants flowering will yield very own seed that are getting adapted to local climate. Abundance to share, and self seeding saves time. Traditional varieties are generally more nutrient-dense than commercial varieties. Home-saved seeds germinate better- fresh seeds germinate at a higher percentage and are more vigorous, i.e., they are quicker to-emerge from the soil and more likely to thrive. Local adaptations suit climate and conditions. Local varieties are resilient and rustic-home-saved seeds will adapt to resist local pest and diseases and over time become more hardy. Home-saved seeds are climate ready- local varieties have a rich genetic past as they had to evolve in farmers' hands with changing climates over thousands of years. They will remain adaptable to future changes compared to uniform highly bred hybrids and genetically modified seeds that are derived from seeds in frozen gene banks.

Training farm women in better selection, treatment, and storage of seeds from their own farms is the needed step. Own saved seed is most appropriate for farmers who cannot afford to purchase seeds. Encourage farm women to make their own selection of traditional varieties, to multiply and store seed of such varieties, and sell this quality seed to other farmers. This method is best suited to farmers who are capable of doing experimentation. Develop modern varieties at research stations, and produce good quality seed of these varieties, through either formal or informal channels, and make it available to farmers at affordable prices. Women's seed breeding skills need to be recognized in agriculture. Farming systems need to be based on women's knowledge of diversity for increasing output of nutrition, increasing resilience to climate change, and reducing inputs of land, water and capital. Community seed banks should be created and women's participatory seed breeding should become the backbone of food security. Laws of intellectual property need to change. The TRIPS has an article which imposes patents and intellectual property rights on seed and life forms. This clause was to have been reviewed in 1999. Most countries had called for a stop to patents on life, which includes seed. This mandatory

review should be completed, and seed removed from patentability, since seeds are not an invention, and hence not a patentable subject matter. Seed laws that are an attempt to make indigenous, open-pollinated seeds illegal must be revoked. Instead we need to shape laws that recognize seed rights as women's rights, and keep seed as a commons.

References

Aditi Kapoor (2012) Nutrition Gardens And Seed Banks: Women Farmers Adapt To Climate Change, March 16, 2012 (http://www.thebetterindia.com/4830/nutrition-gardens-and-seed-banks-women-farmers-adapt-to-climate-change/)

Saswati Roy (2001) The Broken Rifle, February 2001, No. 47 (http://wri-irg.org/node/2222)

http://agropedia.iitk.ac.in/content/seed-problem-unsolved

http://www.fao.org/docrep/x0212e/x0212e06.htm

http://kvknandurbar.net/success-story1.php

http://www.seednet.gov.in

http://seedsavers.net/shop/home/why-save-seeds/benefits-of-seed-saving

Community Seed Banks in West Bengal

Raj Krishna Mukherjee
Development Research Communication and Services Centre, Kolkata

Development Research Communication and Services Centre (DRCSC) is working for the last 25 years for promotion of sustainable agriculture(SA) in the state of West Bengal and working exclusively for the cause of small and marginal farmers. DRCSC works mostly in the rainfed and vulnerable areas of the state and most of the farming households have marginal farm conditions. Promotion of SA requires traditional seed and hence conservation and multiplication of traditional seed is an essential feature of activity. To institutionalize such efforts, DRCSC promoted seed banks in the respective areas at community level comprising seed savers and seed producers. The work of the seed bank is overseen by the seed committee which reports back to Area Resource Training Centre (ARTC), a local farmer body overseeing the whole gamut of activities on SA and group work.

Seeds refer to field crops, vegetables, uncultivated foods and perennial & semi-perennial trees in the form of vegetative propagating materials. Seeds which are locally adaptable, rich in nutrient content, prone to less pest attacks and useful for year round nutritional intake are considered for conservation, multiplication and production. Commercial angles are now also being considered.

Seed savers, producers, seed committee members have different criteria. Normally, a seed saver is inducted in the seed bank after minimum three seasons of practicing SA and orientation and trainings on SA. Seed producers are identified by the seed committee members after visiting their fields, taking into account seed collection techniques, exposure to training on seed production and seed processing and preservation measures. Seeds from seed savers are used for popularization of traditional seeds within the known network to limit the risk of cross pollination, which seldom happens.

Seed producers are seed savers with much exposure to training on seed production especially about maintaining genetic purity at a small farmer's field, having considerable knowledge about choosing the proper fruits and the time of seed collection, having good understanding of traditional seed processing and preservation techniques and following protocols properly. Each seed bank has separate list of seed savers and seed producers.

Seed committee members are selected from the expert seed producers with more exposure to trainings on seed. The seed committee chooses and monitors the seed producers and additions and alterations in the pool of seed producers and seed savers are undertaken by them in different seasons The seed committee has also a member from the ARTC.

Preservation is mainly done in farmer's place and also in the seed bank. Seed bank mainly preserves vegetable seeds. Bulk seeds (paddy, mustard, pulses etc.) are normally kept in farmer's place. It is done because banks are working with very poor or no infrastructure at all. Normally, the banks are housed in ARTC office or at farmers' places and in some case in rented places. This is a big hurdle faced by the seed banks to maintain the quality of seeds.

Despite all hurdles, these seed banks have started supplying seeds to government programs like PKVY and it is a welcome move by the PKVY authorities in West Bengal to accept open pollinated farmer saved and produced seeds. This will genuinely help the small farmers to raise their income and to institutionalize traditional seeds. If given a proper infrastructure, these small seed banks can do marvels. Moreover, it is not only the question of in-situ infrastructure of seed banks but also an ex-situ cluster to be housed in urban area for storage, requisite tests, dispatch and connectivity. It is apparent from some recent supplies that one seed bank is not able to cater to the needs and seeds have been supplied from four seed banks. There are also issues of standard packaging, information tags etc. which is beyond the capacity of individual seed bank operating from the remote places. A list of seed banks promoted by DRCSC is given below.

DRCSC also promotes and a part of state level seed savers network – Paschimbanga Beej Swaraj Manch comprising organizations and individual seed savers in various crops. The members are also facing problems for marketing of their produce – seeds and crops. Formation of a cluster at a centralized urban area will be helpful for them also.

Details of Seed Banks & Organisations:

1. Ankuralay – Hingulgunj, 24 Parganas(N).
2. KIAS- Kayakhata Integrated Agri-Service Co-Operative Society Ltd., Salsalabari, Alipurduar.
3. SJKB – Sundarban Jaibo Krishi Bhandar, Patharpratima, 24 Parganas(S).
4. Sashya Bhandar – Sibgunj, Basanti, 24 Paganas(S).
5. AILA Jaibo Krishi Bhandar – Bermajur, Sandeshkhali, 2 Parganas(N)
6. Dhanchebari Jaibo Beej Bhandar, Dhanchebari, Nandigram, Purba Medinipur
7. Kisan Swaraj Beej Bhandar – Tiorkhali, Bajkul, Purba Medinipur
8. Matangini Jaibo Beej Bhandar – Samshernagar, Hingulgunj, 24 Parganas(N)
9. Seed banks at Purulia, Bankura and Birbhum (all dry land areas of WB).

Community Nursery Raising of Horticultural Crops: A Potential Enterprise for Farmwomen

Naresh Babu
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Horticulturalists play a crucial role in ensuring future food and nutritional security for those most vulnerable to stresses imposed by climate change and resource scarcity. It comprising fruit, vegetable, flower, tuber crops, plantation crops, spices, medicinal and aromatic crops forms a vital component of Indian agricultural production. Horticulture not only plays an important role in Indian Macro- economic issues, but also an essential element of the strategy to make growth more inclusive. It provides protective foods, which contribute required minerals, vitamins and other nutrients of medicinal and therapeutic values. The production and productivity of different horticultural crops have increased significantly since last 3 decades as a results and research undertaken by various agricultural institutes and private sectors. Modern strategic approaches are however, necessary for sustainable development of this sector so as to meet the increasing requirement both in domestic as well as export markets. The population of the country is constantly increasing day by day. Moreover, the productivity of most of the horticultural crops are low as compared to other countries. There are various factors for low productivity of crops, out of them non availability of quality seedling/ planting materials in timely may be important factor. It has now been realised that to achieve higher production levels, productivity has to be increased through the adoption of hybrid varieties and improved production technology. Presently, the commercial growers are quite aware about the importance of hybrid varieties as they are high yielding, uniform in maturity and can tolerate the impact of abiotic and biotic stresses and have better quality produce as compared to standard varieties / cultivars. Though the seeds of many hybrids are made available to the farmers, they lack the technical knowhow of producing quality seedlings. Hence the production and timely distribution of quality seedlings of horticultural crops would pave a better way to achieve the targeted production. The most important and feasible approach to enhance the productivity of horticultural crops would be the production of quality seeds and planting materials and making it availability. The importance of good quality of seeds/ planting materials can hardly be over emphasized as it is crucial for higher productivity. To ensure better production, generally farmers purchased the seeds/ planting materials from the markets which is very costly. With the knowledge of seed/ planting materials production technology of horticultural crops, the farmers can produce the seed/ planting materials at their own and save the money and time. However, they need proper knowledge and skill for production of quality planting materials. In order to meet this challenge, there is need to community based nursery raising of horticultural crops which, would be turn, provide comprehensive knowledge to the growers regarding the recent advances in technologies for planting material production of horticultural crop. Production of quality planting materials is highly remunerative and can be raised in small place with minimum affords making it highly suitable for adoption by small/ marginal women. A space of 1 sq.mt. can easily accommodate about 200 saplings (10x 12 cm polybag size) in plastic bags. However, in case of cucurbits vegetable, an average selling price of about Rs. 10 fetches a gross annual income of Rs.2000 per sq.mt. After receiving training women can able to produce quality planting materials of horticultural crops in community based nursery by different propagation techniques like grafting, cutting, budding, layering etc. and earn the

income by selling it. The demand of quality planting materials is very high. In the regions where horticulture is popular, Self Help Groups and community based nursery can raise quality seedlings as an important income generation activity.

What is community nursery raising and why?

It is the one type of system to producing the good quality planting materials by a number of farmers group to fulfillment of their planting materials requirement in reasonable cost, sufficient amount at appropriate time and an improved variety. In India planting materials supply system missing in some places like nursery sector if we produce sufficient amount of planting materials of a crop but the cost of those planting materials are high, which is not affordable for farmers but in some conditions government also provide the subsidy to planting materials, at that time an another problems happens that the supply of planting materials not available at the time. The most important factor is that, every year so many variety as well as technology developed by the various scientists in which only some are adopted by the farmers that's mean not they are not aware regarding these technologies as well as improved varieties but they are unable to obtain improved planting materials. Therefore, to overcome this types of problem community based nursery raising require in every community level. In other words we can say that the main purpose of community nursery raising is

- Community managed nursery that should provide quality planting materials, desired variety and before planting.
- The same system is intended to serve alternative contingency planting materials in case of crop failure due to weather aberrations.
- Community managed nursery should be evolved based on local agro-ecological systems, market needs, community food needs, local institutional and market linkages.

Objectives of community nursery raising

- Establishment of community nursery that will be managed by members of farmers with collaboration of NGOs, Government departments and financial institutions.
- Facilitation planting materials to link up with all collaborating institutions and organisations.
- Ensuring quality planting materials by establishing community nursery.
- Encouragement of local nurseries to supply annual and perennial plantations

Sexual propagation

Multiplication of plants by seed is known as sexual propagation. In ancient times when the asexual methods of plant propagation were not known this was the only commercial method for plant propagation. Papaya, phalsa and mangosteen are still being propagated by seed.

Advantages

1. It has been responsible for the production of some chance seedlings of highly superior qualities. For example most of the commercial mango (Dashari and Langra) originated from seed and later multiplied by vegetative means.

2..In breeding for evaluation of new varieties, the hybrid plant is first raised by seed.

3. The rootstock upon which the fruit variety are budded or grafted are usually obtained by this method.

4.Polyembryony exists in many fruit plants For example, all the varieties of citrus excepting pummelo (*C. grandis*), Tahti lime(*C. latifolia*) and Turanj (*C. medica*) and

mango Olour, Kurukkan, Chandrakaran Goa and Vellaicolumban are polyembryonic and give rise to more than one seedling from one seed.

5. This is the only means of reproduction where vegetative propagation is not possible, e.g. papaya, phalsa and mangosteen.

Limitation 1.Seedlings have long phase of juvenility and the first crop is obtained very late.2.There is no uniformity in growth, yield and quality of fruits. 3.Seedling trees are usually large in size and thus the cost of harvesting, pruning and crop protection is more. 4.Fruits obtained from seedlings are of inferior quality. 5.Since seed borne viruses exist in a number of fruit plants-psorosis in citrus and mosaic in peach, cherry and almond- the multiplication of such plants by seed is not recommended.

Asexual propagation

Plants have a number of mechanisms for asexual or vegetative reproduction, these have been taken advantage of by horticulturists, and gardeners to produce plants rapidly. Plants are produced using material from a single parent and as such there is no exchange of genetic material, therefore vegetative propagation methods almost always produces plants that are identical the parent.

Advantages

1.The vegetatively propagated fruit plants are true- to – type since they are uniform in growth and fruit quality.

2. The plants producing seedless fruits (banana, pineapple, grape, guava and lemon) can only be perpetuated asexually.

3.Fruit trees come into bearing earlier than the seedlings trees.

4. It is possible to regulate the tree size, fruit quality by using different rootstocks.

5. Some fruit varieties are susceptible to certain diseases. By budding or grafting them on a resistant rootstock, they can be grown without any incidence of pest or disease.

6..Indicator plants can be used for studying various viral diseases. Thus kagzi lime can be used as rootstock (indicator plant) for detecting the presence of tristeza virus.

7. Fruit maturity of a scion variety can be hastened or delayed by using different rootstocks. For Kinnow manadarin, Troyer citrange hastenes the fruit maturity while Karna khatta delays the fruit maturity.

Limitation

***The vegetatively propagated plants particularly budded/ grafted are short lived.**

*No new varieties can be evolved by this method.

Propagation by specialized vegetative structures

Some fruit plants have natural structures- runner, sucker, offset, rhizome and crown- for propagation.

Runner: It is specialized stem, which is produced from the leaf axil at the crown of plant and prostrate horizontally. The roots appear at one of the nodes having contact with soil. After root formation in the new plant, the contact with the mother plant is automatically detached and new plant can be separated and planted. Strawberry is the planted by this method.

Suckers: A sucker is a shoot, which arises on a plant below the ground. However, in practice, shoots, which arise from vicinity of the crown, are also referred to as a suckers. Pineapple and banana is usually propagated through suckers.

Offset: It is lateral shoot or branch, which is developed from base of the main stem. The date palm and pineapple produce such type of lateral shoots by which they can be propagated.

Rhizome: A rhizome is a modified structure in which the main axis of the plant grows horizontally just below or on the surface of the ground. Banana is propagated by this method.

Crown: It designates the part of a plant at the surface of ground from which new shoots are produced. In strawberry plant, which leaves are seen in groups, is referred to as crown of plant. Similarly, at the top is the crown of pineapple plant, which can be used for propagation purpose.

Propagation by layering

Layering is a technique for plant propagation in which a portion of an aerial stem is encouraged to grow roots while still attached to the parent plant, and then removed and planted as a new plant. The layering techniques generally employed in fruit plants are:

Tip layering: In tip layering, rooting takes place near the tip of current season's shoot which is bent to the ground. It is commonly followed in black berries and raspberries. The stems of this plant complete their life in 2 years. During first year, vegetative growth takes place while in the second year fruiting takes place.

Serpentine layering: It is modification of simple layering in which 1- year- old branch is alternatively covered and exposed. The stem is girdled at its lower part. The exposed part of stem should have at least one bud to develop a new shoot. Muscandaine grape is commercially propagated by this method.

Air layering: In this method, roots are formed in the aerial part of the plant. The stem is girdled and rooting hormone is applied to upper part of cut. The moist rooting medium is wrapped with help of small polythene strip (200- 300 gauge, transparent). Litchi, kagzi lime, jackfruit, guava and cashew nut are propagated through air layering.

Mound layering/ stooling: In this method, the plant is headed back to 15 cm above the ground level during dormant season. The new sprouts will arise within 2 months These sprouts are then girdled near base and rooting hormone (IBA). These shoots are left as such up to two days for proper absorption of rooting hormone (IBA) before they are covered with moist soil. Apple and guava are commercially propagated by this method.

Propagation by cuttings: In the method, cuttings of plant parts (specially stem, leaf or root) are used for propagation. Hardwood and semi-hardwood cuttings are used for propagation.

Stem-cuttings: Propagation by hardwood cuttings is simple and cheaper method of multiplication. Hardwood cuttings are easily handled and transplanted. One-year old mature shoots are collected during November-February. Grape, fig., pomegranate, plum and apple are propagated by hardwood cuttings.

Semi-hardwood cuttings are mostly used in evergreen fruit plants – mango, guava, lemon and jackfruit. The available shoots during June-July have not attained the full maturity and are 6-9 months old. Such shoots are used for propagation purpose.

Leaf-bud cutting: A leaf-bud cutting consists of a leaf blade, petiole and a short piece of stem with attached auxiliary bud of actively growing leaf. Black berry is propagated by this method.

Root cuttings: Roots of the plant are utilized as propagating material. Roots 1cm thick and 10-15 cm tall are used. In temperate fruits, such kind of roots are prepared in December and kept in warm place in moss grass or wet sand for callusing and transplanted during February-March in open beds. Blackberry and raspberry are commercially propagated by this method.

Propagation by grafting

Grafting is an art of connecting 2 pieces of living part of plant together in such a manner that they unite, subsequently grow and develop into one complete plant.

Attached method of grafting or approach grafting

In this method, the scion unites with stock while both the components are on their own root system. After the union takes place, the top of the stock above the graft and the base of scion plant are removed below the graft. The various forms of approach grafting are:

Inarching: It is also known as simple approach grafting. In low rainfall areas it should be done with the onset of rains, while in regions of heavy rainfall it should be done soon after the rainy season is over, provided temperature does not fall below 15^0C. Selection of parent tree for taking the scion is an important factor. It is the most common method for mango and guava propagation adopted by nurserymen all over the country.

Tongue grafting: It is modification of simple inarching and is generally practiced with thicker rootstock and scion. The rootstock is first cut as in inarching and a second cut is made into the wood of stem about half way down the first cut in a sloping direction pointing tongue upwards. A similar cut is made in the scion shoot. Both cuts are made in such a manner that one fits into the other tightly. Apple, pear and walnut are propagated by this method.

Detached methods of grafting

Scion is completely severed from the parent plant during the process of union of stock and scion. The various methods used are:

Splice and/or whip grafting: In this method, it is essential that both the stock and scion are of equal diameter. About one year old rootstock is severed at height of 23-26cm from the ground level and a diagonal cut (3-4 cm long) is made at the distal end of the rootstock. A similar slanting cut is made on the proximal end of the scion and cut surfaces of both the rootstock and scion are bound together with polythene tape.

Veneer grafting: This method is simple and can be used on rootstocks of one year having a diameter of 1.0-1.5cm. For veneer grafting, 3-6 months old scion shoots with lush green leaves are selected. March-September is ideal time of veneer grafting in northern India. The rootstock is prepared for veneer grafting by making a slanting cut (5cm long), an oblique cut is then made at the base of the first cut so that a piece of wood along with bark is removed. The base of the scion wood is then fitted into the rootstock in such a manner that the cut surfaces, including the cambium layers of scion and rootstock are facing each other. Mango is commercially propagated by veneer- grafting in north India.

Cleft or wedge- grafting: This techniques is employed using rootstocks of more diameter than the scion. It is useful for top working. Rootstock with 5-7cm or more girth, should be selected and cleft grafted after decapitating the stock 45cm above the ground level. The beheaded rootstock is split to about 5cm deep through the centre of stem. Walnut, hazelnut, peanut and grape are propagated by this method.

Soft-wood grafting : In this technique, grafting is done with mature, procured scion on the emerging soft coppery red shoot of rootstock. The leaves on the stock must be retained while grafting to get high success. This technique is effective in dry, hot weather or in areas of low precipitation. Soft-wood grafting is successful in mango, avocado, sapota an tamarind.

Methods of budding

Shield or 'T' budding: As the name indicates 'shield' is the shape of the bud and 'T' is the shape of cut given on the rootstock for the operation. Fruit plants with thin bark, with sufficient flow of the sap like apple, pear, peach, plum, apricot, cherry and citrus are propagated by this method.

Patch budding: A rectangular patch of a bark is removed completely from the stock and replaced with a patch of bark of the same size containing a bud. This kind of budding is slow and difficult to perform but successfully used on plants with thick bark such as walnuts and pecans where 'T' budding gives poor results.

Ring budding: A complete ring of bark is removed from the stock and the bud stick preferably of same size is inserted. New shoots arising from the heavily pruned plants of ber, peach and mulberry are capable of giving such buds for budding, which can be easily separated.

Chip budding: When the bark is not slipping due to poor sap flow or adverse conditions such as lack of water, defoliations or low temperature, which may lead to tightening of the bark and seriously interfere with the budding operation. Under these circumstances, chip budding can be done in the beginning of February- March. Grape, apple and pear are propagated by this method.

Micro propagation: It refers to propagation of plants from very small plant parts, tissues grown aseptically in a test tube or container under controlled nutritional and environmental conditions. This method is gaining popularity because of advantages over other conventional methods.

Advantages: 1. Large scale multiplication in lesser time and space **2**. Production of virus free plants Year round **3**. Production of plants highly beneficial in those fruits where vegetative propagation is difficult.

In dioecious fruit plants, production of female plants is possible through micro propagation. Papaya is a good example.

Under micro propagation, different plant parts are cultured. They are shoot- tip culture, meristem- tip culture, embryo culture and ovule culture. Tissues culture technique has been perfected in banana. Shoot tip exercised from rhizome of sword suckers are suitable explants and MS medium supplemented with sucrose (3%), and gelite (0.25%) is the best. Shoot tips and micro cuttings are highly suitable explants for faster and disease- free production of grapes. Salt tolerant rootstock of grape has increasing demand and *in- vitro* propagation has been successfully used. Seed – propagated papaya often shows high variability, undesired ratio of male and female plants. Shoot- tip culture technique has been successfully used in producing female plants in papaya.

Seedling production using pro-tray: The seedling tray (pro tray) is filled with the growing medium (coco peat). A small depression (0.5 cm) is made with fingertip in the centre of the cell of the pro tray for sowing. Coco peat with 300 to 400 per cent moisture is used and hence no immediate irrigation is required until germination. After sowing 10 trays are kept one over other for 3 to 6 days, depending on the crops. The entire stack will be covered using polyethylene sheet to ensure conservation of moisture until germination. The stacked trays are spread once the germination commences to avoid etiolation. The trays are irrigated lightly every day depending upon the prevailing weather conditions by using a fine sprinkling rose can or with hose pipe fitted with rose. Drenching the trays with fungicides as a precautionary measure against seedling mortality is also being done. Spraying of 0.3 per cent (3g / litre) water soluble fertilizer using poly feed (19 all with trace elements) twice (12 and 20 days after sowing) is practiced to enhance the growth of the seedlings. The seedlings at right stage of planting are hardened by withholding irrigation and reducing the shade before transplanting or selling to the growers. Systemic insecticides are sprayed 7 - 10 days after germination and before transplanting for managing the insect vectors.

