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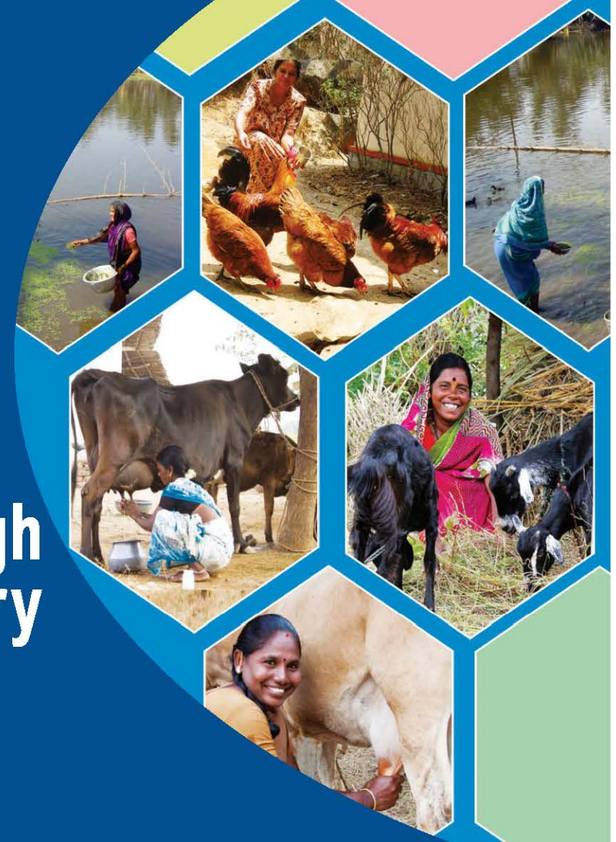
COMPENDIUM

# ICAR Sponsored Short Course on

# Empowering Farm WomenThrough Livestock and Poultry Intervention

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ICAR-CENTRAL INSTITUTE FOR WOMEN IN AGRICULTURE, BHUBANESWAR
(ISO 9001:2008 Certified)

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# ICAR SPONSORED SHORT COURSE
# ON

## EMPOWERING FARMWOMEN THROUGH LIVESTOCK AND POULTRY INTERVENTION

(21-30 NOVEMBER, 2016)

Dr. Jatinder Kishtwaria
Director

**Course Team**

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**Empowering Farm Women through Livestock and Poultry Intervention**

(Compendium: ICAR Sponsored Short Course on "Empowering Farmwomen Through Livestock and Poultry Intervention'', organized at ICAR-CIWA, Bhubaneswar during 21-30 November, 2016)



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## FOREWORD

India is home to the fourth largest agriculture sector in the world with an estimated 180 million hectares of farmland. In India, traditional agriculture is still dominant as many farmers depend on livestock in crop production, for manure as fertilizers, and the use animal powered ploughs. According to 2011 statistics, the average farm in India is about 1.5 acres, minuscule when compared the average of 50 hectares in France and or 178 hectares in United States and 273 hectares in Canada. In rural India, the percentage of women who depend on agriculture for their livelihood is as high as 84%. Women make up about 33% of cultivators and about 47% percent of agricultural labourers. India still faces a big challenge in job creation and maintenance of food security and women's role in farming is still inadequately acknowledged. It is estimated that 78% of India's economically active women are involved in agriculture. Women have been actively involved in operations relating to crop and animal production as well as in post-harvest processing and marketing. Livestock sector is an integral component of Indian agriculture where, livestock production is largely in the hands of women. Most of the animal farming activities such as fodder collection, feeding, watering, and health care, management, milking and household-level processing, value addition and marketing are performed by women. Rural poultry sector contributes nearly 21% of the national egg production in India and is the most neglected one. Poultry production in rural/backyard areas is one promising strategy to enhance the nutritional and economic conditions of population in these areas and women empowerment. Gender equality and women's empowerment are important for achieving sustainable development. Ensuring quality participation and empowerment of women in livestock and poultry production is need of the hour for sustainable development in food production for poverty alleviation, food security and promotion of gender equality. I appreciate the efforts of the course team for organising the short course on "Empowerment of Farm Women through Livestock and Poultry Interventions" at ICAR-CIWA, Bhubaneswar from 21-30 November, 2016 and also brining out this compendium which will be useful for agricultural R & D stakeholders.

Jatinder Kishtwaria
Director

## PREFACE

Agriculture remains a critical component of India's economy and it accounts for 17% of GDP. Women have been contributing significantly to agricultural growth and development through their involvement in crop production, horticulture, animal husbandry, fisheries, natural resource management etc. Globally, women constitute about 42% of economically active population in agriculture. The contribution of Livestock and Poultry to India's GDP is 3.88%. The livestock and poultry sector plays a vital role for livelihood improvement of rural people and women play an important role in it. Women are vital to food security and family well being and their need for labour saving and income generating technologies are acute. The expanding market for livestock products also offers an opportunity for augmenting their income to those who do not have access to land and capital resources. Ensuring quality participation and empowerment of women in livestock and poultry