Conclusion

Planting materials have played a crucial role in the development of horticulture by supplying food, feed, natural products, and traditional medicines. Preparation of nursery on community basis for raising seedlings and planting materials is very much useful for self sufficiency. These can be used for home garden also. Only using of quality planting materials assured better response. Hence, quality seedlings and planting materials production of horticultural crops have a huge potential for improving productivity of horticultural crops and providing livelihood security to farmwomen. It will be helpful for income security of farmwomen in the field of

horticulture. Therefore, it is important that concept of community based nursery for quality planting materials production can be promoted among farmwomen for an employment opportunity and as a source of income throughout the year.

***

Women Friendly IPM Technologies for Seed Production and Storage

S. K. Srivastava
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Women play a crucial role in ensuring supply of food as food vendors. As major buyers of family food and meal-makers, women ensure adequate food security. As primary providers of nutrition to the young children, women are the major decision-makers in ensuring nutrition to the next generation. Marginal farmers are often engaged in professional pesticide spraying and therefore subject to continuous exposure. Women and children are specially at risk because they are frequently employed in mixing pesticides and refilling pesticide tanks. Women and children also perform secondary activities that have been neglected in studies dealing with direct exposure. Extremely time consuming operations such as weeding are often performed by women and children during the peak spraying season, when residue levels in fields are high and can cause secondary poisoning. Women are also exposed to pesticides in the home, by washing pesticide soaked clothing and disposing of /or using, empty chemical containers. Women are particularly vulnerable to pesticides when they are pregnant. Health problems passed on to offspring add to the concern over pesticide poisoning in women. Compared to men, women are usually less informed about safe pesticide practices and the dangerous side effects of pesticide use. High levels of pesticide poisoning among resource poor farmers, especially women, are often reported to be linked to low levels of literacy and education.

Food security as a national objective was placed on the policy agenda much earlier than in other developed and developing countries. Now people have started to give emphasis on safe food / organic food production due to pesticide residues in food chain. Casual approach and indiscriminate application of insecticides incited resistance and resurgence of pests, and threatened health. When we talk about a farmer immediately a man figure comes in the thought. The researches and technological disseminations become biased and women are mostly neglected at the stage. Human development gap was aggravated by substantial gender disparities. Due to increasing migration of man towards urban areas it is forecasted that future agriculture will be in the hands of farm women.

There is wide scope to enhance crop productivity through effective suppression of pests, diseases and weeds. At the same time, there is a rising public concerns about the potential hazards of chemical pesticides on the human health, environment and biodiversity. High pesticide residues in food chain cause pesticides poisoning cases and deaths through organ dysfunctions, immunosupression, neurotoxicity, impairment of reproductive functions, carcinogenicity, tumorogenecity, paralysis etc., and harm to non-target beneficial fauna and flora. Thus pesticides need to be coupled with botanicals, mechanicals, pheromones and cultural practices to develop precise IPM technologies. It is a fact that chemical control now dominates pest management including India. The environmental considerations in integrated pest management have posed new challenges to scientists, for developing environmentally benign pest control chemicals which are effective against the target species but create minimal adverse effects on non-target species.

To regulate pesticide residues to safe levels commission has laid down principles for aiming at the maximum residue limits of pesticides on food commodities. Pesticide residues in food are dealt with by the Codex Committee on Pesticide Residues (CCPR), hosted by the Netherlands government. It is a committee that forms a subsidiary body of the Commission under The Joint FAO/WHO Food

Standards Programme. Codex has become the basis of international food standards for trade between member countries of the World Trade Organizations (WTO).

The farmers identified plants which could resist and repel insects. *Diospyros affinin, Anamirta cocculus, Ananas comosus, Euphorbia antiqourum, Garyota urens, Pongamia pinnata, Crotolaria retusa, Cycos circinalis, Cymbopogon citratus, Areca catechu, Cocos nucifera, Carica papaya*, and *Coleus amboinicus* are some of the plant species used for botanical pest control. The fruits, leaves, bark and seeds of these plants are crushed, cut into pieces, and then buried, hung, or distributed in and around the field. Food and light traps are the major mechanical pest control methods cited by the farmers. Rodents which damage the paddy are controlled by using food traps, while insect pests are caught in light traps. A sticky substance derived from *Artocarpus heterophyllus* is also applied to the winnowing fan to control flies. Farmers have also developed various devices operated by wind or flowing water to generate frightening sounds that drive harmful animals away. They use scarecrows or puppets to frighten rats. They believe that sulphur generates a repelling smell that kept wild boars away from the farm. Farmers said that certain religious practices, like the offering of food, flowers, and lighted oil lamps, would reduce pests. From a scientific perspective, this offering makes sense: birds are attracted to the food while insect pests are attracted to the light. This allows the birds to prey on the destructive insects. These indigenous methods are time- tested, environmentally safe and economically viable.

Gender friendly IPM technologies are aimed at integrating available pest control methods to achieve effective, economical and sustainable combination of chemical, biological and cultural control. In such programme, pesticides are used as a last resort due to their increased application cost and hazards associated with their use. An integrated strategy for crop pest control should include biological control and chemical control with need based use of chemical pesticides including botanical and biopesticides. The extensive studies have been made on the use of plant derivatives both as crude preparations and as commercial formulations against several field crops without affecting their natural enemies.

It is estimated that 100 grams of ground neem powder when mixed with 10 litres of water is capable of repelling pests as foliar spray. Similar economical on-farm solutions should be made available to poor and marginal farmers to protect their crop from solutions should be made available to poor and marginal farmers to protect their crop from pest infestation. Some of the insect pests which can be effectively controlled by botanical pesticides include brown planthopper , *Nilaparvata lugens* (stal); green leafhopper, *Nephotettix* spp, tobacco cutworm, *S. Litura*; leaf folder, *Cnaphalocrocis medinalis* (Guenee); gram podborer, *Helicoverpa armigera* (Hubner) and stored product pests. They are also capable of controlling sheath rot and rice tungro virus disease in rice, and tobacco mosaic virus disease in tobacco. The most important consideration in gender friendly plant protection techniques is that we should not depend on any one method of pest control and other options of biological, cultural, physical and chemical methods are carefully, plant based pestcides like azardirachtin, nicotine, rotenones, ryanodines and annonins, etc. offer considerable promise in pest management.

With global perspectives of environmental protection and food security, herbal pesticides are getting worldwide importance for sustainable food security. To combat the challenges of today's food, health care and nutritional security, herbal pesticides can play a greater role. Use of agro-chemicals for fertigation, pest control and food storage is causing serious health hazards and polluting the scarce natural resources. Our target should be to provide safe food material to the society. Losses due to insect pest

increased in spite of the increase in the use of pesticides. Therefore, shifting on gender friendly plant protection techniques with judicious integration of all methods for the pest management in seed production and storage is of prime importance at present scenario. List of Gender friendly plant protection techniques for the management of different insect pests has been given below:

Table 1. List of gender friendly options which can be incorporated in IPM technologies for seed production and storage.

Name of plant protection techniques	Crop	Pest	Stage of the Pest
Application of *Trichogramma* spp. (Parasitoid) @ 50 000/ha five times starting from flower initiation stage at weekly interval	Vegetables	Fruit Borer	Egg
Pheromone Lure for Diamond Back Moth, Cabbage looper, American Bollworm, Tobacco caterpillar, Pink boll worm, Yellow stem borer, Rice stem borer, Sorghum stem borer, Black cut worm, Potato tuber moth, Oriental fruit moth, Gypsy moth, Codling moth, Almond moth, Angoumois grain moth, Pulse beetle, Cigarette betle, Khapra beetle, Fruit moth ,Melon fly, House fly, Ground nut Leaf miner, Different insect pests of storage.	Different crops	Borer, caterpillar, moth beetle etc.	Adult
Kochilla *Strychnos nuxvomica* with cow-dung compost	Brinjal	Fruit and shoot borer	Larval
Intercropping of Marigold with Tomato (1:16). A 40 days old yellow flower marigold plant should be transplanted with 25 days old tomato plant for effective control. *Heliothis* will lay egg on Marigold due to same flowering time.	Tomato	Fruit borer	Larval
Mixed cropping of Tomato + Rajma (French bean)	Tomato	Bacterial wilt	Reduce wilt
Boiling water with tomato stem and its spray	Cabbage	Aphid and Diamond Back Moth	Adult and larva
Trap crop of Maize	Pumpkin and Musk melon	Fruit fly	Adult
Trap crop of Mustard	Cabbage	Leaf webber, Diamond back moth, Web worm and aphids	Reduce the pest
Early sowing of pumpkin as the emergence of insect takes place in February and by that time vines increased in size, so there is no harm by the insect.	Pumpkin family	Red pumpkin beetle	Adult
Poison attractant viz; 1. Diazinon or Nuvan in liquid sugar/mollases and 2. Malathion in Banana pulp	Cucurbits	Fruit fly	Adult
Insect growth regulator Juvenile or moulting hormone viz; Teflubenzuron @ 45 g a.i./ha.and Flufenoxuron @ 20 g a.i./ha.	Cabbage	Diamond back moth	Adult
Spraying of Virex-X as Biological control	Sugarcane,groundnut, castor, cotton	Shoot borer	larvae

	tobacco.		
Spraying of NPV of *Heliothis armigera* as Biological control	Cotton .pulses vegetables, groundnut	*Heliothis*	Larva
Spraying of BAS Kill (S) as Biological control	Groundnut, castor, cotton tobacco.	*Spodoptera*	Larva
Use of fungal pathogen *Metarehizum anisopliae* as Biological control	Rice, sugarcane, groundnut.	Borer, pyrilla, white grub	Larvae,nymph, grub
Use of fungal pathogen *Nomouraea rileyi* as Biological control	Cotton,pulses , groundnut, castor.	*Heliothis, Spodoptera*,semilooper,looper.	Larvae
Use of fungal pathogen *Alternaria eichhornae* as Biological control	Cotton ,sugarcane oilseeds	*Heliothis, Spodoptera,*shoot borer.	Larvae
Use of fungal pathogen *Fusarium solani* as Biological control	Cotton , pulses castor.	Heliothis,capsule borer.	Larva
Seed treatment with *Trichoderma viridae* available as Eco fit, Bas derma etc.	Root rot Wilt	Oilseeds Pulses Oilseeds cotton	

Some successful examples of gender friendly plant protection techniques for seed production and storage reported by various workers viz; Srivastava and Singh (2000), Srivastava (2001), Dimetry *etal.* (2002), Prakash and Rao (2002) and Shivankar *etal*. (2002) etc. , are compiled and given below:

1. Spraying of Neem kernel 5 kg → 100 liter water → 8 hrs. → 100 ml teepol or100 gm soap→ 500-liter water/ha → green plant hopper.
2. Spraying of 3% neem oil → Yellow mosaic disease in Urd (*Vigna mungo*).
3. Spraying of Neem kernel extract or *Melia* →Kernel Extract 10% → *Earias vitella* in Okra.
4. Furrow application of Neem leaf powder @75kg/ha→ mustard sawfly, pea and chickpea pod borer.
5. Spraying of Neem soaps 10 gm/ liter of water→ cabbage pest.
6. Spraying of Neem leaf 1 kg→ 10 liter water → 4 days in shed → vegetable pest in kitchen garden.
7. Spraying of Kernel of yellow Kaner (*Vitis nerrifolia*) 15-30 gm → Soap 15-30 gm → Water 10 liter → White Fly, Thrips and Caterpillars.
8. Spraying of Leaf extract of bael (*Aegle marmelos*) → Blight disease of Tomato and onion.
9. Spraying of Oak leaves extract 10% → Bud necrosis disease in groundnut.
10. Spraying of Lantana and basil leaves extract→ Leaf miner in bean, brinjal, tomato, chili and onion.
11. Furrow application of *Argimone*, *Acacia* & *Calotropis* leaf powder→ Root Knot nematode.
12. Spraying of Tobacco leaf or *Calotropis* leaf 1.5 kg →water 3-liter → Boil → cool→ 15-liter water → vegetable and crops pests.
13. Spraying of 20 kg Jowar leaf or coconut leaf or *Bougainvillea* leaf or Doob (*Cynodon dactylon*) → 50 liter water → Heat 60^{o} C for 1 hr→ cool→ water 200 liter →Viricide.
14. Application of Dry leaf powder of Senwar *Begunia (Vitex negundo),* wild sage (*Lipia geminata*), Bael (*Aegle marmelos*), Wild basil (*Ocimum canum*) 1 : 100 part of paddy - storage pest.
15. Spraying of Oil of white batch (*Acorus calamus*) 0.1% with water →Dip Gunny bag for 5 minute → Dry → storage pest of *Vigna radiata.*
16. Application of Papaya leaf powder 1 gm/5 kg pulses → *Callosobruchus chinensis*.

17. Soaking of packing sacks for 5 minute with Sweet flags *(Acorus calamus* L.) @0.1% v/v in water prevented cowpea beetle *(Callosobruchus chinensis* Fab.) oviposition on the sac and development of infestation upto 5 months.
18. Application of a mixture of Paste of neem leaves and green kernels (1kg) +Curd (2 liter) + Cow urine (1 liter) +Tobacco (250 gm). All materials keep in a earthen pot mouth tied with cloth under the shade of tree for 1 month. Filter the solution and use for spray @ 250 ml per 15 liter of water.-- Field crop insect pests.
19. Application of a mixture of Green leaves of Besharam (*Ipomoea*) (1kg) + Green leaves of Sitaphal (Pumpkin)(2kg) + Paste of neem leaves and green kernels(1kg) + Paste of Mudar (*Calotropis*) leaves (0.5 kg))+Tobacco (250 gm) +Curd (10 liter) + Cow urine (5 liter). Keep in a plastic container for 1 month. Filter and spray the solution- Field crop insect pests.
20. Dip green chilli and garlic powder (1kg) in Kerosene Oil (1 liter) for an overnight in an earthen pot. Take another pot and mix powder of green chilli (1kg) +water (2 kg). Filter and mix the extract of both pot in water (200 liter) + detergent powder (200 gram).Spray the solution-- Field crop insect pests-- All type of pod borers.
21. Spraying of Aqueous leaf extract of *Datura metel* (2%w/v) or *Lawsonia inermis* (5%w/v) is found effective to reduce the severity of Late Leaf Spot in Groundnut-- Late Leaf Spot-- up to 115 days
22. Spraying of Garlic 1 kg + Dried Tobacco Leaf 200 gm + Washing soap 200 gm → 5 liter water → 150 liter water /Acre—Paddy-- Gandhi Bug.-- Nymph and adult stage.
23. Spraying of Doob Ghas extract 10%-- Tomato-- Spotted DryVirus--20 Kg Doob Ghas + 50 Litre Water—Heat 60 degree C -1hour- sieving- Solution in 200 litre water.
24. Spraying of Water extraction of the Root of Raspberry and Canna-- Field and vegetable crops-- Longidorous Nematode-- Contains Tannin andPolyphenos chemical.
25. Spraying of 20 kg Jowar leaf or coconut leaf or *Bougainvillea* leaf or Doob (*Cynodon dactylon*.) → 50 liter water → Heat 60^{o} C for 1 hr→ cool→ water 200 liter →Viricide-- Field and vegetable crops--- Viral diseases
26. Dry leaf powder of Senwar (*Begunia),* wild sage (*Lipia geminata*), Bael (*Ajali marmilos*), Wild basil (*Ocimum canum*) 1 : 100 part of paddy -- Paddy Storage pest
27. Spraying of Kernel extract of Karanj *(Pongamia glabra*), Mahua (*Madhca longifolia*), Bada Kulanjan (*Alpinia indica*), Castor (*Ricinus communis*) or oil and white kaner (*Nerium odorus*) root extract @ 1.5%-- Insect pest of citrus group.
28. Furrow application of Neem leaf powder @ 100 kg/ha.—Sesamum-- Hairy caterpillar—Larvae.
29. A 10 gm dose of Capsicum annuum powder; *Vitex negundo* and Azadirachta indica leaf powder is found effective for the safe storage of pigeon pea up to 6 months which is found gender friendly as well as ecofriendly.
30. Pigeon pea can be stored up to one year with 19.17 per cent and 10.95 per cent damage from pulse beetle *Callosobruchus chinensis* with the use of sand and wood ash, in comparision to control (38.35%). Use of sand was found cost effective and beneficial to farmwomen and easily available. Cost of standard check neem oil was Rs.14.00 / 10 kg, while the cost of sand was Rs. 3.00/10 kg.
31. Use of Begunia leaf powder @15 gm/kg showed minimum incidence of *Sitophilus oryzae*. However, neem leaf powder and chilli powder @10 gm/kg were found next effective options.
32. Chilli powder @ 10gm/kg and Begunia leaf powder @15 gm/kg is found effective to minimise incidence of *Corcyra cephalonica* followed by neem leaf powder @10 gm/kg maize grain.
33. Minimum number of eggs of *Callosobruchus maculatus / 100 seeds were recorded in sand followed by b*ig cardamom@ 10 number /kg, asafetida @6 gm/kg and small cardamom @20number /kg. Minimum per cent bored grain after 8 months was recorded in neem oil @5ml/kg followed by sand @ 1200 gm/kg and big cardamom@ 10 number /kg. Maximum germination percent was recorded in sand @ 1200 gm/kg and big cardamom@ 10 number /kg.

34. In neem oil @5ml/kg per cent bored grain after 8 months was found lowest, due to juvenomimetic effects of neem oil. In long run after 8 month of storage neem oil has shown adverse effect on germination and recorded lowest germination percent, therefore storage of cow pea with neem oil is not suitable for seed purpose.
35. Indicator device, Air bin, Insect egg removal device, Probe trap, Pit Fall trap, 2 in1 trap , UV light trap and Trap for stack storage developed by TNAU Coimbatore, Tamil Nadu are very good women friendly tools for the management of storage insect pest.

No granaries in the earth can be filled with grains without insects. The harvested produce contains egg (or) larvae (or) pupae in them because of field carryover infestation which cannot be avoided in developing countries like India. Hence, timely detection of the stored grain insects will help to prevent heavy losses. TNAU developed devices exploit the wandering behaviour of the insects and help in timely detection of insects in stored produce leading to timely control. All these devices can be used for both monitoring and mass trapping of stored grain insects. It is important to note that even a single live insect presence in food grain can't be tolerated as they build up and cause enormous loss in storage due to their high reproductive rate. These devices are-

1. Insect probe trap.
2. Pitfall trap.
3. Two-in-one trap for pulse beetle.
4. Indicator Device.
5. Automatic insect removal bin.
6. UV – Light trap for warehouse.

1. **Insect probe trap:**

Components

- A main tube, insect trapping tube and a detachable cone at the bottom.
- Equispaced perforations of 2 mm diameter are made in the main tube.

Concept

- Insects love "AIR" and move towards air. This behaviour of the insect is exploited in this technology

Method of working

The insect trap has to be kept in the grain like rice, wheat etc., vertically with the white plastic cone downside as shown the figure.The top red cap must be with the level of the grain. Insects will move towards air in the main tube and enter through the hole.Once the insect enters the hole it falls down into the detachable white cone at the bottom. Then there is no way to escape and the insects are trapped forever.The white detachable cone can be unscrewed once in a week and the insects can be destroyed.

Salient Features :

No chemicals, No side effects and No maintenance cost, TNAU Insect traps are excellent insect detection devices in food grains and more effective in the detection of stored grain insects namely *Rhyzopertha dominica* (F.), *Sitophilus cryzae* (L.) and *Tribolium castaneum* (Herbst) in stored food grains both in terms of detection as well as number of insects caught than the standard normal sampling method (by spear sampling).The detection ratio (trap : normal sample) is higher in trap than of normal sampling method by factors ranging from 2 : 1 to 31 : 1.The insects catch is also higher in the probe trap than the normal sampling method by factors ranging from 20 : 1 to 121 : 1. They are also good mass trapping devices when

used at 2 – 3 numbers / 25 kg bin (28 cm dia and 39 cm length).They should be placed at top 6 inches of the grain, where the insect activity is seen during early period of storage.They can remove > 80% of the insects within 10 –20 days.

Insect probe trap

2. Pit fall trap:

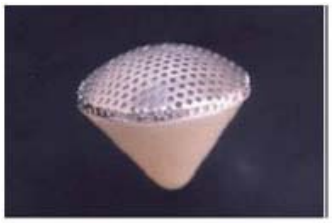
Pitfall traps are used for capturing insects active on grain surface and in other layers of grain. (Monitoring and mass trapping tool).

Standard Model

Standard model of pitfall trap has 2 parts, perforated lid (2 mm (or) 3 mm) and a cone shaped bottom portion.Application of special coating with sticky material on the inner side of cone to hold trapped insects is necessary

TNAU Model

TNAU model has perforated lid, cone shaped bottom which tapers into a funnel shaped trapping tube. Hence sticky coating is dispensed. Commercial model is in plastic, simple and economical (cost per trap is Rs. 25/- only). It is easy to handle.



Standard Model of Pit fall trap

TNAU Model of Pit fall trap

3. Two-in-one model trap:

The probe trap containing the components namely the perforated tube, pitfall mechanism, a collection tube and the cone shaped pitfall trap with a perforated lid and the bottom tapering cone were combined as a single unit.Combination of probe and pitfall increase the trapping efficiency of insects. Best suited for pulse beetles as they are seen only on grain surface wandering here and there.It does not require tedious procedures like coating the inner surface of pitfall cone with sticky materials before

trapping to hold pulse beetles.Beetles are captured alive in this trap, which may facilitate release of pheromone and there by attract more insects.

Two-in-one Model trap

4. Indicator device :

Device consists of a cone shaped perforated cup (3mm perforation) with a lid at the top. The cup is fixed at the bottom with a container and circular dish, which are to be smeared with sticky material like vaseline. Farmers, before storing their pulses, should take 200 g of pulses to be stored and put them in the cup.When the field carried over beetles start emerging, due to their wandering behaviour, they enter the perforations and get slipped off and fall into the trapping portions.As they stick on to the sticky materials, farmers can easily locate the beetles and can take out the bulk-stored pulses for sun drying. The device with 2mm perforations can be used for cereals.This will help in eliminating the initial population, which acts as the major source for further build up. Thus, timely detection will help the farmers to preserve their valuable pulses during storage.

Indicator Device

5. Automatic insect removal bin:

Insect removal bin can remove insect automatically. The structure has 4 major parts namely outer container, inner perforated container, collection vessel and the lid.The model exploits wanderin behaviour of stored product insects as well as the movement of these insects towards well aerated regions. The grains are held in the specially designed inner perforated container.The space between inner and outer container provides good aeration for the insects. Insects, while wandering, enter the perforation to reach the aerated part and while doing so, get slipped off and fall into the collection vessel through a pitfall mechanism provided in the collection vessel.In order to quickly collect the insects, as and when they emerge from grains, perforated (2 mm) rods are fixed in the inner container.The container will be useful for storing rice, wheat, broken pulses, coriander etc. The insects such as rice weevil, lesser grain

borer, red flour beetle, saw toothed beetle, which are commonly found attacking stored grains can be removed automatically by storing grains in this container. Within a very short period of 10 days a majority of the insects (more than 90 per cent) can be removed from the grains. The containers are available in 2 kg, 5 kg, 25 kg, 100 kg and 500 kg capacities.

Efficiency :

Grains (paddy and sorghum) stored in Automatic insect removal bin (100 kg and 500 kg) recorded only 1 – 4% damage by insects compared to 33 to 65% damage in ordinary bin after 10 months of storage. The population of insects (*R. dominica, S. oryzae)*ranged from 0 – 2 / kg in grain stored in 100 kg. Automatic insect removal bin compared to 5 – 191 / kg in ordinary bin after 10 months of storage.

Automatic insect removal bin

6. UV – light trap for grain storage in godowns:

The UV light trap mainly consists of an ultraviolet source (4 W germicidal lamp).The lamp produces ultra-violet rays of peak emission around 250 nano meter.The light is fitted at the centre of a funnel of 310 mm diameter at the top and 35 mm diameter at the bottom.The bottom end of the funnel is attached with a transparent plastic container for collecting the trapped insects.To hang the unit at desired points, three hooks have been provided at the periphery of the funnel. The unit is also provided with a tripod stand.The UV light trap can be placed in food grain storage godowns at 1.5 m above ground level, preferably in places around warehouse corners, as it has been observed that the insect tends to move towards these places during the evening hours.The trap can be operated during the night hours.Lesser grain borer the light trap attracts stored product insects of paddy like lesser grain borer, red flour beetle, and saw toothed beetle, in large numbers.Psocids which are of great nuisance in godowns are also attracted in large numbers. Normally 2 numbers of UV light trap per 60 x 20 m (L x B) godown with 5 m height is suggested.The trap is ideal for use in godowns meant for long term storage of grains, whenever infested stocks arrive in godowns and during post fumigation periods to trap the resistant strains and left over insects to prevent build up of the pest populations.In godowns of frequent transactions the trap can be used for monitoring.

Efficiency:

It has been found that two traps kept at the corners of the warehouse (60m x 20m x 5m) can catch around 200 insects/day even from a godown where normal

sampling did not show any insect presence, thus indicating its effectiveness as a monitoring and mass trapping device. It has been recorded around 3000 lesser grain borer on a single day from single trap kept in a paddy godown.

UV – light trap for grain storage in godowns

Conclusion:

India has achieved self sufficiency in the production of food grains, but still we are not in a position to meet the standard dietary requirement of the increasing population. Food security is important throughout all aspects of day to day living. There is an urgent need to empower women for gender friendly IPM technologies for seed production and storage. This can be achieved by enhanced use of ICT and awareness generation programmes. Ensuring the production of safe foods, free from potentially harmful contaminants, is of enormous significance throughout the world, which can be achieved only with the use of suitable IPM technologies. There is need to identify Pest Free Area (PFA), Area of Low Pest Prevalence (ALPP) and looming pests before planning the programme of seed production and their storage. This will be a vital input for planned growth and sustainable development of food security in the country.

*****

Seed Material Production of Root and Tuber Crops

M. Nedunchezhiyan, S.K. Jata, K. H. Gowda, V.B.S. Chauhan and V.V. Bansode
ICAR-Central Tuber Crops Research Institute, Regional Centre, Bhubaneswar

Introduction

Root and tuber crops are the most important crops of man after cereals and legumes. They are now considered as secondary crops extending primary functions especially for weaker sections. They contribute 3.9% (cassava 1.9%, sweet potato 1.5% and yams and other root and tuber crops 0.3%) energy requirement of world population. Tropical root and tuber crops supply food 28.5 kg/head/year and 75 kcal energy/head/day (Nayar, 2014). They produce large quantities of energy (carbohydrate) in relatively less time than other crops. The time is not far off that they have to take the role of a primary crop in view of anticipated food security gap from cereals. It is estimated that there will be food demand gap of 26 million tonnes by 2020 for which alternative sources of dietary energy like tuber crops are inevitable. The estimated gap has to be made from 80 million tonnes of tubers. In spite of the fact, there is a drastic decline in the tuber crop area due to change in the food habits of people, the future role of tuber crops cannot be underestimated in view of increasing population.

The popular root and tuber crops include cassava (*Manihot esculenta*), sweet potato (*Ipomeas batatus*), greater yam (*Dioscorea alata*), white yam (*D. rotundata*), lesser yam (*D. esculenta*), taro (*Colocasia esculenta*), tannia (*Xanthosoma sagittifolium*), elephant foot yam (*Amorphophallus paeniifolius*), yam bean (*Pachyrrhizus erosus*), coleus *(Solenostemon rotundifolius*) etc.

Availability of seed/planting material is the basic pre-requirement for the faster spread of the high yielding varieties. Seed of modern varieties is the most important and least expensive agricultural input and plays a critical role in the transfer of other technologies. Availability of seed of an adapted variety at planting time determines crop production potential under a given farming system. Seed therefore plays a central role in food production capacity at both household and national levels. The role of modern varieties in increasing crop production, and thereby increasing farmer income and enhancing food security is well recognized. Thus, adequate, reliable and sustainable seed supplies will continue to play an important role in achieving national food security.

Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson)

Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is a popular tuber crop widely cultivated through-out India. The modified stem tuber botanically called corm is consumed as vegetable.

Climate and soil

Elephant foot yam is a tropical crop and it is grown under warm humid climate with a mean annual temperature of 30–40^{o}C and a well distributed rainfall of 1000-1500 mm. The crop performs well under irrigated conditions as it provides ample moisture availability during the growth phase of the crop which is essential for proper vegetative development and tuberization during the crop period**.** It grows well on a variety of soils, but the ideal soils are well drained black sandy loam or sandy clay loam soil with a pH of 6.5 to 8.5. The soil should be rich in organic matter with adequate amount of available nutrients.

Planting season and variety

Elephant foot yam is mainly grown as an early *kharif* crop, which is planted during May-June and harvested during January-February. In Andhra Pradesh

especially in Godavari zone it is also grown as a *rabi* crop by planting in November-January and harvested in April-June.

Gajendra is the ruling variety in India. NDA-9 and Bidhan Kusum are the other varieties. Sree Padma and Sree Athira are the hybrids released by CTCRI.

Propagation

Amorphophallus is propagated through corms and cormels (Fig. 1). The whole corm size of 500-750 g is preferred as planting material (seed). But, the availability of 500-750 g seed corms is a major constraint in elephant foot yam production. Hence, at the time of planting, the whole corm is cut vertically into setts of 500-750 g each bearing a portion of central bud. Whole seed corm always sprouts earlier than cut corms (Sen and Goswami, 1996). Availability of 500 g seed com is a major constraint in elephant foot yam production. Research findings from various institutes revealed that 500-700 g size seed corm could be produced from vertically cut 100 g corm sett (Nedunchezhiyan et al., 2006) as well as 40-60 g size cormels (Sankaran et al., 2007).

(a) Cormels

Elephant foot yam produces cormels (daughter corms) very few to many depending upon the variety. Cormels detached from the mother corms and used as seed material. Cormels are varying in size (10-60 g). The cormels are planted on the ridges at a spacing of 30 x 30 cm. After planting, it should be mulched with paddy straw or any dried farm waste. At basal farmyard manure 10 t/ha should be applied followed by fertilizer 60:40:60 kg $N:P_2O_5:K_2O$/ha in two split doses. Two hand weeding at early stages (30 and 60 days after planting) was essential and it was followed by earthing up. Third weeding in severely weed infested fields should be carried out at 90 days after planting to prevent yield loss. The crop can be harvested after complete drying of pseudostem (7-10 months after planting).

(b) Corms

Minicorm sett weight and Spacing

Traditionally elephant foot yam is cultivated by using corms either whole or cut pieces (setts). Ten minicorm setts could be made from a corm weighing 1.0 kg. The prepared minicorm setts treated with *Trichoderma* mixed in cowdung slurry to protect the crop against attack from *Schlerotium rolfsii* a soil borne fungus which causes collar rot. Then they are spread under shade for drying before planting into the main field. A minicorm sett weight of 100 g should be planted at 60 x 30 cm spacing.

Manures and fertilizers

Farmyard manure 25 t/ha along with 100:80:100 $N:P_2O_5:K_2O$ kg/ha was optimum for seed corm production. Farmyard manure and phosphorus should be applied at last ploughing and incorporated. N and K is applied at 1, 2 and 3 months after planting.

Irrigation

Seed crops are grown under protective irrigation. Depending upon water requirement the seed crop was irrigated. Excess water during high rainfall period should be properly drained out otherwise which affect the crop growth.

Harvesting

The crop would mature in about 8-10 months time indicated by the drying of pseudostem. Corm yield increased gradually with the duration of crop but the maximum net return was obtained when market prices are favourable.

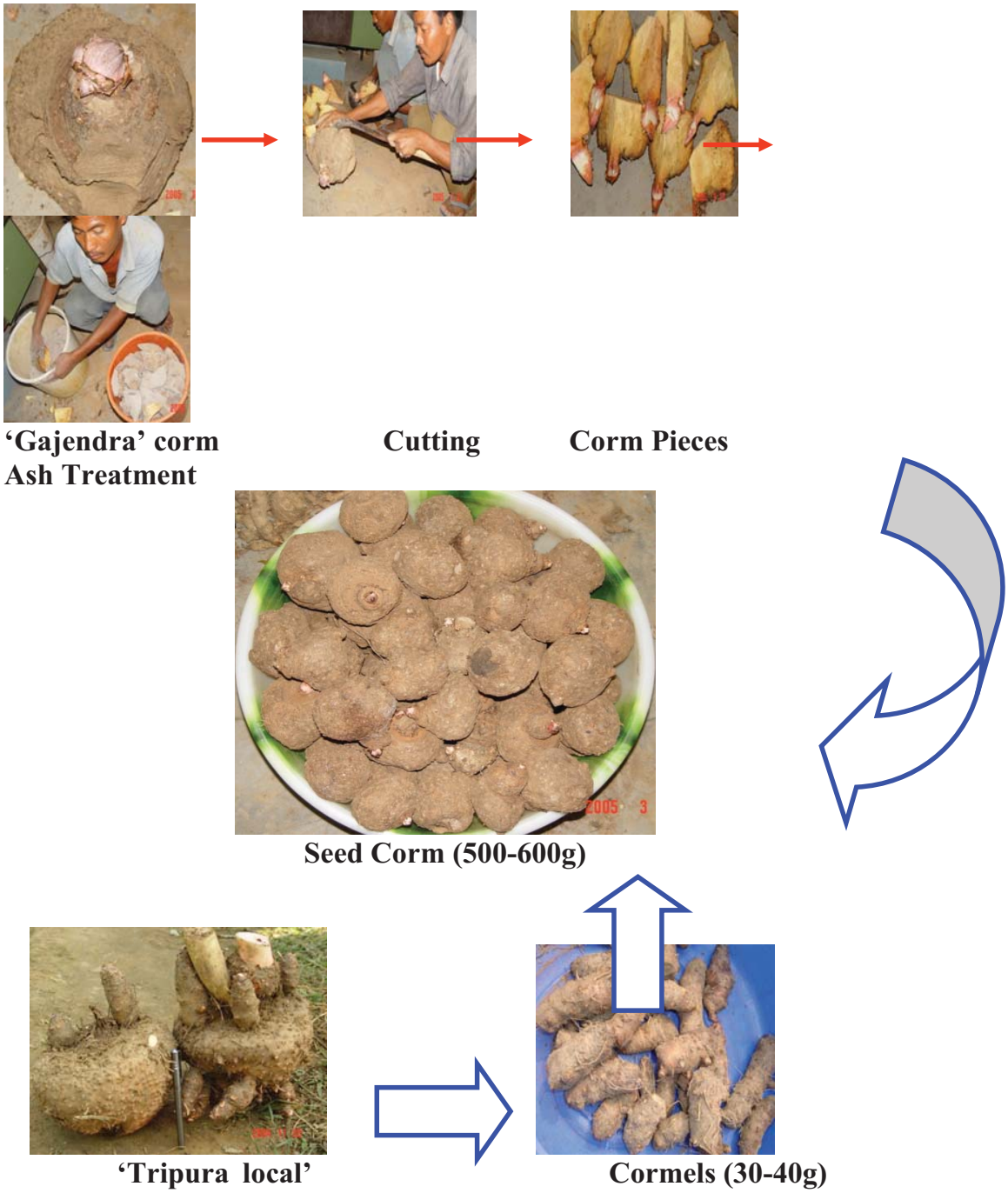


Fig. 1. Seed corm Production Technology

Storage of seed corm

After curing, storing the corms by spreading them closely in single layer and covering with coarse dry sand in a cool and ventilated place followed by periodic removal of damaged corms/portions if any was found to be the best method of storage that allowed minimum decay and weight loss.

Yams (*Dioscorea* spp.)

Yams (*Dioscorea* spp.) are considered as tropical vegetables and also serve as an important staple food in many parts of the world. The most important cultivated yam spp. are *Dioscorea alata* (greater yam) *Dioscorea rotundata* (white yam) *Dioscorea esculenta* (lesser yam).

Climate and soil

Yams are tropical crops and hence thrive well under warm sunny weather with plenty of rains. It is widely reported that the crop requires a temperature of 25-30º C and the growth is severely affected, if the temperature is restricted below 20º C. Adequate moisture is required for the growth, development and yield of yams, which is often fully met by the well distributed rains, a common feature in the traditional yam growing areas. Deep and loose friable soil of any kind with adequate nutrient and moisture status is well suited for the growth and development of yams.

Time of planting and varieties

April-June is the suitable time of planting. Some of the high yielding varieties available to farmers are given in the Table 1.

Table 1. High yielding varieties of yams

Greater yam	Lesser yam	White yam
Sree Keerthi	Sree Latha	Sree Subhra
Sree Roopa	Sree Kala	Sree Priya
Sree Shilpa	Konkan Kanchan	Sree Dhanya
Odisha elite		
Sree Swathy		
CO-1		
Konkan Ghorkand		

Land preparation and planting

Plough the land to a depth of 15-20 cm. Open pits of 45 x 45 x 45 cm size at the spacing of 90 x 90 cm. Fill up three fourths of the pit with top soil and FYM and reform into a mound. Plant the seed tubers of 200 g size on the reform mounds. About 2.5-3.0 tonnes of seed material is required to cover one ha. Mulch the crop with dried leaves or green leaves to hasten sprouting.

Manures and fertilizers

Apply cattle manure or compost @ 10 t/ha as basal dressing before planting. A fertilizer dose of 80 kg N, 60 kg P_2O_5 and 80 kg K_2O / ha in two split doses is needed for yams. Half dose of nitrogen (87 kg of urea or 200 kg of ammonium sulphate), full dose of phosphorous (300 kg of rock phosphate) and half dose of potash (67 kg muriate of potash) are to be applied within a week after sprouting. The remaining nitrogen and potash may be applied one month after the first application.

Diseases

Anthracnose disease

Anthracnose disease of yam has had a considerable impact on yam production worldwide. All the above cultivated species are infected by the diseases but *D. alata* is highly susceptible. This is caused by *Colletotrichum gloeosporioides*. On susceptible yam cultivars, symptoms appeared as small dark brown or black lesion on leaves, petioles and stems. The lesion is often surrounded by a chlorotic halo enlarged and coalesces, resulting in extensive necrosis of the leaves and die-back of the stem.

.**Management**

- Use of crop rotation, fallowing, removal of debris and ploughing immediately after harvest also helps to reduce the inoculam,
- Planting of healthy material and destruction of infected cultivars.
- Spraying Dithane M-45 (0.2%) and Bavistin (0.25%)

Cercospora leaf spots

Next to anthracnose, leaf spots caused by *Cercospora* spp are important. It starts as small chlorotic leaf spot which enlarges and finally turns necrotic. In each leaf large number of spots could be seen which will coalesce in the latter stage.

Black spot

The black spot/ leaf blight caused by *Sclerotium rolfsii* showed black, circular, concentric spots, 5–10 mm in diameter in the middle and bottom portion of the vines. As the disease advanced, the central portion of the leaf spots dried and fell out, resulting in shot-hole symptoms. When the leaves are wet, abundant fluffy white mycelia emerged from the leaf spots.

Management

- Field sanitation by removal of debris after harvest
- Spraying Dithane-M-45 (0.2 %) or Bavistin (0. 2%) when the symptom initiates and three sprays at weekly intervals

Viral diseases

Seven different viruses are reported to infect *D. alata* plants. The infected plants show mosaic, green banding, chlorosis, leaf distortion etc.

Insect pests

No major insect pest was reported.

After care and harvesting

Top dressing of fertilizers should be followed by weeding and earthing up. Trailing is necessary to expose the leaves to sunlight. It is done within 15 days after sprouting by coir rope attached to artificial supports in the open area or to the trees where it is raised as intercrop. Maize can also be raised as intercrop which gives staking support to yam in addition to grain yield. Yam is ready for harvest by 9-10 months after planting. Carefully dig out the tubers without causing injury. The crop yields 23-28 t/ha

Post harvest management of yams

Scale insect and mealybug infestation on yam tubers during storage was reported, apart from weight losses. For long storage of yams, any of the following management practice can be followed.

1. Storage of yam tubers at low temperatures (but higher than 12^0 C to avoid damage to tubers) retarded the development of yam moths.
2. Storing the tubers in sand resulted in 92.3% control on the incidence of scale insects.
3. Treating the tubers with monocrotophos (0.05%) and then storing in sand was found more effective.
4. Storing the tubers in saw dust, paddy husk and wood ash were found effective, whereas storing of the seed yams in fine-sand was found best.

Taro (*Colocasia ensculenta* L.)

Taro (*Colocasia ensculenta* L.) is very popular crop in Odisha, Andhra Pradesh, Tamil Nadu, Kerala amd Madhya Pradesh.

Climate and soil

Taro requires warm climate hence it thrive well under warm sunny weather with plenty of rains. The annual rainfall of 900-1200 mm spread over five to six

months period is ideal and the most critical period of rainfall/ moisture in the first five months after planting. The soil should be rich in organic matter with adequate amount of available plant nutrients.

Planting season and variety

Under rainfed condition, however, planting should be timed to precede or coincide with the rainy season. In India, taro is planted with the onset of pre-monsoon showers, i.e., May- June.

Sree Rashmi, Sree Pallavi, Muktakeshi, Jhankri, Sonajuli, CO-1, Satamukhi, Bhavpuri, Panisau-1, Panisaru-2, Indira Arvi-1, Narendra Arvi-1, Narendra Arvi-2, Rajendra Arvi-1, BCC-1 and BCC-17 are the high yielding varieties available for cultivation.

Planting and spacing

Deep ploughing to a depth of 25-30 cm is essentially done prior to planting in hot summer months (March-April) to have healthy soil free from diseases and pests. In general taro is planted at distance of 60-45 x 30-45 cm in *kharif* and 45 x 30 cm in *rabi*. Taro is planted by using corm or cormels. The traditional practice of propagation in taro is using corms or cormels. Setts from corm normally give a higher yield than those from cormels.

Manures and fertilizers

Application of 10 t/ha of FYM and 80:60:80 kg/ha of $N:P_2O_5:K_2O$ has been recommended. Traditionally full dose of phosphorus and entire FYM are applied as basal, and nitrogen and potassium should be given as topdressing in three equal splits. I^{st} dose immediately after emergence, 2^{nd} dose one month after 1^{st} dose and 3^{rd} dose one month after 2^{nd} dose. Fertilizers should be applied in pocketing method at a depth of 2-3 cm on either side of the plant at a distance of 7-10 cm. Fertilizer application is usually done along with weeding and earthing up.

Weed management

Three hand-weeding at 30, 60 and 90 days after planting is required. However, pre-emergence herbicides like Butachlor @ 5 l/ha or Pendimithalin @ 2.5 l/ha can be applied immediately after first irrigation which reduces weed infestation up to 40-50 days. Apart from chemical control it also requires one or two hand weedings at 60 days after planting and another at 30 days after 1^{st} hand weeding.

Irrigation

Taro should be provided with sufficient water for maximum vegetative growth and leaf production during the growth period. It is primarily adapted to moist environments, but can very well grow under a wide range of moisture regimes. It is essential to maintain soil moisture at field capacity which when fails, should be supplemented with irrigation. However, under rainfed situation, a short term drought should be supplemented by irrigation otherwise it would accelerate maturation and reaches the senescence stage. When it is cultivated during summer requires frequent irrigation at 7-10 days interval.

Taro leaf blight

Leaf blight of taro, caused by *Phytophthora colocasiae*, is the most destructive disease of colocasia. *Phytophthora* blight of colocasia appears as small, water soaked spots that increase in circumference and also spread to healthy plants. The entire leaf area is destroyed within few days. Under cloudy weather conditions with intermittent rains and temperature around 28^oC, the disease spreads at tremendous speed and the entire field gives a blighted appearance. Yield losses of 25-50% are common due to this disease. The rainy season crop is damaged during its peak of crop growth.

Several methods for the management of leaf blight of colocasia have been recommended but the use of tolerant cultivars seems to be the most ideal and economical method. Many cultivars of taro tolerant to leaf blight have been reported from India. The cultivar Muktakeshi has shown high degree of field tolerance to blight. A farmer's friendly IDM package for the management of the taro blight has been developed at CTCRI. The package includes growing resistant variety like Muktakeshi, short-duration variety with early planting, one protective spray with mancozeb (0.2%) at 45 days after planting followed by one more spray with metalaxyl (0.05%) at 60 days after planting in susceptible cultivars, intercropping with non-host crops, use of disease free seed tubers and seed tuber treatment with *Trichoderma viride*.

Dasheen mosaic

This disease is caused by virus and is widely spread and observed in the entire region. However, the incidence of this disease is generally less than 5% and all the leaves of mosaic-infected plants do not show the symptoms. The disease is characterized by interveinal yellowing along the major veins and vein lets. In severely infected plants leaf distortion symptoms like cupping, curling and shoestring appearance are observed. This disease is sap transmissible. From economic point of view, this disease is not considered to be significant. However, use of seed tubers from mosaic-infected plants should be invariably avoided.

Corm rot

The corm rot caused by *P. colocasiae* is commonly found. The symptoms in young plants may be confined to small spots, which later cause severe stunting or death of the plant. In older plants, chlorosis, stunting and wilting followed by collapse of the whole plant are seen. Dipping planting material in fungicides and soil drenches has been suggested. Dasheen type of taro is affected by the *Pythium* rot. *P. myriotylum* causes serious root rot disease in taro under high soil moisture (60%) and high temperature (25-30%). *Sclerotium rolfsii* causes soft rot, which is easily recognized by the presence of white mycelial growth with distinct Sclerotia on the infected parts. *Fusaium* spp., like *F. solani* and *F. coeruleum* cause dry rot of the tubers. The infected tubers are brown, black, dried and shrunken with deposition of dry powder like fungal growth. Dry rot caused by *Fusarium* spp. casuses major loss of taro tuber in storage.

Pests

Aphids (*Aphis craccivora*) and corm borer (*Aplosonyx chalybaeus*) are reported as major problem in coastal Odisha, West Bengal and North Eastern Region. *A. chalybaeus* was the major pest resulting in 60-70% damage to corms and 10-12% foliar damage. Corm borer was managed by hand picking and killing the adult beetles. Aphids were controlled by spraying dimethoate, monocrotophos, fenthion and fenitrothion 0.05%. Spraying of Imidacloprid (1 ml/10 litre of water) was found very effective against aphids.

Harvesting

Duration of the crop varies with cultivars and methods of cultivation. Taro is ready for harvesting when most of the leaves begin to turn yellow which is ready for harvest in about 5-7 months depending on the cultivar. Harvesting could be done at the convenience of the farmer as well as market price as there is no serious deterioration has been noticed if the harvest is delayed over a few weeks.

Sweet potato (*Ipomoea batatas* L.)

Sweet potato is usually propagated through vine cuttings obtained either from freshly harvested plants or from nursery. However, recurrent use of vines can cause

increased weevil infestation, even though there is less change of root yield reduction. Vines obtained from nursery should be healthy and vigorous for maximum root production.

Nursery preparation

Primary nursery

The nursery preparation starts 3 months prior to planting in the mainfield. For planting one ha of land, about 100 m^2 of primary area and about 100 kg of medium size weevil free seed roots (125-150 g each) are required. The roots are planted at spacing of 20 cm on ridges formed 60 cm apart. To ensure quick growth of vines it is top-dressed with 1.5 kg urea/100 m^2 at 15 days after planting (DAP). The nursery is irrigated on every alternative day for the first 10 days and thrice in a week thereafter. At 45^{th} day the vines are cut to a length of 20-30 cm for further multiplication in the second nursery (CTCRI, 1987).

Secondary nursery

To produce enough planting material to plant one ha of land, vines obtained from the primary nursery are further multiplied in the secondary nursery to an extent of 500 m^2. Farmyard manure or compost 500 kg is applied at the time of preparation of nursery bed and ridges are formed at a spacing of 60 cm apart. Vines obtained from the primary nursery or from freshly harvested crop are planted in the secondary nursery at a spacing of 20 cm within ridges. To ensure enough vegetative growth 5 kg of urea is applied in two splits at 15 and 30 DAP. For the better establishment of vines in nursery irrigations are provided at every alternate day for the first 10 days and thrice in a week thereafter. The vines will be ready for planting in the main field within 45 days (CTCRI, 1987).

Vine portion and length of cutting

The apical and middle portion of the vine is found to be best to get higher root yield from sweet potato. Bottom portion usually thick and woody, some times fail to establish further chance of weevil spread is more due to proximity with the crown portion, where sweet potato weevil multiplies. A vine length of 20-40 cm with at least 3-5 nodes is found to be optimum for the storage root production.

References

CTCRI. 1987. Cultural practices of sweet potato. Extension Bulletin, Central Tuber Crops Research Institute, Thiruvanathapuram, 8 p.

Nayar, N.M. 2014. The contribution of tropical tuber crops towards food security. Journal of Root Crops, 40(1): 3-14.

Nedunchezhiyan, M., Misra, R.S. and Naskar, S.K. 2006. Seed corm production techniques in elephant foot yam. In: 14^{th} Triennial Symposium of the International Society for Tropical Root Crops, held during 20-26 November 2006, Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala, India. pp. 187-188.

Sankaran, M., Singh, N.P., Santhosh, B. and Jai Prakash. 2007. Minicorm production techniques in elephant foot yam (cv.Tripura Local). In: 2^{nd} Indian Horticultural Congress, held at ICAR Research Complex for NEH Region, Umiam, Barapani, Meghalaya from 18-22 April, book of Abstract, pp. 345.

Sen, H., Das, P.K. and Goswami, D.B. 1996. Growth and corm production of elephant foot yam as affected by seed corm size, type, NK nutrition and harvesting date and evaluation of the low cost storage methods. In: Tropical tuber crops: problems, prospects and future strategies, Science Publishers USA, pp. 298-305.

Gender Concepts and Methodologies

Dr. B. N. Sadangi and Shivaji Argade
Emeritus Scientist, ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Understanding the gender concepts and their uses in agriculture development constitutes the basis learning. Each concept has broad theoretical definition and operational aspects according to the field of development. Given below definitions of concept commonly used in gender studies. A clear understanding of concepts would help the participants to formulate gender development paradigms having constructs and variables derived from the concepts.

1.	Sex	Means the biological differences between women and men, which are universal, obvious and generally permanent.
2.	Gender	Means the socially constructed differences in roles and responsibilities assigned to women and men in a given culture or location and the societal structures that support them. Every society has different 'scripts' for male and female members to follow. Thus members learn to act out their feminine or masculine role, much in the same way as every society has its own language. The term gender was first used by Ann Oakley and others in 1970s as analytical tools to understand the characteristics of men and women which are socially determined in contrasts to biological differences.
3.	Gender roles	The role refers to the activities perform by men and women in different situations and in different times and within the different cultures, classes, castes, ethnic groups etc. The roles of men and women are shaped by various forces such as social, cultural, economic, environmental, religious and political. The gender roles may change depending on the socio-cultural dynamics of the society.
4.	Triple roles	Are roles (tasks and responsibilities) men and women may have related to: production (producing money value), reproduction (the child bearing and rearing responsibilities required to guarantee the maintenance and reproduction of labour force), community management/ community politics (producing community goods and well beings).
5.	Gender analysis	Gender analysis is a tool to better understand the realities of the women and men, whose lives are impacted by planned development. These include gender issues with respect to social relations; activities; access and control over resources, services, institutions of decision-making and networks of power and authority and needs, the distinct needs of men and women, both practical and strategic.
6.	Access to productive resource	Refers to right and opportunity of men and women to use the resources as per one's need to carry out his/ her activities.
7.	Control over productive resources	Refers to the rights and power of men and women to decide on the use and destination of the resources.
8.	Practical gender needs	Practical gender needs are the needs women identify in their socially accepted roles. Practical gender needs do not challenge the gender divisions of labour or women's sub-ordination position in society,

		although rising out of them. PGN are a response to immediate perceived, identified necessity, within a specific context. They are practical in nature and often are concerned with inadequacies in living conditions such as water provisions, health care and employment.
9.	Strategic gender needs	Strategic gender needs are the needs women identify because of their subordinate position to men in their society. These vary according to particular context. They relate to gender divisions of labour, power control and may include such issues as legal rights, domestic violence, equal wages etc. meeting strategic needs helps women to achieve greater equality. It also changes existing role and therefore challenges women's sub-ordinate position.
10.	Gender equality	Gender equality means that women and men enjoy the same status. Gender equality means that women and men have equal conditions for realizing their full human rights and potential to contribute to national, political, economic, social and cultural development, and to benefit from the results. Gender equality is therefore the equal valuing by society of both the similarities and differences between women and men, and the varying roles that they play.
11.	Gender equity	Gender equity is the process of being fair to women and men. To ensure fairness, measures must often be available to compensate for historical and social disadvantages that prevent women and men from otherwise operating on a level playing field. Equity leads to equality.
12.	Gender blind	Gender blind is a person who does not recognize that gender is an essential determinant of life choices available to people in society.
13.	Gender bias	Perception that both sex are not equal and do not have similar rights to resources.
14.	Gender Discrimination	Unfavourable treatment of individuals on the basis of their gender.
15.	Gender mainstreaming	Mainstreaming, a gender perspective, is the process of assessing the implications for women and men of any planned action, including legislation, policies and programmes, in all areas and at all levels. It is a strategy for making women's, as well as men's concerns and experiences, an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal is to achieve gender equality.
16.	Women in development (WID)	WID subscribes to the assumptions of modernization theory. Its programmes generally stress western values and target individuals as the catalysts for social change. Modernization theory identifies traditional societies as male-dominated and authoritarian compared to modern societies which are democratic and egalitarian. It usually seeks to integrate women into development by making more resources available to women. However, these efforts led to increase in women's work load, reinforced inequalities, and widened the gap between men and women.
17.	Women and	It emerged from a critique of the modernization theory. The

	development (WAD)	theoretical base of WAD is dependency theory and focuses on relationship between women and development process and examines the nature of integration. It is concerned with women's productive role and assumes that once organizational structures become more equitable, women's position would also improve.
18.	Gender and development (GAD)	The gender and development seeks to base interventions on the analysis of men's and women's roles. This approach developed in the 1980s. It questions the basis of assigning specific gender roles. Recognizes that patriarchy operates within and across classes both inside and outside the home and oppresses women. A workshop on "Gender analysis in Agriculture" jointly organized by KAU, Thrissur and MS Swaminathan Research Foundation, Chennai from 6-8 November, 2000 given bellow the gender relations in agriculture - Unequal rights to private and common land and other assets - Unequal rights to lease land - Unequal access to non-traditional tasks - Unequal total workload - Unequal access to extension inputs and credit - Unequal access to family labour - Unequal access to cooperative membership and leadership - Unequal wages for work of equal value - Unequal assess to markets and control over income - Unequal access to food and nutrition
19.	Gender planning	An important underlying rationale of gender planning concerns the fact that men and women not only play different roles in society, with distinct levels of control over resources, but that they therefore often have different needs. As gender planning is done only on basis of gender needs, gender needs assessment is an important aspect of the whole process. Gender planning is undertaken with the objectives of achieving gender equity, equality and empowerment through practical and strategic gender needs.

Goals of Gender Mainstreaming:

The fundamental goal of gender mainstreaming being equality between men and women in all aspects of socio-economic development, numerous aspects have been identified by gender experts across societies to achieve equality. The process of gender mainstreaming results in many benefits which can be discussed under three broad groups.

(i) **Recognition and visibility of women:** Women in rural areas work hard and undertake activities of different nature for longer hours and larger volume. In spite of their critical roles in families, communities, organizations and societies, they do not get respectable positions and pushed to a lower strata. The mindset of the members of the society should change and women should get recognition for their contribution and constructive roles. The negative forces that suppress. Women's worth must be neutralised and helped to assess the contribution of women more objectively.

(ii) **Participation:** Participation being an important instrument for personality development and prosperity, all out efforts are required to facilitate participation of women in the following areas. An conducive/ enabling climate in the family, community and organization is prerequisite to enhance the participatory behaviour of the women.

- Decision making
- Development/ extension programmes
- Participation in research
- Access to productive resources
- Control over resources and outputs.
- Organizational participation
- Access to food and health care services.

(iii) Benefit sharing: Women must get their due benefits for their work which may be in terms of money, products, by-products/ productive employment etc. Gender bias renders the women resource poor and promotes inferiority and sub-ordination. Besides benefits in the above areas women should get mental and physical relief from their monotonous and hazardous work. It is intended that women should use drudgery reducing implements and appliances to derive health related benefits.

Methodologies

Stated below very briefly the approaches, activities and strategies required for gender mainstreaming.

(i) **International collaboration:** It should be in the form of 'Platform of Action' and exchanges between countries.

(ii) **National Gender Policy:** It should address the gender issues specially access of women to productive resources, control over resources and out put, wage rate, food, nutrition and health care etc. and seek greater participation of women in legislation, development and organization.

(iii) **Gender planning:** It should follow the gender policy to strengthen practical and strategic gender needs. Exclusive schemes for women under a special ministry/ department and women inclusive development under other sectors are needed. Special budget for the purpose is provided under different Five Year Plans.

(iv) **Gender sensitization for all stakeholders including general public:** Unfavourable treatment to women in the society as well as at work places is a matter of concern to welfare programmes. Backing from traditional norms, local proverbs, religions beliefs and men folks of the society, has made the aforesaid matter more deep rooted which adversely affected the process of development. The phenomenon is called as gender bias and gender discrimination. It is needed that men and women must have equal conditions for realizing their full human rights and potential to contribute to the national, political, economic, social and cultural development and to benefits from the results. Besides the above we have to be very fair to woman in terms of giving benefits as per their contribution or share. The harmonious and balanced rural development not only give due emphasis on agriculture and allied field but also on gender mainstreaming. It is needed that men and women in rural areas must play supplementary and complementary roles in agriculture and achieve their potentiality. The greatest stumbling block in the said process is the gender blindness of our general public, development functionaries, planners and policy makers. All the stakeholders in the agriculture development from the top to bottom should be gender responsive in their behaviour.

People both educated and uneducated have learnt varying degree of discriminatory style of living so much that mere logical acceptance may not bring a check to it. People are found very vocal for the cause of women but fail to act when given a chance. Development agents working in women empowerment programme or project are sometime found hypocrats because what they say they do not do in real field. In the above backdrop, gender sensitization has been

conceived as a very important national agenda. Laws have been promulgated to enforce the rights of women in the society and constitutional provisions have been made to ensure their participation in development programmes. But implementation is found far from expectations. Women's access to and control over productive resources for agricultural production is found ranging from nil to negligible. Women do not get equal treatment at home, community and welfare programmes. Their activities and entrepreneurial skills are not accounted for to provide benefits due to them. To counter the prevailing ill practices against the women inner changes among one and all must take place and a bigger social movement must begin with. In the said endeavour an individual should acquire a gender responsive behaviour patterns through stimulations of socio-psychological and educational nature. It is assumed that a gender sensitized individual would be different from a gender-informed individual and the response of the former one would be very congenial in sustainable basis for gender mainstreaming. Considering the quality of changes and the volume of work required, it is very much desired to work out the methodology, materials and approaches for gender sensitization.

The gender analysis frameworks like Harvard Analytical Tools, Moser Framework, SEAGA Approach etc. are quite helpful to the participants to understand the gender issues and become sensitive.

(v) **Strengthening gender in the institutions:** Women leadership, gender balancing and facilities at work place for women may be promoted. Institutional mechanism to address the women's' needs and problems must put in place to promptly address the needs and problems of the women.

(vi) Participatory approaches: Participation of women in extension programmes and research projects is very ideal for gender mainstreaming.

- Appointment of women as grass root worker in different sectors would promote participation of women (Gender Sensitive Extension Approach).
- Training programmes and field activities must take into account the problems and needs of the women.
- Activity calendars of various departments should understand the women's role before deciding the date and time for various programme.
- Agricultural programmes having horticulture, livestock, honey bee, value addition, post harvest enterprises can promote participation of women.
- While addressing the practical gender needs, participatory approach should be employed to find a best solution.
- Research projects in agriculture on problems and needs of women should be plan and executed through participatory on-farm trials (Gender Sensitive Technologies).
- Drudgery reduction of farm women through various farm implements can be demonstrated by involving women.
- Programme on bio-diversity, seed production, homestead farming and organic farming may provide better opportunities for women in terms of employment and income.

Conclusion

The concept and methodology give the learners a wide ranging thoughts for promoting growth, harmony and peace in the society. The operational parts would be more useful to the participants in initiating and directing the refers to achieve gender mainstreaming.

Minimizing Health Hazards of Farmwomen in Seed Production and Management

Jyoti Nayak, G. Moharana, C. Mhatre, P. K. Rout
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Agriculture is a vital part of both the economy & the health of consumers, thus the health & productivity of farm workers ultimately affect everyone. Lower productivity may result in lower crop yields & higher prices for consumers. Agricultural farm women engaged in outdoor activities are susceptible to numerous factors in their environment that may result in work related hazards. Farm women are more exposed to hazardous working conditions such as exposure to pesticides, working long hours in hot climate which predispose farmers to occupational skin disease among other health problems.

Exposure to pesticides is one of the most important occupational risks among farm women in developing countries. At present, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides. Farm women who are engaged in spraying pesticides in the crops get the direct exposure of pesticides due to unsafe and non preventive work practices. They do not use the personal protective equipments (PPE) like safety masks, gloves and other protective gear regularly during pesticide application to crops which results in direct dermal exposure.

Rural women play a pivotal role in agricultural and rural economies in all developing countries. They play key roles by working with full passion in production of crops right from the soil preparation till post harvest activities**.** Women in food and farm systems have yet to get due recognition in Asia and the world over. At the village, commune and household levels, they remain key to a family and community's health, nourishment and well being. Just as seed is central in agricultures, so are women central as seed keepers, knowledge holders and small farmers in their own right.

How important are women to agricultural production?

Economic integration has been strongly associated with increased employment of women in the paid, non-agricultural labour. Nevertheless, today, more than half of all women contribute to food production both for household production and sale. Women account for almost half of the world's agricultural workforce. They represent 47% in Africa, 17% in Latin America and the Caribbean and 44% of the regional agricultural workforce in Asia. However, women's role in agricultural production has been traditionally under-estimated and gender inequalities are pronounced in this sector. In developing countries, the great majority of women workers in agriculture are in subsistence farming, self-employed or working as unpaid family members. In addition to their productive work, they have the primary responsibility for domestic chores such as cleaning, cooking, taking care of the children, the sick and the elderly, fetching water and fuel-wood. They are also engaged in other income-generating activities to contribute to the family subsistence.

countries involve in most cases poor quality jobs and their average earnings are less than those of men. Negative factors such as political docility appear to be behind the preferential demand for female labour. Long hours of work, congested housing, extremely strict supervision, and long travel to work are the rule in this type of work.
The cultivation of non-traditional export crops has also provided low-paid jobs which complement the income of small-scale farmers. Much of this labour often involves a worker's whole family (including children and the elderly). Women often take their children with them into the fields, thus exposing both the children and themselves to occupational hazards. With the introduction of non-traditional crops in small-scale farming, men are found to share the work with women but not the profits from sales. This is likely to have a disproportionate effect on women since they have traditionally been the producers and marketers of food for the local market.

Role of farmwomen in seed production and management:

In seed production, women involve in selection, treatment, raising seedling, harvesting, storing activities. All these activities require knowledge, skill. Seed thus selected are sun dried for two or three days. When their moisture content has reduced to a sufficient level (roughly 10-13 percent), the seeds are stored in mud containers. Before sowing they are once again sun dried. Seed viability will not be affected for two to three years if they are well dried and kept in airtight containers. Seeds of vegetables are mixed with burnt ash and then sun dried. The fruits of a few vegetables during the third or fourth harvest cycle are left on the plant to ripen. The seeds of certain vegetables are left on rooftops to dry. Thus, women perform the role of seed selector and preserver, using traditional wisdom and knowledge. Apart from their own field experience, mothers, elders and older siblings are the sources of knowledge.

While performing above activities they are in contact with soil, pesticides and expose to environment. In every step there is a chance to hazard.

Mostly farmwomen involve in seed treatment, spraying, post-harvest activities for seed production and management. Many researchers developed safety kit for spraying operation. The main objectives are to prevent the operator against exposure to pesticides during spraying, the operator needs to wear the personal protective equipment (PPE) which consists of a face mask, a pair of hand gloves, eye protector, and an apron.

What is the impact of working conditions on women's health?

Women in agriculture, like many other rural workers, have a high incidence of injuries and diseases and are insufficiently reached by health services. Most of them have practically no education, training or access to information on the risks involved in their work.

Exposure to poor working conditions has serious repercussions on pregnancy, and can worsen pathologies brought on by old age. The risk of miscarriages, premature deliveries and spontaneous abortions has been directly related to work in greenhouses microclimates and to exposure to pesticides. Heavy work during crop cultivation and harvesting is frequent. Some studies have shown that traditional "female" tasks, such as sowing out, picking out, and clearing, implies a significant workload, particularly because they are not assisted by mechanical means during

irrigation, ridging and farming. When such tasks involve machinery handling, they are traditionally undertaken by male workers.

Carrying loads is one of the major chores of rural women-workers in developing countries. They can spend over 20 hours a week on trips collecting vegetables, seed, water, firewood, laundry and livestock, tending and marketing goods and carrying weights of more than 35 kg on their heads and backs over considerable distances. Carrying heavy loads cause serious musculoskeletal disorders, such as chronic back pain, chest pain and miscarriages. **Hazard** is any source of potential damage, harm & adverse health effects on something or someone under certain conditions at work.

Most frequent hazards in agriculture

- Machinery such as tractors, trucks and harvesters and cutting and piercing tools
- Hazardous chemicals: pesticides, fertilizers, antibiotics and other veterinarian products
- Toxic or allergenic agents: plants, flowers, dusts, animal waste, oils etc
- Carcinogenic substances or agents: certain pesticides such as arsenicals and phenoxyacetic herbicides, UV radiations, parasitic diseases such as biharzias and facioliasis
- Transmissible animal diseases: brucellosis, bovine tuberculosis, rabies, lyme disease
- Confined space such as pits, cellars and tanks
- Noise and vibration
- Ergonomic hazards use of inadequate equipment and tools, unnatural body posture or prolonged static postures, carrying of heavy loads, repetitive work, excessive long hours
- Extreme temperatures due to weather conditions
- Contact with wild and poisonous animals insects, spiders, scorpions, snakes, certain wild mammals

Workplace Hazards

The major workplace hazards are physical hazards, chemical hazards, biological hazards, ergonomically hazards, and psychosocial hazards. In seed production and management, mostly farm women are prone to chemical, biological, ergonomically and psychosocial hazards.

Chemical hazards

About 100 000 different chemical products are in use in modern environments and number is growing. Routes of entry into the body through inhalation, ingestion, skin contact. Routes of excretion are gastro-intestinal, renal, respiratory and skin. Health effects include renal diseases, respiratory disease, and hematologic, cardiovascular, neurologic diseases, carcinogenic, teratogenic. Women exposed to toluene have reported a greater frequency of menstrual dysfunction including dysmenorrhoeal, irregular cycles and spontaneous abortions.

Biological hazards

Exposure to some 200 biological agents, viruses, bacteria, parasites, fungi, moulds and organic dusts occurs in selected occupational environments lead to chronic diseases among agricultural workers. The diseases are cold, influenza, diphtheria, tuberculosis, anthrax, ring worm, tetanus, hook worm, rabies.

Ergonomically hazards

Ergonomics involve the environment, the tool, the workstation, the task, the organization. It goal to reduce work-related musculoskeletal disorders (MSDs) developed by workers. MSDs are injuries and illness that affect muscles, nerves, tendons, ligaments, joints or spinal disks. Common symptoms of MSDs are painful joints, numbness in hands, waists, forearms, shoulders, knees and feet, back or neck pain. Swelling or inflammations are common. Risk factors are static posture, forceful exertion, repetitive movement, extreme range of motion, awkward posture.

Psychosocial hazards

Occupational stress is one of the major problems from a gender perspective. Stress caused by time and work pressures has become more prevalent during the past decade. Monotonous work, work that requires constant concentration, irregular working hours, shift-work, and seasonal-work can also have adverse psychological effects. Stress is the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources or needs of the worker.

How productivity will increase by analyzing and addressing OHH of farmwomen?

1-Improved tools and equipment help to achieve.

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

2-Stipulations of rest periods

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

3-Improvement of Workstations and Work methods

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

need to wear the personal protective equipment (PPE) which consists of a face mask, a pair of hand gloves, eye protector, and an apron.

CONCLUSION

Women's roles range from managers to landless labourers. In all farm production, the average contribution of women is estimated at 50% to 60% of total labour, much higher in certain regions. Girls are preferred in cottonseed production because their wages are lower than those of adults (see table for wage differentials in agricultural labour). Moreover, they work longer hours and more intensively, and are generally easier to administer. Gathering of fuel wood is the exclusive responsibility of women and girls. In general, male activities such as land preparation, planting, sowing, and fertiliser application are one-time jobs, usually accomplished within a stipulated time. Female activities, however, such as weeding, are recurrent daily activities, lasting from the time the seed is planted until it is harvested.

Health hazards have been a widespread problem in agriculture in more than a decade. The identification of health hazards and development of systems to evaluate intervene and decrease musculoskeletal risk factors and resulting disorders is quite crucial for safety of farm women. Role of women in agriculture is increasingly understood and recognized in agriculture. There is need to initiate women oriented researches in agriculture.

Assessment of Drudgery of Women in Agriculture

Gayatri Moharana, Jyoti Nayak, Chaitrali Mhatre and Pragati Kishore Rout
ICAR-CIWA, Bhubaneswar

The women are the backbone of agricultural workforce but worldwide her hard work has mostly been unpaid. They perform most of the 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. The majority of these activities, which are full of drudgery, have not been supported by the mechanical advantages of tool and appliances. Still women are considered as secondary workers in the economic scenario. Agriculture ranks as one of the most hazardous industry because it is manual labour oriented and agricultural workers are exposed to a variety of hazards that are potentially harmful to the health and well-being. The physical demand of the farm work which ranges from moderate to heavy, often include standing, squatting, bending, reaching, carrying heavy loads and working for long hours may bring drudgery and certain hazards to the person. Thus due to drudgery the health of farm women is always at risk. Women with poor health status are generally required to carry heavy loads or to adopt difficult, awkward postures for prolonged periods, which is a great cause of musculoskeletal problems. Moreover for certain agriculture activities female workers are also considered better than male workers. The daily work schedule for them thus becomes very demanding and arduous. The safety and prevention of hazards in agriculture assumes critical significance. Women need to be made aware that jobs with repetitive motions put their bodies under tremendous jeopardy. It is crucial to understand the peril of women's job, in order to minimize the potential consequences, drudgery and health hazards.

Drudgery of women in agriculture

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.

Risk Factors at the workplace responsible for drudgery while performing various agricultural activities

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

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

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

Physiological cost of operation: It is indirectly measured either with heart rate or oxygen consumption. Physiological cost of operation is influenced by the health of operators, nutrition, basal metabolic rate and energy expended while working that can be indirectly measured by measuring oxygen consumption and heart rate. In general, person's subjective experience of a particular workload or rate of work is more closely related to heart rate than to oxygen consumption during the performance of work, since the heart rate, in addition to the actual workload, also reflects emotional factors, heat, the size of engaged muscle groups, etc. The physiological cost of operation is indirectly measured by measuring oxygen consumption and heart beat rate. Pheasant (1991) concluded that the heart rate is a better index of the overall physiological demand of work than energy expenditure and it has the additional

advantage of being very much easier to measure in the field. Oxygen uptake gives the absolute load but the heart rate gives the relative load, which in many instances may be just as important or even more important.

Steps for measurement

1 Plan experiment statistically
2 Follow protocol.
3 Set parameters against which evaluation is to be conducted.
4 Develop test code using BIS/RNAM/FAO test codes.

Parameters for assessing the equipment ergonomically

Sl.	Parameters for Suitability	Details
1	Anthropometrical	5th and 95th percentile
2	Functional/ Machine Parameters	Crank speed, pedal stroke etc.
3	Safety provision	Available/ Not Available/ Not Required
4	Technical skill of worker & required	Low/Medium/High
5	Weight of equipment	For carrying- 30% of body wt. Limit for design- 40% of body wt. For occasional carrying- 50 % of body wt. (5th percentile: 41 kg)
6	Acceptable physiological workload	Δ HR : 40 bpm for continuous operation with normal rest pause
7	Pull and push forces	Continuous- 30% of maximum force Intermittent- 50 % of it
8	Leg strength	Same criteria
9	Requirement of rest pause	Normal/Intermittent/Frequent
10	No. of workers required	As per Wok load
11	Feedback of subject	Satisfied/Not Satisfied
12	Output	At par with original unit
13	Constraints, if any	w.r.t. comfort of the worker in operation
14	Recommendation	Suitable/Suitable with rest pause/ Needed refinement/ Not suitable

Following formula can be used for calculating,

The **lean body mass** of the subjects was calculated using Hume's (1966) formula

= (0.29569 x body weight, kg) + 0.41873 x body height, cm)- 43.2933

Body mass index of participated subjects was calculated using following formula:

Body mass index (BMI)= Weight (kg)/ Height (m)2

The **rest pause** to the subject was also calculated using following formula, as given by Pheasant (1991):

$$\frac{r}{t} = \frac{E - A}{E - B}$$

Where, r = resting time (min),

T = total working time/ day (min),

E = Energy expenditure during working task (kcal/min),

A = Average level of energy expenditure considered acceptable,

B = Energy expenditure during rest.

Physiological cost of any operation of equipment is expressed in terms of heart rate and oxygen consumption rate. For an 8 h work period for women workers a work load requiring oxygen consumption at a rate of 0.6 l/min is considered as the maximum acceptable workload for continuous work. The heart rate for such workload will be about 110 beats per min. For agricultural activities, up to 40% of the individual's aerobic capacity should be taken a limit for longer period of work (Nag and Chatterjee, 1981, and Tewari, 1985). The work pulse of 40 beats per min, as suggested by Saha et al (1979) and Brundke, (1984) may also be considered as optimal criteria, for the quick appraisal of the state of activity that may be continued for a longer period. As per rating of perceived exertion, workload (Varghese et al, 1994) can be assessed which is given below,

Type of workload	**Physiological Variables for women**	
	Energy Expenditure, kJ/min	**Heart rate, beats per min**
Very light	<5.0	<90
Light	5.1-7.5	91-105
Moderately heavy	7.6-10.0	106-120
Heavy	10.1-12.5	121-135
Very heavy	12.6-15.0	136-150

Discomfort Assessment: Discomfort is the body pain arising as a result of the working posture and/or the excessive stress on muscles due to the effort involved in the activity. Sometimes, it is also called as overall discomfort or simply, discomfort. Any awkward posture will lead to body discomfort, or even pain, as will any excessive stress on the muscles due to the effort required to complete the activity. In

some of the situation, works may be well within the physiological limit or tolerance but the musculoskeletal discomfort may restrict the duration of work. A good posture is one which can sustain a minimum of static effort and which allows the subject to perform the given task more effectively and with least muscular discomfort. The drudgery caused due to bending in different operations reflected in terms of postural discomfort experienced by the workers. Considering this aspect, they suggested that when work can be done in sitting/standing posture, it should be done in bending posture of the operator during work.

Assessment of postural discomfort may include overall discomfort rating (ODR) and body part discomfort score. For the assessment of overall discomfort rating a ten point psychophysical rating scale (0 = no discomfort, 10 extreme discomfort) may be used, which is an adaptation of Corlett and Bishop (1976) technique. Prior to the assessment of postural discomfort the subject should be anchored to the psychophysical rating scale. This anchoring may be carried on tread mill at forward speeds which are likely to be obtained during the test under actual field conditions. A scale of 70 cm length should be fabricated having 0 to 10 digits marked on it equidistantly. A movable pointer should be provided to indicate the rating. Trial of 2 h duration should be conducted and at the end of 2 h trial period the subject should be asked to indicate his overall discomfort rating on the scale.

Overall discomfort rating (ODR): A ten point psychophysical rating scale (0 = no discomfort, 10 extreme discomfort) may be used (Fig. 1), which is an adaptation of Corlett and Bishop (1976) technique.

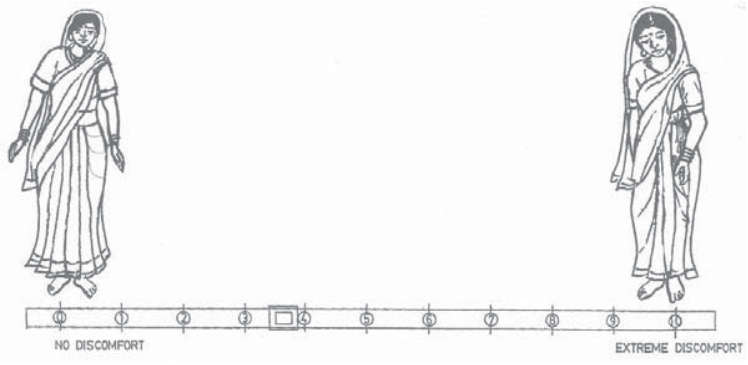
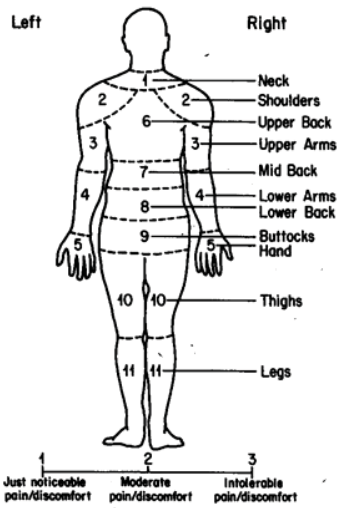


Fig 1. Visual Analogue Discomfort Scale (Legg and Mohanti, 1985)

Body parts discomfort score: To measure localized discomfort, Corlett and Bishop (1976) technique is used. In this technique the subject's body is divided into several region's (Fig. 2) and the subject is asked to indicate the regions which are most painful. Having noted these, the next most painful areas are asked for to indicate the regions, which are most painful and so on until no further areas are reported. It is considered that when " No discomfort " is reported, this is the common baseline for all the subjects. The number of different groups of body parts which are



identified before " No discomfort is reported " represent the number of intensity level of pain experienced. Each separately reported group could be seen as being separated by a recognizable difference in the level of discomfort. The data are collected at the end of 2 h work period. The overall discomfort rating given by each of the five subjects are added and averaged to get the mean rating. For assessing localized discomfort, scores are allotted to different regions as per Corlett and Bishop (1976) technique and total score for the subject is calculated. The body discomfort score for all the subjects is added and averaged to get mean total score.

Musculoskeletal disorders in agriculture: Musculoskeletal disorders (MSDs) cover a broad range of health problems. The main groups are back pain and injuries, and Work Related Upper Limb Disorders, commonly known as "repetitive strain injuries" (RSI). Lower limbs can also be affected. Health problems range from discomfort, minor aches and pains to more serious medical conditions requiring time off work, medical and hospital treatment. In more chronic cases, treatment and recovery are often unsatisfactory, and the result can be permanent disability, with loss of job. Some MSD injuries include Low Back Strain, Neck Strain, Tendonitis, Carpal Tunnel Syndrome (CTS), Rotator Cuff Syndrome, and Tennis Elbow.

Causes of Musculoskeletal disorders (MSDs): Causes of MSD may be physical, organization of work. Physical causes of MSD include manual handling, loads, poor posture and awkward movements, highly repetitive movements, forceful hand applications, direct mechanical pressure on body tissues, vibrations, and very hot and cold work environments. Causes due to the organisation of work include pace of work, repetitive work, time patterns, payment systems, monotonous work, and also psychosocial work factors. **The Risk Factors** for MSDs are force, vibration, repetition, extreme temperatures, awkward postures, work stress, static postures etc.

Assessment tool for MSDs

RULA (Rapid Upper Limb Assessment): This was developed earlier by McAtamney and Corlett, 1993, to provide a rapid objective measure of musculoskeletal risk caused by mainly sedentary tasks where upper body demands were high; where work related upper limb disorders are reported. The RULA method evaluate the ergonomics risk factor by observation the posture of workers while they working at their workstation directly. Postural and biomechanical loading were assessing on the upper limbs by valid RULA method.

Rapid Entire Body Assessment (REBA): REBA was proposed by Hignett and McAtamney as a means to assess posture for risk of work related musculoskeletal disorders (WRMSDs). This ergonomic assessment tool uses a systematic process to evaluate whole body postural MSD and risks associated with job tasks. A single page worksheet is used to evaluate required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk (Sue and McAtamney, 2000) :

Score	Level of MSD Risk
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7	medium risk, further investigation, change soon
8-10	high risk, investigate and implement change
11+	very high risk, implement change

Combating MSDs Risks

If your general assessment identifies risks from manually handling loads, one should:

- Eliminate the job if it is reasonably practicable to do so;
- Assess the operations that cannot be avoided;
- Take steps to reduce the risk of injury.

Solving MSD problems will often involve a combination of actions, including:

- Physical measures – changing the workplace or load
- Changing work methods
- Information and training for the worker

Often the costs of these solutions are small and they are always tiny in comparison to the costs of disabling and painful injuries. Reducing risks from manual handling will usually improve the efficiency of the task, reduce labour costs and improve workers motivation.

Need for drudgery reduction

The quality of work life of women in agriculture is characterized by long hours of work, awkward postures and drudgery experiences at work due to work load and unsuitable farming equipments. They adopt very awkward static posture squatting, bending, sitting and performed task repetitively which was responsible for musculoskeletal disorders and leads to occupational health hazards. There is lack of awareness about different improved tools and agricultural implements. These are some of the factors lead to drudgery and stress among the farm women in the field. Human power plays a great importance in agriculture system since agrarian and they are involved in various farm operations. Hence in the design of farm tools and equipment, everything known about operator is very important, as they have to work with the designed/developed equipment. It is reported that many agricultural projects aimed at men with the assumption that they will somehow automatically benefit women though the ergonomical characteristics of women are different than men

workers. The contribution of women is very high in the farm sector as they are involved in majority of farm operations and are therefore subjected to extra harsh conditions of work that leads to drudgery. Therefore introducing women friendly ergonomically designed farm tools or implements is required to reduce drudgery and health hazards as well as increasing working efficiency of farm women. Thus ergonomics plays a major role in such aspects.

Conclusion

It is very evident that women involved in agriculture are doing very tedious activities which are very drudgery prone and there are chances of health of health hazards likely to be happened at their workplaces. 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. These all are responsible for drudgery which creates hurdles while performing various activities. Ergonomics provides a wide horizon to modify the work station, tools & equipment, work place and working environments according to the need and suitability of the worker such as in case of farm worker and farm women. During the performance of workers simultaneously postures adopted by them can be aasessed with standardized tools and improved method can be advised in order to reduce awkward postures and repetitive motions. It will also help in the increasing the working efficiency of the farm women and improving their work productivity. It decreases the work place stress of a worker at his/ her work place. It will also reduce the chances of occupational health hazards, accidents and musculoskeletal disorders. Ergonomically modified workplace will be helpful in solving the health and safety issues of the farmer/farmwomen/ worker.If the workplace will be modified ergonomically then drudgery, health and safety issues of the farmer/farmwomen/ worker can be solved ultimately. This also leads in the direction of technological empowerment of rural women involved various agriculture, household and allied activities

References

Astrand, I., Astrand, P O., Hallback, I., Kilbom, A., 1973. Reduction in maximal oxygen intake with age. J. Appl. Physiol., 35: 64.

Astrand, P O., Ridahl, K., 1986. Text Book of Work Physiology. McGraw-Hill, New York.

Chakrabarti, D. (2007).Anthropometry and Some Design Issues. Edited by Suman Singh. Ergonomic Interventions for Health and productivity. Himanshu Publication. Pp. 17-30.

Ciesielski, S., Hall, S P and Sweeney, M. (1991). Occupational injuries among North Caroline migrant farm workers. Am. J Public Health, 81: 926-927.

Crutchfield, C D and Sparks, S T. (1991). Effects of noise and vibration on farm workers. State Art Rev Occup Med, 6: 355-369.

Dosman, JA., Graham, BL and Hall, D. (1987). Respiratory symptoms and pulmonary function in farmers. Occup. Med, 29: pp 38-43.

Gite, L P and Singh, G. 1997. Ergonomics in Agriculture and Allied Activities in India. Technical Bulletin No. 70. Central Institute of Agricultural Engineering (CIAE), Bhopal, 9 pp.

Gite, L P., Majumder, J., Mehta, C R and Khadatkar, A. 2009. Anthropometric and Strength Data of Indian Agricultural Workers for Farm Equipment Design. Book No. 4. Central Institute of Agricultural Engineering, Bhopal.

Kalyani, K.S.; Deosingh, K.; and Naidu, S.K.(2008).Occupational health Hazards of Farm Women in Tobacco Cultivation. *Indian Research Journal of Extension Education*. 8(1).

Laperrière, E.; Ngomo, S.; Thibault, M. C. and Messing, K. (2005). Indicators for choosing an optimal mix of major working postures. *Applied Ergonomics*. 37(3):349-357.

Nag, P K and Chatterjee, S K. 1981. Physiological reactions of female workers in Indian agricultural work. Human Factors, 23(5):607-614.

Singh, S. (2007).Ergonomic-the Ubiquitous Science of Work. Eddited by Suman Singh. Ergonomic Interventions for Health and productivity. Himanshu Publication. Pp.1-2.

Van D, M.; Lotters, F. and Burdorf, A. (2005). Influence of modified work on return to work for employees on sick live due to musculoskeletal complaints. *Journal of Rehabitational medicine*.37 (3):172-179.

Need of Ergonomics and Safety in Agriculture and Promotional Issues for Women Friendly Farm Tools and Equipments

Mhatre C.S., Gayatri Moharana, Jyoti Nayak, Rout P.K.
ICAR-CIWA, Bhubaneswar

Agriculture in India employs 263 million human workforce, of which about 37% are women workers. By 2020, the ratio of agricultural workers to total workers will go down to 40% from 56% at the present and the number of workers would be around 230 million, of these about 45% will be women workers as against 37% at present. There are about 120 million agricultural machines operated by either tractors, power-tillers, electric motors, diesel engine, animal or human workforce. The number of agricultural hand tools is about 400 million. The workforce engaged in agriculture is reducing as large number of male population is migrating from village to towns and cities for jobs in industry/service sector. This leaves the females incharge of the house and the farm. Hence, women face increasing workload and wider scope of agricultural task, decision making etc., but the degree to which they have access to improved agricultural technologies needs a special consideration.

As men leave there is unavailability of labour during critical time period of farm operation. Therefore carrying out various farm operations more and more mechanization is required Hence , there is a need for skilled agricultural labour (women) to operated these machineries to improve work efficiency to complete the operations timely operations.

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

Many times, due to poor design of machines or faulty procedure or operation or lack of safety awareness, a number of accidents happen causing injuries to workers which may be non-fatal, or fatal in nature.

The annual investment in farm equipment industry in our country is about Rs. 80,000 crore. Due to shortage of labourers in agriculture, the number of farm machines are going to increase a lot. Also, generally, nobody wants to work in a situation where drudgery is high. Therefore, it is necessary to design the equipment as well as work places giving due consideration to the anthropometric and strength data of women agricultural workers and other ergonomical principles so as to have a higher productivity along with reduced drudgery and enhanced safety of workers.

Higher participation of female workforce and changing scenario of technologies demand more emphasis on development of gender-friendly tools, equipment as well as workplaces. As mentioned earlier, by 2020 the number of women workers engaged in various agricultural activities in our country will be about 104 million i.e. 45% of the total agricultural workforce. At present, these farm women are generally used as a source of power because of the social as well as technical constraints. Traditional system limits women's access to resource and impose sexual division of labour (traditional gender roles). Poor purchasing capacity also further hamper the adoption

of the farm mechanization. Lack of awareness in the women farmers needs to be address to increase their interest in using these drudgery reducing technologies. Non-availability of tools, equipments and their maintenance facility in women's vicinity is an hindrance for the women farmers. With constant efforts and attitudinal change in the society these restrains have to be removed. Thus making women equal beneficiaries of the technological advances in the agricultural sector. Hence, it is necessary to give due considerations to their ergonomical characteristics, their capabilities and limitations while designing various tools and equipments.

Rural women are rarely considered as research clients. Women have different physique and stamina than mentherefore present technology may not be relevent to women's needs. Safety issues like wearing loose clothes (sarees, dupatta), social taboos, casual approach, lack of cautionary tips also cause to lower rate of adoption of the tools and equipment.

Technical training and extension programmes are exclusively targeted at me. Lack of land, credit etc., leads unintentional bypassing by extension services (5% extension services, FAO) Improper assumptions such as "women to be tied down to household, children or are shy, difficult to reach and oppose innovation"

Performance of every tool differs according to the conditions of the location in which it is being operated. There is also need for consolidated and validated tool packages for various crop production systems. Thus work is also needed to be done in assimilating such tool packages and validating them for localised conditions.

Rural women have to play a dual role in the household. They have to not only take care of the farm activities but also of the house and family. Hence, we have to introduce them to integrated farming systems. This will allow them to utilise their resources like land, farm ponds, etc, to an optimum level and in return they will get more than one output viz., fish, vegetables, etc, that will help increase their income and reduce their dependency on others, while reducing their drudgery.

Hence it is required to develop as well as modify farm tools and equipment with women's perspective for drudgery reduction of farm women, and application of drudgery and time reducing technologies to ultimately improve their overall living conditions.

To achieve these objectives we need to focus on:

- Developing safety devices, practices and strategies to minimize farm accidents based on survey and analysis.
- Studying the human-machine-environment interaction to generate data for developing ergonomical design guidelines.
- Integrating the anthropometric and strenght data and other ergonomical principles in design of agricultural tools and equipments.
- Assessing the occupational health hazards and developing ergonomical interventions for their minimization.

Addressing the promotional issues:

1. Research and development issues :

Considering the ergonomic needs and differences of farm women

- Anthropometry : Clearance, reach, posture, strength 6 to 21 % lower than male
- Muscular strength : 11 to 153 % lower than male
- Aerobic capacity : 65-75% that of the men's capacity
- Physiological cost of operations: 0.7 l/min and 110 bpm for men while for women it is 0.6 l/min and 105 bpm
- Posture: avoid squatting or bending, use sitting or standing (farm women prefer sitting)
- Load carrying capacity : 21 % less
- Safety : proper protection gear for women, covering machine moving parts etc

2. Extension issues :
   - Facilitating counselling and creating awareness of existing technologies
   - Training women in safe handling and safety precautions
   - Developing a database of
     - Activities and multiple roles of women
     - Women specific tools and equipments
     - Success stories
   - Using progressive farm women as a resource person
   - Training of trainers
   - Training for women farmers for skill up-gradations to increase productivity and reduce drudgery
3. Social and general issues :
   - Attitudinal changes are needed specially amongst the male member about the machinery operation by women workers
   - Organising women groups for custom hiring of tools to avoid individual purchase
   - Advocating policy prescriptions
   - On-the-spot guidance/maintenance systems
   - Manufacturers of improved women friendly tools and machines need to be given incentives through various policy initiatives.
   - Encouragement in the form of awards may be given

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

Digitization in Agriculture

Ananta Sarkar, Shivaji D. Argade and L. P. Sahoo
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

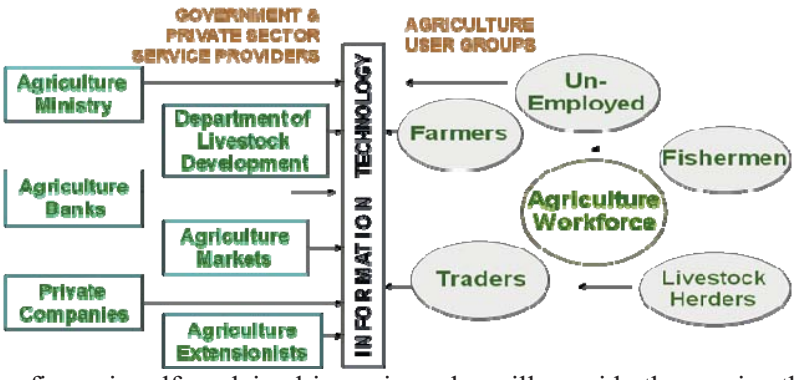
Digitization is the process of converting information into digital format. This is beneficial for every sector of economy of a nation. It is very efficient, effective, time saving, innovative and simple approach to reach different stakeholders. Thus it is also necessary for agriculture in India because Indian agriculture is facing many challenges viz.

- Lack of appropriate new technologies, land fragmentation, lack of soil for recreation, more and more use of fertilizers and chemicals etc. all cause little growth in agricultural sectors.
- Diet diversification: it is observed that, due to increase in income, there is shift from staple foods to higher cost foods such as poultry, fruits and vegetables, and dairy products.
- Climate change: there is more stress on soil and its fertility and environment due to increase in GHGs emissions, pollution, non seasonal rains, floods, droughts etc.
- Non-scientific practices: excess irrigation, water intensive crops in drought areas, stubble burning etc.
- Missing link between forward and backward linkages in agriculture.

Digitization may be useful in sorting out many of the above challenges in agriculture in India. There is need of a connected ecosystem where the knowledge about every single issue of agriculture is available and all the stakeholders in the value chain collaborate to make things better.

Stakeholders who need ICT for agriculture development: Govt. Agriculture Dept. , Traders, Agriculture Extensionists, Livestock Farms, Livestock Herders, Fishermen, Farmers etc.

IT for Agriculture Development: Matching Service Providers with Rural User Groups



The above figure is self explained in saying who will provide the service through IT and to whom.

Digitization process can help in following ways

- Providing farmers access to communication facilities: phone, internet, email, fax, mobile phone etc. for getting market prices, information on upcoming pest and disease attacks, information on seeds/ irrigation/ soil/ cropping pattern/ weather/ climate change patterns.
- Providing interactive demand based agriculture services: Government programs and subsidies in agriculture, online application for loan facilities, online

agriculture extension and query redressal, information on cropping pattern and fertilizer use.

- Facilitate credit and insurance through PM Fasal Bima Yojna, facility to secure farmers against any distress.
- Backward and forward linkage will be smoothed and can attract Foreign Direct Investment (FDI) and thus promotion of Indian agriculture in global markets.
- Market prices and trend helps in monetary gain of farmers and promote productivity. Actual market rates knowledge through internet and smart phones prevent them to be exploited by the cartel of Mandi agents. Online trading/ E-auction like NAM helps farmers in finding suitable customer for their crops and commercialization of farming.
- Helps in Leveraging world level technology and knowledge in the farming practices.

Digitization process has the potential to create more welfare for farmers in terms of incomes as well as for people of our country especially those do not get access to right to food to fight against hunger, achieve food security and improved nutrition and promote sustainable agriculture. Among the recent developments in India many government and private sector institutions are in process of developing mobile apps and decision support systems for farmers to combat the challenges in agriculture along with the mobile based services (kisan call centre, SMS through mKisan portal etc.). Some of the apps along with brief description are given in sequel.

Apps developed by ICAR institutions

- Mobile App 'riceXpert'
- ICAR - NRCP (Pomegranate)
- ICAR - Mushroom
- CAZRI KRISHI
- ICAR - NIANP FEED CHART
- ICAR - DMAPR (Medicinal Aromatic Plants Research)
- Oil Palm - Nutrient Management
- Oil Palm - Cultivation Practices
- Oil Palm - Pest Management
- Oil Palm - Disease Management

Apps developed under mKisan

- Kisan Suvidha
- Pusa Krishi
- mKisan Application
- Shetkari Masik Android App
- Farm-o-pedia
- Bhuvan Hailstorm App
- Crop Insurance mobile app
- AgriMarket
- Sikkim Horticulture And CashCrop Assistance
- Sikkim Allotment Of Breeding Bull
- Application for Poultry
- Pashu Poshan
- Digital Mandi India
- MNCFC
- Karnataka Bhoomi

- HP Soil Testing
- Crop Info
- Intelligent Advisory System for Farmers

'***riceXpert***': The App provides information to farmers in real time on insect pests, nutrients, weeds, nematodes and disease-related problems, rice varieties for different ecologies, farm implements for different field and post harvest operations. It is a web-based application systems which facilitates flow of information from the farmer to the farm scientist and get their instant solution. Farmers can use this App as a diagnostic tool in their rice fields and make customize queries for quick solution of their problems by sending text, photo and recorded voice. The mobile app provides information on rice cultivation and enable farmers to consult panel of experts.

Kisan Suvidha: Kisan Suvidha is an omnibus mobile app developed to help farmers by providing relevant information to them quickly. With click of a button, they can get the information on weather of current day and next 5 days, dealers, market prices, agro advisories, plant protection, IPM Practices etc. Unique features like extreme weather alerts and market prices of commodity in nearest area and the maximum price in state as well as India have been added to empower farmers in the best possible manner.

Farm-o-pedia: The app is useful for farmers or anyone related to agriculture. It is available in English and Gujarati languages. The main functionalities of the app are: get suitable crops as per soil and season, get crop wise information, check weather in your area and manage your cattle.

Crop Insurance mobile app: Crop Insurance mobile app can be used to calculate the Insurance Premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer. It can also be used to get details of normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified area.

AgriMarket: AgriMarket mobile app can be used to get the market price of crops in the markets within 50 km of the device's location. This app automatically captures the location of person using mobile GPS and fetches the market price of crops in those markets which falls within the range of 50 km. There is another option to get price of any market and any crop in case person does not want to use GPS location.

Pashu Poshan: NDDB has developed an android based software that can be used on phones as well as tablets. With the help of this software balanced ration is formulated while optimizing the cost considering animal profile, i.e. cattle or buffalo, age, milk production, milk fat, and feeding regime etc. and milk producers are advised to adjust the quantity of locally available feed ingredients offered to their animals along with mineral mixture.

Digital Mandi India: This App helps in checking the latest Indian agricultural commodities Mandi prices from different states and districts. Easy to use and intuitive, the app enables farmers, traders and all others to know the updated Mandi price from anywhere.

HP Soil Testing: With the help of this app farmers can submit soil health samples of their land to the concerned soil health testing lab of their district/ block.

{*Description about the above selected apps are as it is written in their original description*}

Issues related to Digitization:

- Lack of access to Smartphones by farmers/ specially farm women.
- Lack of access to Internet by farmers/ specially farm women.

- Mental blockage in our society to use smart devices mainly by farm women.
- Affordability of smart phones specially by farm women.
- Difficulties in accessing appropriate information and app details.

Probable solutions to handle above issues:

- With National Optical Fibre Network (NOFN) program i.e. to connect all panchayats by 2019 means that internet will penetrate to hinterland and the remotest area than one think of will solve the access to internet facilities.
- Service providers can access the digital information and share with different needy communities.
- Service providers can create digital groups (viz. Whatsapp group) to share information among farmers (service provider to farmer or farmer to farmer)
- Village level leadership development among the farmers/ farm women in specific so that the information/ knowledge can reach to the last one.
- Mental blockage can be removed by sensitizing all local stakeholders.
- Service providers are to use authentic information (specially developed by Govt. sector institutions) and guide farmers in accessing the same.

In India, the government has taken number of steps in promoting digitization in the field of agriculture for a better future. Seed production is one of the most important component in Agriculture. Digitization is possible in every step of information on quality seed availability, seed treatment, quality seed production, harvesting, storing, etc. and thereby efficiently and effectivly managing seeds in each stage for better management.

Seed Quality Management

S. Mohanty and Chakradhar Patra
O.U.A.T. Bhubaneswar

Quality seed has been recognised as the basic yet cheapest input in agriculture. Much of our success in increasing food production has been due to the use of quality seed of superior crop varieties and hybrids. For this quality seeds are rightly called as the "seeds of green revolution". The techniques of production of quality seed are somewhat different from those of commercial crop production. While higher yield is the main objective in crop production, both seed quality and yield are given due importance in seed production. Since the farmers do not grow seed crops separately and retain a portion of their commercial produce for sowing the next crop, the farmers' saved seed are inferior in quality and fail to achieve the yield advantage of using quality seed. The general principle of quality seed production of crop varieties / hybrids is discussed below.

1. ***Selection of suitable agro-climatic region:*** A crop variety to be grown for seed production in an area must be adapted to the photoperiod and temperature conditions prevailing in that area. The crop varieties sensitive to photoperiod and temperature should be grown in selected localities where these could be economically produced. Regions of moderate rainfall and humidity are much more suited to seed production than regions of high rainfall and humidity. Most crops require a dry sunny period and moderate temperatures for flowering and pollination.

2. ***Selection of seed plot:*** Plot selected for seed crop must have the following characteristics:

a) Soil texture and fertility of plot should be according to the requirement of the seed crops.
b) The seed plot should be free from volunteer plants, weed plants and other crop plants.
c) Soil of the seed plot should be relatively free from soil-borne diseases and insect pests.
d) In the preceding season, the same crop should not have been grown on this land, if it is so required by the seed certification standards.
e) The seed plot must be levelled.
f) It should be feasible to isolate the plot as per requirements of certification standards.

3. ***Isolation of seed crops:*** The seed crop must be isolated from other nearby fields of the same crop and other contaminating crops as per requirements of certification standards. The isolation of a seed crop is usually done by providing distance between seed fields and contaminating fields. In certain cases, when space isolation is not feasible, time isolation may be provided. Moreover, the distance isolation may be reduced by planting additional border rows (in case of certified maize seed production). On a small scale, i.e. in nucleus / breeder seed production, the isolation can also be provided by enclosing plants or group of plants in cages or enclosing

individual flowers, or by removing male flower parts and then performing artificial pollination of individual flowers.

4. ***Preparation of land:*** The land for the seed crop must be well prepared. Good land preparation helps in improved germination, good stand establishment and destruction of potential weeds. It also aids in water management and good uniform irrigation.

5. ***Selection of variety:*** The variety for seed production must be carefully selected. Except in exceptional cases it should satisfy the following criteria.

a) The variety should be adapted to the agro-climatic conditions of the region.
b) The variety should really be a high yielder.
c) The variety should possess other desirable attributes, namely, disease resistance, earliness, grain quality, etc.

6. ***Quality of seeds used including the source:*** The seed used for raising a seed crop should be of known purity, appropriate class and invariably obtained from an authorised official agency. While buying the seed, the following factors should be carefully examined.

a) That the seed of the appropriate seed class is bought.
b) That the tag and seal of the breeder / foundation seed bag purchased are intact.
c) That the validity period has not expired.
d) That all the bags are of the same variety.

7. ***Seed treatment:*** The seeds may require seed treatment before planting, if they are not already appropriately treated. Depending upon the requirement one or more of the following seed treatments may be given: chemical seed treatment, bacterial inoculation for legumes, or seed treatment for breaking dormancy.

8. ***Time of planting:*** The seed crops should invariably be sown at their normal planting time. Depending upon incidence of diseases and pests, some adjustments could be made, if necessary. At the time of planting, there should be sufficient soil moisture for germination to take place.

9. ***Seed rate:*** Lower seed rates than usual for raising commercial crop are desirable because they facilitate roguing operations and inspection of seed crops.

10. ***Method of sowing:*** The seed crops should usually be sown in rows, except in thickly sown crops where the sowing could be done by broadcasting. Sowing of seed crops in rows helps in conducting effective plant protection measures, roguing operations and field inspections. For hybrid seed production, it is important to ensure that seeds of the male and female parental lines are not mixed while planting.

11. ***Depth of sowing:*** Depth of sowing is extremely important in ensuring good plant stands. Small seeds should usually be planted shallow, but large seeds could be planted a little deeper.

12. ***Roguing:*** Adequate and timely roguing is extremely important in seed production. Rogues may cause quick deterioration in seed stocks through cross-pollination, transmission of disease, etc. They should, therefore, be removed as early as possible, preferably before flowering. It is wise to remove the whole plant and not just the

flower head. Roguing in most of the field crops may be done at any stage as per needs of the seed crop. The number of roguings necessary will vary with the crop, purity of the planting material and stage of multiplication of the seed crop.

13. ***Supplementary pollination:*** Provision of honeybees in hives in close proximity to the seed fields of crops largely cross-pollinated by insects, ensures good seed set and thereby greatly increases seed yields.

14. ***Weed control:*** Good weed control is a basic requirement in producing good quality seed. Weeds may cause contamination of the seed crop in the following ways, in addition to reduction in yield.

a) The presence of weed plants at the time of crop harvest leads to mixing of weed seeds with crop seeds. In many instances, it is difficult to remove them during processing of seeds.
b) Weeds in the seed field or nearby areas may serve as hosts to a number of diseases.

Weed management may be practiced by planting on clean fallow, following a good crop rotation, thorough intercultural operations and by hand weeding from time to time or through use of appropriate herbicides at the right time and in right manner.

15. ***Disease and insect control:*** Successful disease and insect control is another important factor in raising healthy seed crops. Apart from reduction in yield, the quality of seeds from the diseased and insect attacked plants is invariably poor. Systemic diseases, if not checked, produce seeds infected with spores that produce diseased plants in the next generation. e.g. loose smut of wheat. Non-systemic diseases may leave their spores on seed coats, which may cause greater susceptibility to various seedling diseases that can affect the crop.

16. ***Nutrition:*** Adequate and balanced fertiliser application at the right time results in maximum yields, good seed quality, and better expression of plant type, which facilitates roguing and thereby helps in maintaining higher genetic purity as well. Nitrogen, phosphorus, potassium and several other elements play an important role for proper development of plant and seed. Hence, these nutrients should be applied in adequate amounts, at the right time and in the correct form.

17. ***Irrigation:*** Comparatively drier regions are more suitable for good quality, disease-free seed production. In such regions, irrigation is essential to obtain good seed yields. Irrigation may be required before planting and at intervals up to flowering. One or two irrigation(s) beyond flowering are desirable for many seed crops. In general, lighter soils need more frequent irrigation than heavy soils. Care should be taken to avoid water stress during flowering and seed set. Adequate and timely irrigation also helps in efficient nutrient use by the plants. In addition, proper drainage is necessary for most of the crops, as it helps in better aeration to the roots. The seed fields should be properly drained at the time of maturity.

18. ***Time of harvest:*** It is of utmost importance to harvest the seed crop at the optimum time, which will allow maximum yield as well as best quality seed. Early harvesting

makes combining difficult and losses due to threshing and cleaning are greater. It may also result in a larger proportion of partially filled seeds. Similarly, delayed harvest, may expose the seeds to the vagaries of nature. There are chances of shattering of the seeds in the field before or at the time of harvest. If the seeds are sufficiently dried in the field, there are chances of higher proportion of broken seeds. If there are rains at the time of maturity, some crop varieties may show viviparous germination. e.g. certain varieties of paddy, finger miller, etc. The moisture content is a good indication of the optimum time of harvest for most seed crops. For wheat and rice, usually the moisture content of the seeds at the time of harvest is 15–17%.

19. ***Method of harvesting:*** In India, harvesting of the crops is mainly done manually. Care should be taken to avoid mechanical mixture and mechanical injury to the seeds during threshing. The lot identity should be maintained. If harvesting is done by combines, precautions should be taken to adjust the combines properly so as to keep losses and mechanical injury to seeds at a minimum.

20. ***Drying of seeds:*** Seeds contain high moisture at the time of harvesting and threshing. In order to preserve seed viability and vigour, it is necessary to dry the seeds to safe moisture levels. Drying of the seeds should be started as early as possible, preferably in shade to begin with, and followed by sun drying. In summer seasons shade drying is preferred, because rapid drying of the seeds immediately after harvest may cause cracks in the seed coat, thus deteriorating its quality. e.g. groundnut, soybean, etc. Care should be taken to avoid mechanical mixtures during drying.

21. ***Storage of raw seeds:*** Seeds can effectively be stored for short periods in sacks or bags in godowns after proper drying. The seeds should be filled in neat and clean bags. If old bags are used, the bags should be dipped in 2% Malathion solution, dried and cleaned before they are filled with seeds. Each and every bag should be marked appropriately with information on the name of the variety, the plot where the seed was produced and also the name of the owner. The storage godown should be clean, dry and cool and should not have damp floors.

22. ***Processing:*** Seed lots received from the field often contain trash and other inert materials, weed seeds, deteriorated and damaged seeds, off-sized seeds, etc. Seed processing is necessary for removing or reducing the extent of various undesirable materials, uniform size grading, seed treatment and upgrading the overall quality of seed. Care should be taken to avoid mechanical mixtures during the processing operations.

SEED CERTIFICATION

Seed Certification may be defined as a systematically and scientifically designed process to secure, maintain, multiply and make available to the farmers good quality seed of superior crop plant varieties.

Seed production is different from crop production. A seed programme is successful if it can make available sufficient quantity of high quality seed at the required time,

at a reasonable cost and at the place where it is needed. A **good quality seed** means that it is -

(i) High in germination and vigour.
(ii) Reasonably pure, genetically and physically.
(iii) Free from seed borne diseases.
(iv) Free from insect damage.

Good quality seed can be obtained by controlling the seed production. This control can be exercised in **two** ways:

1. Seed multiplication and processing are arranged in such a way so as to avoid or minimise the risk of mechanical or genetic contamination.
2. By fixing minimum field and seed standards and checking each seed lot against these standards at an appropriate time.

To ensure and exercise this control, seed certification is necessary. The purpose of seed certification is to maintain and make available high quality seeds and propagating materials of notified plant varieties, so grown and distributed as to ensure genetic identity and genetic purity. Seed Certification is performed in **six** phases:

a) Receipt and scrutiny of application.
b) Verification of seed source, class and other requirements.
c) Inspection of the seed crop in the field to verify conformity to the prescribed field standards.
d) Supervision at post-harvest stages including processing and packing.
e) Seed sampling and analysis (including genetic purity and/or seed health test) to verify conformity to the prescribed seed standards.
f) Grant of certificate and certification tags, labelling and sealing of the containers.

Under the provisions of Seeds Act, 1966 and Seed Rules, 1968 made there under, seed certification is done in the following manner.

1. ***Application for seed certification:*** All those interested in certified seed production are required to submit an application on prescribed proforma to the concerned State Seed Certification Agency. The seed certification agency upon receipt of the application is required to verify the following:

i) that the variety/varieties are eligible for seed production under certification.
ii) that the seed source of crop to be sown is authentic and is in accordance with the conditions laid in the minimum seed certification standards.
iii) that there would be no difficulties in reaching the field for carrying out timely field inspections.
iv) that the seed producer is able to provide requisite isolation and that the field meets the land requirement mentioned under the minimum seed certification standards.
v) that seed processing facilities are available to the applicant.
vi) that the requisite application fee has been paid.

2. ***Inspection of seed fields:*** Inspections are made in the field on the standing seed crops and if they meet the prescribed field standards, they are approved. After harvest

of the approved seed crops, representative seed samples are taken from the harvested seed lots and tests are performed in the laboratory for conformity to the prescribed seed standards. Accordingly, the seed lots may be approved or rejected.

3. ***Rejection of the fields:*** If a seed crop does not meet the certification standards, it may be rejected. Complete rejection of the seed plot may be done on the basis of extent of contaminants, while partial rejection may be done on the basis of insufficient isolation. Rejection of the problem fields is done at the end of the inspection season. The action taken is communicated to the seed grower, with a copy to the seed inspector.

4. ***Inspection of seed processing:*** Seed certification agency representatives make as many inspections of the seed lots, records and processing plant as may be required. These are done to ensure –

(i) that admixtures of other kinds and varieties are not introduced during seed processing,
(ii) that the seed is being cleaned and graded in a satisfactory manner,
(iii) that the seed, if dried by heated air at the processing plant, was dried with an air temperature not exceeding 43^0C,
(iv) that seed treatment being done is as per directives of the SCA, and
(v) that the lot being made is fairly homogeneous.

5. ***Seed sampling and testing:*** SCA representatives at the seed processing plant are required to take seed samples of all seed lots that are to carry the agency's tags. These seed samples are then sent to an Official Seed Testing Laboratory for evaluation of purity, germination and moisture.

6. ***Tagging and sealing:*** Upon receiving a satisfactory report from the official STL, a certificate is issued for each seed lot, along with tags and seals for each container in the seed lot, in accordance with the general seed certification requirements. The certificate issued is valid for a period of 9 months from the date of test. Affixing of tags and seals on the containers completes the process of certification of seeds.

7. ***Control plot testing:*** The SCA should arrange for a post-season grow-out test of all the hybrid seed lots as prescribed in the standards, and also a random sampling of lots certified during the previous season. The purpose is to check the efficiency and accuracy of the work done.

8. ***Conditions for intercropping during certified seed production of oilseeds and pulses:*** Intercropping can be taken up only in oilseeds and pulses for production of CS class, but the FS class shall strictly be restricted to a single crop. Other types of cropping patterns are not permitted. The crops selected for intercropping should be of different genera and preferably different maturity. Only the basic crop is eligible for certification and not the companion crop. The number of rows of both the crops should be uniform throughout the field. Crops are selected based on the following criteria.

i) The companion crop should not hamper the operations needed for the seed crop.
ii) It should not starve the seed crop of nutrients and moisture.

iii) It does not mature simultaneously with the seed crop.
iv) It does not carry any weed seeds, which may mix with the seed crop at maturity.
v) It does not have common pests and diseases.
vi) It does not render certification work difficult.

9. ***Extension of validity period or revalidation:*** The extension of validity period of certified seed shall be for a period of 6 months at each subsequent validation as long as the seed conforms to the prescribed standards.

10. ***Revocation of certificate:*** If the SCA is satisfied that the certificate granted by it has been obtained by misrepresentation as to an essential fact; or the holder of the certificate has, without reasonable cause, failed to comply with the conditions subject to which the certificate has been granted, then after giving the holder of the certificate an opportunity of showing cause, it may revoke the certificate.

11. ***Appeal against certification agency:*** Any certified seed producer, aggrieved by a decision of the certification agency, may appeal against the decision of the certification agency to the appellate authority specified by the concerned State Government within 30 days from the date of receiving rejection letter from the certification agency.

Important events in Indian seed industry

- Establishment of NSC Ltd. in 1963
- Seeds Act passed in Parliament in 29th December 1966
- Seed Rules formulated in 1968
- Seeds Act, 1966 enforced from 2nd October 1969
- Establishment of SFCI and TDC in 1969
- MSCS fixed in 1971
- Seeds (Control) Order, 1983
- Revised MSCS in 1988
- New Policy on Seed Development, 1988
- National Seed Policy, 2002
- New Seeds Bill, 2004
- New State Seed Policy, 2008

Community Seed Production for Self Utilization of Farm Women

Anuj Rai and Laxmipriya Sahoo
KVK Malkangiri, Odisha

- Introduction
- What is community seed production and why?
- Present status of seed production and requirements:
- Objectives of community based seed production
- Feasibility of community based seed production
- A checklist for sustainable seed production
- Community based seed bank
- Functions of cbsb
- Establishment of community seed banks
- Case study of the green foundation in south India

INRODUCTION

More than 70% of the population of India depends on agriculture and allied things for household food security, livelihoods, and incomes. Women contribute 50-60% of labour in farm production in India. There is evidence to suggest, writes Kavya Dashora, that if agriculture were focused on women, outputs could increase by as much as 10-20%, the ecological balance could be restored, and food security of communities improved. In India, there are distinct male and female roles in the rural economy. Women and girls engage in a number of agro-oriented activities ranging from seedbed preparation, weeding, and horticulture, and fruit cultivation to a series of post-harvest crop processing activities like cleaning and drying vegetables, seeds, fruits and nuts for domestic use and for market, so Government arestrong-mindedfor the development of agriculture sector to help the poor people as well as reduce the food security. In which, seed is a most important input by which we can increase our production approximately 20%. Seed is an important catalyst for the development of agriculture and it was played the important role to Green revolution in India by which we increased our production about 50 times more than that condition.

The availability of quality seed is the foundation for food production and productivity and a forerunner to crop and food diversification. Efforts to improve the performance of the agricultural sector should include seed production and delivery systems. National agricultural research systems and international agricultural research centres have worked together to develop new, stress tolerant crop varieties that are well adapted to smallholder farmers' conditions. However, most farmers in the maximum areas have little or no access to improved seed and continue to recycle seed that has been exhausted after generations of cultivation, and therefore yields have remained poor, resulting in persistent food insecurity.

What is community seed production and why?

It is the one type of system to producing the good quality seed by a number of farmers group to fulfilment of their seed requirement in reasonable cost, sufficient amount at appropriate time and an improved variety. In Indian seed supply system missing in some places like seed sector if we produce sufficient amount of seed of a crop but the cost of those seeds are high, which is not affordable for farmers but in some conditions government also provide the subsidy to seed, at that time an another problems happens that the supply of seed not available at the time of sowing. The most important factor is that, every year so many variety as well as technology developed by the various scientists in which only some are adopted by the farmers that's mean not they are not aware regarding these technologies as well as improved varieties but they are unable to obtain improved seed. So, to overcome to these types of problems community based seed production require in every community level. In other words we can say that the main purpose of community seed production is

- Community managed seed system that should provide quality seeds, desired variety, diversity of seeds, before sowing time.
- The same system is intended to serve alternative contingency seeds in case of crop failure due to weather aberrations.
- Community managed seed system should be evolved based on local agro-ecological systems, market needs, community food needs, local institutional and market linkages.

Present Status of Seed production and Requirements:

Requirement and availability of certified/quality seeds during kharif-2013			
State :Odisha		**quantity in quintals**	
Crop	**Requirement**	**Availability**	**Status**
Urd	2600	9410	6810
Ragi	211	25	-186
Moong	2036	8855	6820
Groundnut	12607	18648	6041
Jute	256	0	-256
Maize	219	0	-219
Niger	152	37	-115
Paddy	667876	681075	13199
Arhar	985	0	-985
Sesame	113	0	-113
Sunflower	2	0	-2
TOTAL	687056	718050	30994

Objectives of community seed production

- Establishment of community seed system that will be managed by members of farmers with collaboration of NGOs, Government departments and financial institutions.

- Evaluating sustainable seed system that can provide quality seeds, diversified seeds to all dry-land farmers of the community, before sowing season at affordable prices.
- Facilitation seed system to link up with all collaborating institutions and organisations
- Ensuring quality seed supply by establishing community seed bank.
- Provide training to manage quality crop harvest, grading and processing.
- Conservation and promote traditional varieties of all crops.
- Protect farmer rights on their varieties.
- Encouragement of local nurseries to supply annual and perennial plantations.

Feasibility of community seed production

The feasibility of farm-scale biodiesel production from oilseed crops has been investigated for oilseed-producing regions of the U.S. by Kenkel and Holcomb (2008); Australia by Carter (2006), Kingwell and Plunkett (2006), and Whittington (2006); and Scotland by Booth, Booth, Cook, Ferguson, and Walker (2005).

A community based seed production successfully done by the government of Tanzania with the collaboration of ICRISAT. They were started their programme (project) on the basis of farmers difficulties, particular draught problem and selected some schools and their teachers including head master, and trained by various scientists.

• The program was launched as a pilot scheme 4 years ago, with 50 schools in one district. Today itcovers 250 schools in 8 drought prone districts

Each school supplies approximately 500 kg of high-quality seed to the surrounding community everyyear, at affordable prices. As a result, the area under improved varieties has increased 5–6 fold,pushing the area under improved pearl millet and sorghum varieties in Tanzania from base levels ofaround 5-7% in 1999 to current levels of 29% for pearl millet and 36% for sorghum (Monyo*et al,*2002).The range of crops has expanded. Initially only sorghum and pearl millet seed were multiplied. Todayseed of sorghum, pearl millet, pigeon pea, sesame, groundnut, and maize is being multiplied and sold.The program has been so successful in Tanzania that it is being replicated in Malawi, and theMozambique government has expressed interest.

A checklist for sustainable seed production

1. Purpose i.e. profit or only for self-consumption seed production
2. Selection of varieties
3. Source of foundation seeds or farmers seed
4. Community size (No. of farmers)
5. Seed requirement/ consumption
6. Financial responsibility
7. Utilization of methodologies to minimization of cost of cultivation
8. Distribution

Community based seed bank

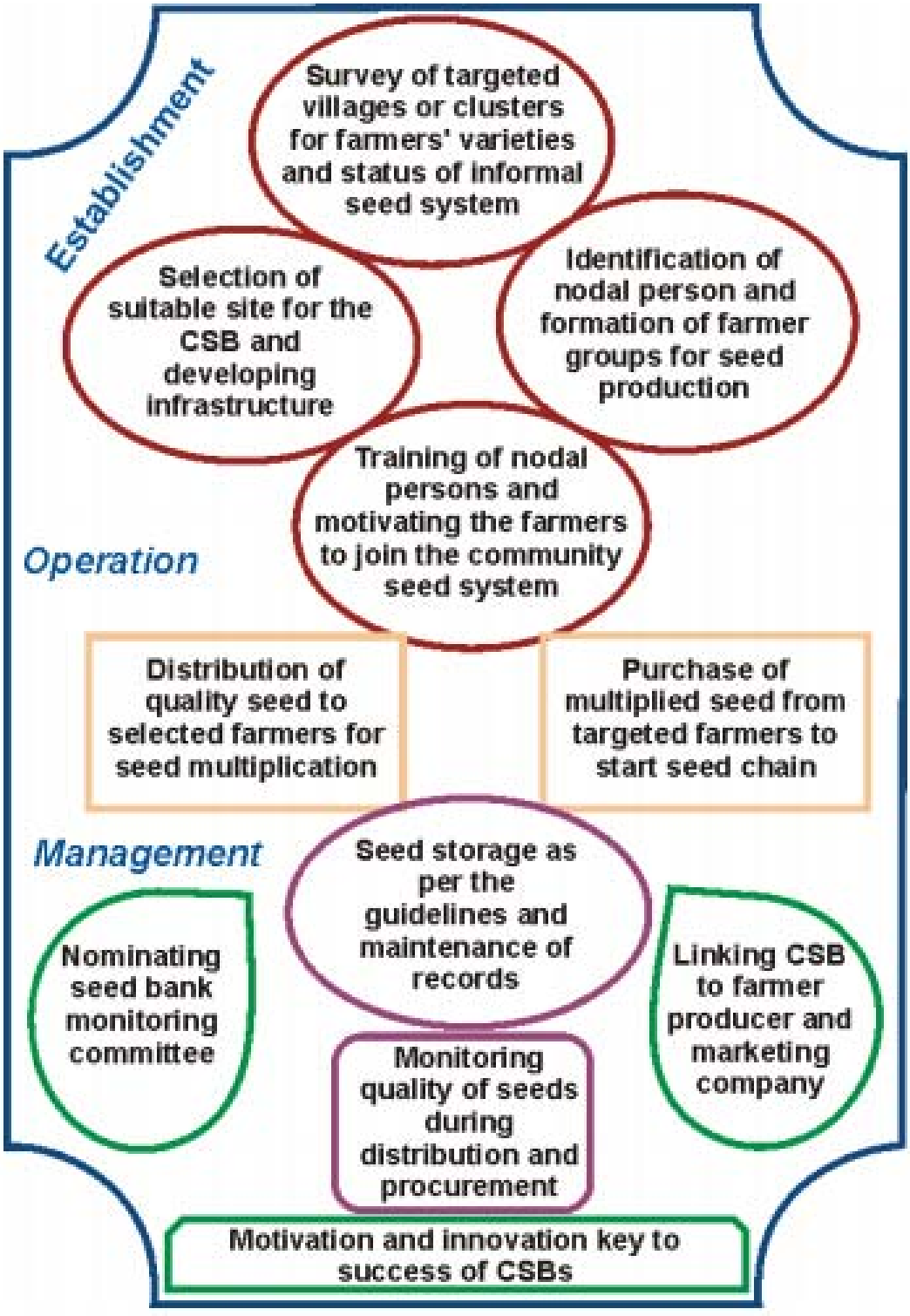
Community Seed Banks fulfils diverse purposes of sustainable agriculture for small and marginalfarmers. These seed banks serve as focal pointin maintaining indigenous

genetic diversity onfarm involving farmer's community. CSBs servelocal farmers to form an informal seeddistribution system prevailing in villages sinceancient time at no or very low cost. Communityparticipation in maintaining local geneticdiversity provides pride to farmers and senseof belonging for local landraces. This system isrun, maintained and promoted by farmers tofacilitate good quality seeds and input.Wherever in the world community seed banksystem is operational farmers are immenselybenefited and local landraces are protected fromextinction. Community seed banks are morebeneficial for small and marginal farmers whoare involved in subsistence agriculture for theirself-sustenance rather than commercialagriculture. These farmers very well understandthe importance and qualities of their Inadracesas they are growing these for centuries for theirhome consumption.

Functions of CBSB

1. Conservation of local varieties including inheritance and rare varieties (food, fodder,
   and medicines, religious uses)
2. Restoration of "lost" varieties (for example, due to natural disasters)
3. Crisis/disaster/shortage responsiveness and insurance
4. Maintain and improve accessibility of seeds at the community level by develop community based seed production (traditional and modern varieties)
5. Offer seeds at low(er) costs (than the commercial sector)
6. Facilitate seed exchanges
7. Help particular groups to obtain seeds
8. Seed multiplication, including of participatory bred varieties
9. Make money through the sales of seeds
10. Share agricultural biodiversity knowledge and expertise
11. Platform for community-based biodiversity management
12. Link in situ and ex situ conservation
13. Preserve diversity and sustainable protection of farmer landraces.
14. To aware about Farmers' Rights.

Establishment of Community Seed Banks



Case study of the green foundation in south India

This was started in 1994 with a handful of women in the small village of Thalli, South India, driven by the aim of empowering small scale and marginal farmers of the country. On 13th February 1996, shortly after beginning, the Genetic Resource, Ecology, Energy and Nutrition (GREEN) Foundation was registered as a public charitable trust and now handful of women farmers has grown in number to include more than 2460 families. There are five aspects to GREEN's work: economic, ecological, political, cultural and **women's empowerment.**

Work of GREEN foundation

1. Conserve local seed diversity, promote an increased dependence on biodiversity-based ecological agriculture.
2. Create a gender-sensitive environment that enhances women's leadership skills.
3. Contribute to livelihoods by creatively marketing "value-added" cultivated and wild agricultural biodiversity.
4. Connect the natural elements i.e. soil, water, air, sunlight, and seed—to ensure an abundance of nutritious food and other basic community needs.
5. Continue to nurture community participation and assist in building robust community institutions.

Conclusion

Seeds have played a fundamental role in the development of civilizations by supplying food,feed, natural products, and traditional medicines.Only seed with assured quality can be expected to better response tomanures and other inputs in expected manner, otherwise seed hope of future may turn into seed of frustration (Sudhir Sen, 1974) in other words we may say that the "**Quality seed is the symbol and foundation of good agriculture"**. So, through the community based seed bank as well as seed production encourage the farmers that they trust in seed quality because they are also involve within this programme directly or indirectly and by conserving the seed they protect the land races which one may utilise for breeding purpose to develop the new high yielding varieties.

Extension Strategy to Address Limited Access of Farm Women to Quality Seed- ICAR-CIWA Experience

Dr. Sabita Mishra
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Agricultural extension services are an important instrument for the provision of information on new technologies and crops (Anderson and Feder, 2003; Evenson, 2001; Doss and Morris, 2001). Women were often over looked by extension agents in their extension programmes and extension services often fail to reach female farmers, in particular female - headed farm households (Doss and Morris, 2001; Quisumbing, 1994; Saito et al., 1994); despite strong preference of female farmers for such services (Saito et al., 1994). Many extension approaches have been tried in India to meet the needs of farm women and farmers. Still gender gap persists in effective delivery of extension services. It is found through DRWA research that the extension needs of both the gender is different in the areas like preference for type of contact, time of contact, place of contact, suitable extension agent, effective group methods, boundary of tour, interval of contact and place of meeting. Therefore, it is required to follow the appropriate extension approaches for TOT among farm women. According to Sadangi, et. al. (2005), the role of grass root change agent is crucial, utmost care may be taken to analyze the factors like socio-cultural environment of women and participation of women in agriculture for the purpose of selecting change agents with appropriate background.

Seed Production for Farm Women, Why?

Women estimated to produce more than 50% of all the food, are responsible for production of most staple foods and help to "feed the world". but, have lack of access over the agriculture inputs like seeds and less opportunity for capacity building programmes. However, women play the major roles in conservation of seeds for the next year without technical knowledge for seed production and its storage. Here, different extension approaches are required to address the issues of farm women in above mentioned activities. Many extension models have been developed for the welfare of the women as follows.

Extension Models Developed in India

- Conventional Extension Model/CD model (CEM)
- Mass media Model (MM)
- Target group/area Model (TM)
- Training and Visit Model (TVM)
- Front line Extension Model (FEM)
- Integrated Extension Model (IEM)
- Training and Extension for women Model (TEM)
- Broad based Extension Model/ ATMA (BEM)
- Public-Private Extension Model/Agri-business Model (PPEM)

But all the models were analyzed and found that none of them has touched or partially touched the women issues to bring gender mainstreaming. Keeping it in view, a gender sensitive extension model was designed and tested.

Action Research at the DRWA, Bhubaneswar (ICAR)

Here, attempt was taken to test a gender sensitive extension model with a focus on involvement of a group of Village level Para Extension Workers (VPEWs) in extension. The model had a broad objective of providing

extension services to gender by ensuring equity and equality, cost effectiveness, sustainability, cost recovery and location-specific needs. Besides this, the model would promote gender mainstreaming in agriculture and provide wider scope to extension agencies for adoption.

Philosophy and Broad objective of the model:

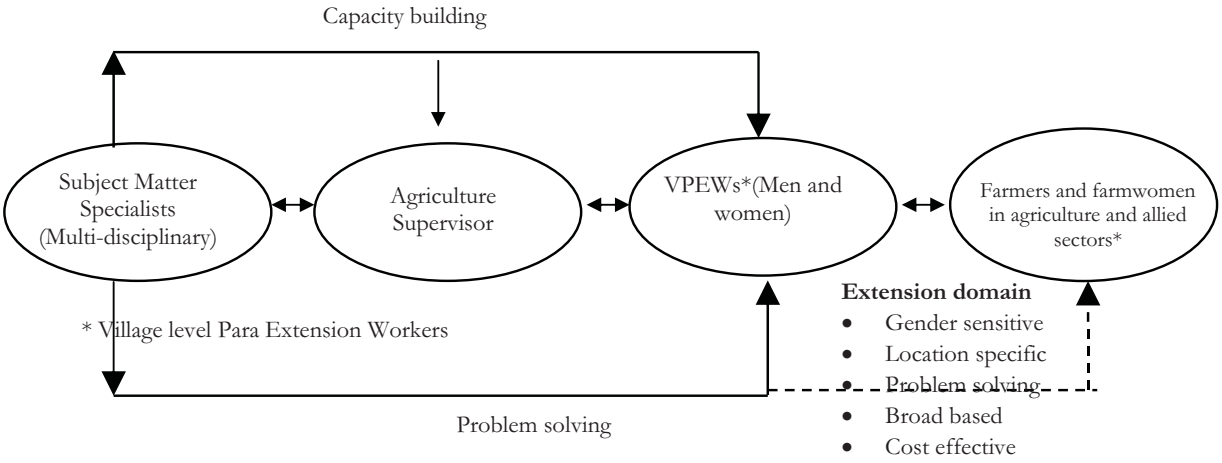
(i) Developing young leaders in farming at village level

(ii) Enabling young leaders to provide gender sensitive and location specific extension services

(iii) Promoting gender mainstreaming in agriculture

(iv) Providing wider scope to extension agencies for adoption

Developed Logistic Extension Model



Key Positions in the Model: Given below a detailed description of the structural and functional aspects of the model for the use of practitioners.

1. **Village-level Para-Extension Worker (VPEW):** Village level Para Extension Workers (VPEWs) comprising of one man and one woman would be selected for a standard village consisting of about 200 farm households. Selection of workers would be based on parameters viz., academic qualification, farming background, social participation and outside contact. The village community is to contact to verify the motives and antecedents of the individuals. The VPEWs get monthly honourarium from the implementing agency.

2. **Agriculture Supervisor:** A group of VPEWs would work under a qualified agriculture graduate/post graduate who is stationed at block/panchayat headquarters in the department of agriculture. It is estimated that a Supervisor can effectively supervise 25 to 30 VPEWs covering 12 to 15 standard villages. The Supervisor is primarily responsible for effective capacity building of the VPEWs. He is entrusted to conduct trainings and undertake following activities.

(i) **Bench mark survey:** A brief interview schedule may be developed for bench mark survey to record the responses of men and women on identified parameters. Survey should be taken up before launching of the model to get an overall view of agriculture and technology dissemination.

(ii) **Monitoring the activities of VPEWs:** A set of parameter is employed for each VPEW to play in the field as: writing of weekly diary, avg. number of farmers contacted per week in the preceding month, avg. number of farm women contacted per week in the preceding month, avg. No. of field visits per week in the preceding month, avg. No. of problem identified in the preceding month, avg. No. of demonstration conducted in the preceding month, avg. No. of other related agencies contacted in the preceding month, avg. No. of consultation made with scientists for capacity building in the preceding month and avg. No. of exposure to agriculture information - leaflet, newspaper, etc. in the preceding month.

(iii) **Diagnostic visit:** Diagnostic visits by SMS and supervisor are conducted to provide solutions to the unsolved farm problems through SMS-farmers interactions. They are to organize field studies to assess the impact of the technologies on gender and the constraints in technology dissemination among farmwomen.

(iii) **Programme review meeting:** Programme review meetings need to be held at six monthly intervals wherein the VPEWs can attend the meeting to assess the achievements of the last six months and develop a plan for the coming six months.

(iv) **Monitoring and evaluation of pre-seasonal trainings:** The supervisor develops a participatory pre-seasonal training programme with VPEW based on the location specific needs of farmers and farmwomen in his/her cluster. All the sessions are to develop the skill among VPEWs to address the needs and problems of the village.

(v) **Monitoring gender sensitivity of the programme:** Here, care is taken to select and disseminate the gender sensitive technology through comparisons between men and women in different aspects such as participation, employment, monetary and non-monetary benefits and other behavioural changes.

(vi) **Performance evaluation and counseling of VPEWs:** After two years of implementation of the model an exercise to measure the change in capacity of VPEWs is taken up by the judges.

(vii) **Helping the VPEWs to coordinate:** The supervisor prepares a list of stakeholders in the locality for agriculture development. Accordingly a plan is drawn up by the VPEW to implement the programmes under the model.

(viii) **Concurrent evaluation:** A concurrent evaluation is taken up after completion of two and half years of the project. The supervisor, SMS and VPEW must jointly evaluate the outcome of the model.

Capacity building of the supervisors: As the Agriculture Supervisors are responsible for management of extension in the village, they need fundamentals on gender analysis, survey, village farm plan development, monitoring, evaluation, case study writing, conflict management, team building, coordination and marketing.

Subject Matter Specialists: Specialist not only from crop science but also from horticulture, fisheries and animal husbandry would be involved in the model to impart pre-seasonal trainings for VPEWs as well as for the capacity building of agriculture supervisors. These specialists can strengthen the model very well in the way of incorporating benchmark survey, gender analysis, technological need analysis, organizing village communities, self-help groups and farm schools, participatory extension, monitoring, coordination, concurrent evaluation, case studies and success stories.

References:

1. Anderson, Jock, and Gershon Feder. 2003. "Rural Extension Services." World Bank Policy Research Working Paper 2976.

2. Doss, Cheryl, and Michael Morris. 2001. "How Does Gender Affect the Adoption of Agricultural Technologies? The Case of Improved Maize Technology in Ghana". Agricultural Economics 25:27 – 39.

3. Evenson, Robert. 2001. "Economic Impacts of Agricultural Research and Extension". In *Handbook of Agricultural Economics*, *Vol. 1,* ed. Bruce Gardner and Gordon Rausser, 573 – 628. Elsevier.

4. Quisumbing, Agnes. 1994. "Improving Women's Agricultural Productivity as Farmers and Workers." The World Bank, ESP Discussion Paper 37.

5. Saito, Katrine, Hailu Mekonnen, and Daphne Spurling. 1994. "Raising the Productivity of Women Farmers in Sub – Saharan Africa". World Bank Discussion Paper 230.

6. Sadangi, B. N., et. al. 2007-10. Final project report on Designing gender sensitive extension model and testing its efficacy, DRWA, Bhubaneswar,Odisha, p.24.

****

Fish Seed Production in Community Ponds

Tanuja. S
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

Introduction

The consumption of fish worldwide is on the rise due to the increasing awareness on the health benefits from eating fish than red meat. The global fish production touched 156.2 million tonnes in 2011. Fish is an important source of quality protein and cheaper in cost compared to other source of animal protein. About 35% of Indian population is fish eaters and the per capita consumption is 9.8 kg whereas the recommended intake is 13 kg. India with its fishery resources of 8129km of coast line, 1.97 lakh km of rivers and canals, 3.15 million ha of reservoirs, 2.35 million ha of ponds and tanks, 1.3 million ha of oxbow lakes and derelict waters, 1.24 million ha of brackish waters and 0.29 million ha of estuaries stands 5rd in global fish production and 2nd in global aquaculture production, next only to China. Fishery sector offers employment to around 14 million people in the country either directly of indirectly. The present fish production in India is around 6.4 million tonnes. In this 3.4 and 3.0 million tonnes are contributed by inland sector and marine sector respectively.

Seed production in aquacultured fishes

The production of marketable fish begins with the stocking of fry or juveniles into a rearing environment that assures optimum and rapid growth to allow harvest in the shortest possible time. The fish farmer has to obtain adequate number of fish seed to meet his production goals. These fish can come from wild capture. However, there is little or no guarantee that adequate numbers can be captured and stocked in the time corresponding to optimum production conditions. For certain farmed fish, it is not yet possible to understand and control all the stages of reproduction, and farmers depend on natural supply. In most cases, these fish are brackish water species and their biological cycle includes migrations into a different environment, either moving to the sea, or into fresh water. In general, fish can only be reproduced on the farm if conditions that correspond to natural spawning can be closely approximated.

The technological breakthrough in induced breeding of carps through hypophysation in 1957 revolutionalized freshwater aquaculture of the country. With the ready availability of hormone formulations, the production of carp seed through induced breeding led to a tremendous fillip and subsequently, riverine seed collection and bundh breeding became obsolete. Breeding and culture technologies for other species such as catfish, murrels and prawns has also been addressed along with that of carps. Carp hatcheries, in both the public and private sectors, have contributed towards the increase in seed production from 16 589 million fry in 1999–2000 to over 21 000 million fry at present.

Due to their unique taste, catfishes are considered a delicacy for fish consumers. For diversification of culture species, the Government of India has identified catfish farming as a national priority. Amongst the catfishes, *Clarias batrachus*, known as magur is the most preferred indigenous catfish in India. Its breeding and grow-out farming techniques has been standardized at the Central Institute of Freshwater Aquaculture (CIFA), Bhubaneshwar. The fish is currently propagated on a large scale along the north-eastern regions, mainly the State of Assam. Of late, Government of India has permitted culture of pangassius and tilapia species laying down strict guidelines as an alternative crop to carp fishes. In addition to carp fish varieties, successful breeding and larval rearing of the giant river prawn (*Macrobrachium*

rosenbergii) and the monsoon river prawn (*M. malcolmsonii*) provided scope for the farmers to diversify their culture practices. Successful commercial production of scampi seed began in 1999 based on techniques developed by research at the College of Fisheries in Kochi during the early 1990s. There are 71 scampi hatcheries in India including 43 in Andhra Pradesh with an installed production capacity of about 8 billion post larvae/year.

Scientific brackish water aquaculture in India has been initiated only in early 1990s. The importance and role of shrimp farming in India's economy was realized in the early seventies. Shrimp seed production studies were initiated in Narakkal, near Kochi, in Kerala, by the Central Marine Fisheries Research Institute of ICAR. Large-scale development of shrimp farming took place only after 1988–1989 with the establishment of the commercial shrimp hatcheries by the Marine Products Export Development Authority (MPEDA). In the late 1980s, MPEDA established the Andhra Pradesh Shrimp Seed Production Supply and Research Centre (TASPARC) based in Andhra Pradesh and Orissa Shrimp Seed Production Supply and Research Centre (OSPARC) based in Orissa which provided assistance and paved the way for the establishment of a number of private hatcheries. At present, there are around 351 shrimp hatcheries in the country with a total production capacity of 14 billion PL20/year (Handbook of Fisheries and Aquaculture, 2013) meeting the seed requirement of the brackish water shrimp farming sector.

Among finfishes, technologies for breeding and seed production has been developed for barramundi, (*Lates calcarifer*) along with farming demonstrations. CMFRI met success in controlled breeding and spat production of the Japanese pearl oyster (*Pinctada fucata*) in 1981 and the blacklip pearl oyster (*P. margaritifera*) in 1984. Intensive research on various aspects of the culture of the Indian backwater oyster (*Crassostrea madrasensis*) has been made and the technology has also been developed for the hatchery production of seed. Success has been achieved in the broodstock development and spawning of greasy grouper, *Epinephelus tauvina, Lates calcarifer* and *M.cephalus*. Out of three, larval rearing technology of *Lates calcarifer* has been commercialized.

Method of induced breeding by hypophysation

The technique of breeding the fish by administering pituitary gland extract injection is known as induced breeding or hypophysation. The pituitary gland secretes several hormones of which Gonadotropin is the most important for breeding. The increasing demand of fish pituitaries have now been solved to some extent by the introduction of HCG, now readily available in the market. A mixture of HCG and pituitary hormone extract in definite proportion are employed successfully for breeding fish.

Rural Carp seed production

Carp seed production using technologies adapted to locally available and limited resources of households. Rural carp seed production is not very capital intensive or input intensive and contributes to the income of rural livelihoods. Fish seed production includes egg to spawn production for 3 days, spawn to fry nursing for 15-20 days, fry to fingerling rearing for 60-90 days and fingerling to yearling rearing for 8-9 months. Thus the carp seed may be categorised at its final size into spawn (6-8 mm size), fry (20-25 mm size), fingerlings (100-150 mm size) and yearlings (100-200 g weight). Pond breeding, Hapa breeding or hatchery breeding are the methods followed by rural farmers for production carp fish seed.

Spawn production

In pond breeding, brood fish are reared in composite fish culture ponds. For common carps, clean aquatic weeds such as **Hydrilla / Najas** or water hyacinth are placed in pond's corners or inside floating bamboo frames in the evening hours for the deposition of eggs. In Hapa breeding, during monsoon season brood fishes are netted out from ponds and fully mature males and females are selected. Breeding hapas are fixed in composite fish culture ponds. Generally for one female two males are used. Intra-muscular and/or intra-peritorial injection is administered to brood fish during June-October.

Spawning starts after 4-6 hours of injection. Fertilised eggs are identified. Spawn are collected after 72-80 hours of hatching by filtering.

For hatchery breeding, brood stocks are maintained in separate ponds by stocking 1-3t/ha brood fish under scientific management. Brood fishes are injected with inducing hormones as mentioned in hapa breeding. Two-three year old carps weighing 2-5 kg are the best for hypophysation. "Eco-hatchery" is used by the village entrepreneurs. It includes overhead tank, spawning pools, egg collection chamber, incubation pools and spawn collection chamber

Central Institute of Fresh water Aquaculture (CIFA)A has designed and fabricated portable FRP carp hatchery in 1989 which is being used by the village entrepreneurs to produce carp spawn. From hatchery breeding farmers get 80-95 per cent recovery from the viable eggs.

Carp fry and fingerling rearing in rural areas

In rural areas, spawn to fry nursing is carried out in smaller ponds of 0.02-0.05 ha (0.5-1.0m depth). Fry, fingerling and/or yearlings can be reared in succession in perennial ponds during June-July, August-November and December-June respectively. For rearing larger size carp fingerlings, 0.05-0.1 ha with an average depth of 1.0-2.0m are preferred. In case ponds are used for fry rearing, fry are harvested by repeated netting on day 15-20 of stocking.

Large sized fingerling and yearling production

Yearlings are produced traditionally in village ponds. The surplus fingerlings which the farmers couldn't sell will remain in their ponds to become yearlings. Before monsoon, when ponds are prepared for next fry rearing crops, these yearlings can be sold out for grow out culture. When these stunted fingerlings are kept on a high quality diet they grow rapidly leading efficient body weight.

Role of Directorate of Research on Women in Agriculture (DRWA) in gender mainstreaming through technologies in aquaculture seed production.

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 rural women through different aquaculture technologies. The aquaculture technologies like fry production, composite fish culture, integrated fish farming and ornamental fish culture have been studied in women perspective. Rural women have also been trained in induced breeding of carps, nursery raising, hapa 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. To create more interest they were taken for field visits to CIFA,

Bhubaneswar. 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 suitable for 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)

****

Understanding Gender Perspective in Agricultural Research and Development

Dr. H. K. Dash
ICAR- Central Institute for Women in Agriculture, Bhubaneswar

I. Introduction

Gender has, now-a-days, become an area of immense interest in agriculture and rural development. The term 'gender' was first used by Ann Oakley and others in 1970s to describe the characteristics of men and women which are socially determined in contrast to biological differences. Gender means the socially constructed differences in roles and responsibilities assigned to women and men in a given culture or location.

The distinction between sex and gender is made to emphasize that everything women and men do, and everything expected of them, with the exception of their sexually distinct functions(childbearing and breast feeding; impregnation) can change, and does change, over time and according to changing and varied social and cultural factors. As culture is dynamic and socio-economic conditions change over time, so also gender patterns. Thus gender is a dynamic concept (Williams, 1999).

II. Women Vs Gender

Many often wonder- Why 'gender'? Why not 'women'? In fact shifting of focus from women to gender reflects the changed approach of world community for addressing problems of women. The term 'women in development' (WID) was coined in the early 1970s by the Women's Committee of the Washington DC, Chapter of the society for International development, a network of female development professionals. The term was adopted by the United States Agency for International Development (USAID), and gave rise to what is known as 'Women in Development (WID)' approach. The underlying rationale of WID approach is that women are an untapped resource who could contribute to economic development. Therefore, development outcomes would be better realized if women were fully incorporated into the development process. It focuses mainly on women in isolation, and advocates measures such as access to credit and employment for integrating women into development process. But WID approach by focusing on women in isolation ignored the real problem, i.e. subordination of women to men, which is manifested in unequal gender relations.

There emerged another school of thought, which, after recognizing such limitations of WID approach, drew attention to the concept of gender and propounded 'Gender and Development' (GAD) approach. This approach focuses on gender rather than women. In other words, it look not only at women as a category, but also at women in relation to men, and the way relations between men and women are socially constructed (Moser, 1999).

To explain the term 'gender' further, it is a neutral term meaning either men or women or both in a particular context. For example, in men dominated society, gender issues would mean mostly the issues concerning women as it can be fairly assumed that men in general are better off socially as compared to the women. Similarly, in women dominated system, gender issues should focus on problems faced by men. Our goal is to improve the status of disadvantaged class and get rid of socially created and approved discriminations. Therefore, while discussing gender issues in particular context focus could either be on men or women or both. Obviously, reference has to be made to the relative gender position in the society or system or domain in question in order to assess and appreciate the situation from gender perspective.

III. Gender- some connotations

The word 'gender' carries different connotations. First, it is a concept that describes the socially constructed roles played by men and women. This concept has given rise to several other concepts and terminologies that are of socio-economic relevance. Importantly, these concepts are having significance for planning research, development and policy interventions.

Second, gender is an important subject of Research & Development. During past years, there has been a spurt in gender related activities in areas like research, development and documentation. This has contributed to a wealth of literature, including volumes of gender disaggregated data, tools for analysis and framework for planning and implementation of research and development activities with gender perspective. After all, as a subject it has not only found space within many other disciplines, but also has given rise to new universe of study encompassing different disciplines. For example, within disciplines like agriculture, horticulture, fishery, livestock production and management, the subject of gender is gradually taking shape and gaining importance. Similarly gender as a subject can also encompass other disciplines into its fold for a comprehensive understanding of the situation. However, till today the subject has remained largely unexplored and is still evolving.

As a subject it has the blend of sweetness and sourness. Sweetness; because it is an interesting as well as exciting subject for many, particularly those in the field of social science. But it may be somewhat sour and confusing for many particularly those are from commodity research background. At the same time, it is a challenging area especially when we are looking at gender in the context of technology generation and refinement for creating gender friendly technologies. Notwithstanding the challenges in applying the idea, it has become one of most sought-after subjects in research and development.

Third, gender is a factor in R &D process. It is a factor because men and women are primary stakeholders in development process. It is the quantity and quality of their labour and human resource that determine the outcome of development process. It is precisely in this context that researchers have tried to investigate if 'gender' (man or woman) as a factor has any influence on output or outcome. In this case we treat gender as a variable in nominal scale that takes values either 0 (say for man) or 1 (for woman) for doing the analysis. Lessons from such exercises may imply how the presence of men or women affects the outcome of interventions and what are the specific attributes that might have resulted in differential output or outcomes.

IV. Gender and Agricultural R &D

In past many of the developments in gender related knowledge were sociological in nature. Of late, gender concepts have found increasing attention and application in applied areas such as agriculture, livestock, fishery, rural development and livelihood security etc. There are two ways that we can look at gender in the context of agriculture R & D. First, effects of R & D process on gender and second, gender role in R & D process.

A. How R & D process affects men and women?

This is an important approach to study relationship between gender and R&D processes. A very common area of research in this context is gender impact analysis of agricultural research and development. For example, how the structural, technological and institutional changes have affected men and women from different background in different situations in matters like sharing of benefits, work burden, changes in gender role, access to resources etc. and reasons thereof. How the much

talked triple role of women i.e. reproductive, productive and community roles have been affected by the developments. Such studies are quite useful as the findings can be used in revision of the programmes and policies to create wider and equitable gender impact.

B. How gender affects agricultural R & D process?

The focus here is on gender as a factor in R&D process. This approach to study the relationship between gender and R & D considers both similarities and differences between men and women. Similarities, because both men and women are important stakeholders in R&D process, and differences, because men and women have different roles to play and needs to address. At the same time they have attributes that can differentially influence R&D process. The objective is to see how men and women do participate in R & D process and influence the outcomes. How they differ in their perception about R & D processes and in managing the situation. In other words, we have to characterize the situations to explain the level and diversity of gender participation. What should we do to make men and women more effective?

In this approach we can focus on case studies, evaluation studies like performance of men and women managed systems and enterprises. Some useful theme areas could also be gender role, participation and contribution in agriculture and allied sectors, and their dynamics under varying situations to understand gender implications in research and development. Outputs from such studies would be useful to design interventions for strengthening gender role in agricultural development and develop gender based R&D models.

V. Gender perspective in development

In development context, there are two critical issues that a development manager should worry about; smooth implementation of programme as per plan, and attainment of envisaged objectives leading to desired outcomes. Adding gender perspective to an intervention would, therefore, mean looking at these two different aspects through gender lens. First, what is gender role in implementation of interventions? Is there any scope for strengthening gender role in carrying out the intervention? Secondly, how would the development intervention affect men and women? Would there be gender equity in sharing of benefits of intervention, or would there be differential incidence of adverse consequences on gender?

Even though the two aspects appear completely different, at certain level, one reinforces the other. For example, adding gender perspective in management of intervention may lead to better outcomes in terms of gender equity in sharing of benefits. Similarly, equitable gender impact may motivate men and women to participate in development process.

In recent years there has been a greater emphasis on people's participation in planning and implementation of development interventions. Since the impact of these interventions ultimately reflects upon the living conditions of people, following the same traditional approach of project planning and implementation without understanding gender implications thereof may exclude women from benefit sharing process. In situations, it may even make women worse off in normal course of development. Therefore, a development manager should be careful not to lose sight of gender perspective before implementation of the intervention in order to reap additional dividends in terms of enhanced output, and gender equity.

Government policies are important instruments to influence the development process. In fact policies are aimed at creating a favorable environment for accelerated development. For creating wider and equitable impact, policies should contain

adequate provisions to encourage women's participation. In other words, policies should be gender sensitive.

Incorporating gender perspective in development necessitates two simultaneous activities; (a) making development institutions gender sensitive, (b) enabling development managers and planners understand and apply gender perspective in respective areas.

To make the organizations gender sensitive, there is a need for re-orientation on following lines.

- Adding gender dimension in development approach
- Making an explicit mention of gender in mandates, objectives and policy documents of departments
- Recognizing women as a stakeholder in organization's programmes
- Providing for opportunities to encourage women's participation

Besides the above, there is also an urgency to introduce reforms both in structure and functioning of the organizations to impart gender sensitivity. No doubt, we have, in India, a host of central sponsored women specific programmes being implemented by agriculture departments of state government. However, review of policy documents, thrust areas and mandates of agriculture departments of state governments suggests that very few states have made explicit mention of gender.

The second part, i.e. enabling development managers understand gender perspective, involves orientation and capacity building on gender. In other words, they should not only be gender sensitized, but also fairy educated on the subject.

VI. Gender in the context of research

There are two points that are worth mentioning in the context of research.1) Is there any need to incorporate gender perspective in research; If so, how? 2) Does gender as a factor influence the research output?"

Technology development

It is generally argued that the process of technological development in agriculture has largely bypassed the needs of women. As a result, many of the technologies developed so far are said to have failed the test of gender suitability as evidenced from very low level of adoption by women and gender inequity in sharing of benefits of such technologies. This suggests that technologies, in order to create desirable impact on agriculture and rural households, must also be accepted and adopted by women, who constitute a significant part of workforce in agriculture. The level of acceptability and adoption of a technology would be high if natural demand of that technology is high. When we talk of natural demand of a technology, it means the technology must have the characteristics to meet different gender needs in the said context. This is only possible if a researcher adds gender perspective into the technology development process considering relevant gender needs. Therefore, incorporating gender perspective in technology development process is an essential condition, if not a sufficient condition, to develop gender friendly technologies for meeting gender needs and preferences that would ultimately push up the adoption level.

With increasing complexities of socio-economic environment, social science research has now-a- days assumed greater significance. Moreover, poor adoption of agro-technologies among clientele and not-so-encouraging performance of technologies in the field have led us to realize the importance of socio-economic inputs not only in technology development and refinement process but also in planning and implementation of technology transfer programmes. Policy research is another area that have gained significance at a time when there is need for gender

sensitive polices for mainstreaming gender concerns in agriculture and creating equitable gender impact.

Why Gender for a researcher?

There seems to be an initial reluctance on part of researchers in general to accept the concept of gender. Also, they do not find the concept comfortable to work with. It is but natural for them to ask, 'why to add gender perspective in research'?

As we know, all researchers invariably look for certain output from their research. But all may not be fully convinced as to how the output would be useful. Except in case of basic researches, outputs from all other types of researches have implications for development, and could be used for designing, planning and implementation of programmes. Outputs could be new information and knowledge, technology, methodology and even policy recommendations. Therefore, every scientist should see that the outputs from her/his research should be relevant, acceptable to, and used by the stakeholders.

The very objective of adding gender perspective in our research is 'to add value to our research output so that research output becomes contextually more relevant and appropriate, and there is enhanced scope for application and acceptability of research findings'.

As men and women are equal partners in development process and have equal stakes in the use of technology, there is a need for adding gender perspective in our research to obtain gender friendly technologies. Research with gender perspective would also generate information of value and new knowledge that can be used in planning gender based research programmes. To realize this, there has to be a change in the mindset and actions of researchers. In other words, the scientists should be gender sensitive, and responsive enough to discuss, debate, understand and incorporate gender in their own field of work.

Summing up

Understanding and applying gender perspective in agricultural R & D is very important in the present context of social, cultural, technological and economic changes that we are facing. Such a paradigm shift is needed to obtain crucial gender related information and knowledge based on which measures for mainstreaming gender concerns in agriculture can be initiated.

References

Suzanne, W., Janet, S. and Adelina, M. 1994. The Oxfam gender training manual.

Caroline, O. N. M. 1993. Gender planning and development-Theory, practice and training.

LIST OF PARTICIPANTS

Sl. No.	Name of Participant	Designation & Address	Mobile	E-mail
1)	Dr. Nita Chanda	Assistant Director of Agriculture (Farm Superintendent), Rice Research Station, Chinsurah, Hoogly	09433091582	nitachanda8@gmail.com
2)	Dr. Anita Roy Choudhury	Assistant Director of Agriculture (Seed), Burdwan	09434468563	jtdabdn@gmail.com
3)	Mrs. Basabdatta Banerjee	Assistant Director of Agriculture (Soil & Fertilizer), Burdwan	09434426663	jtdabdn@gmail.com
4)	Miss U. K. Chandrika	AHO Tarava, Sonepur	09853900261	coolupali@gmail.com
5)	Smt. Kenpi Lollen Padu	Agriculture Development Officer, Pangin, Siang, Arunachal Pradesh	08414978729	kenpipadu@gmail.com
6)	Smt. Aruna Manchey	Agriculture Development Officer, Namsai, Arunachal Pradesh	08413925809	arunamanchey72@gmail.com
7)	Smt. Shubhanjana	Sub-division Agriculture Extension Officer, Lucknow, Uttar Pradesh	09451063198	jaanvi3440@gmail.com
8)	Smt. Sangeeta Katiyar	Sub-division Agriculture Extension Officer, Lucknow, Uttar Pradesh	09295209449	sangeetakatiyar76@gmail.com
9)	Mr. R. L. Bhariya	Senior Agriculture Development Officer, Surajpur, Chhattisgarh	09406092303	premnagrsado2016@gmail.com
10)	Mr. Dilip Kumar Bhagat	Senior Agriculture Development Officer (FM), Jashpur, Chhattisgarh	09425598513	bhagatdk042@gmail.com
11)	Mr. Harish Kumar	Agriculture Development Officer, Mandi, Himachal Pradesh	07807171211	harishsaini8000@yahoo.com
12)	Mr. Baldev Chand Prashar	Agriculture Development Officer, Mandi, Himachal Pradesh	09418062576	prashar.baldev@gmail.com

13)	Smt. KPBS Madhavi Latha Devi	ADA (F) Bapatla, Guntur	09440899076	trk.vet@gmail.com
14)	Mr. Abhay Kumar Singh	Plant Protection Inspector, Patna, Bihar	09431081564	aksingh2373@gmail.com
15)	Mr. Ram Dayal Singh	Plant Protection Supervisor, Patna, Bihar	09939391885	ramdayalsingh85@yahoo.com
16)	Smt. Anita Majumder	Agriculture Officer, Gomati, Tripura	09436594242	anianitamajumder@gmail.com
17)	Smt. Gopa Rani Pal	Agri Sector Officer, Sephaijala, Tripura	09436927427	goparani96@gmail.com
18)	Miss Anwisha Mishra	ADA-II, DA&FP, Bhubaneswar, Odisha	08895586005	anwishamishra@gmail.com
19)	Miss Sudeshna Parida	Assistant Agriculture Officer, SORO-II, Balasore, Odisha	09437727818	Sudeshnaparida1989@gmail.com
20)	Mr. Chakradhar Patra	Ph.D. Research Scholar, OUAT, Bhubaneswar	09437469190	chakradhar.agri@gmail.com
21)	Mr. R. G. Jivtode	Senior Agriculture Development Officer, Sausar, Chhindwada, Madhya Pradesh	08718046341	ddagrichi@mp.gov.in

ICAR- Central Institute for Women in Agriculture
(ISO 9001-2008 CERTIFIED)
(Indian Council of Agricultural Research)
Plot No.50-51, Mouza-Jokalandi
Post-Baramunda, Bhubaneswar 751 003, Odisha, INDIA
Phone : 0674-2386220; Fax : 0674-2386242
E-mail : director.ciwa@icar.gov.in
Web : http://www.icar-ciwa.org.in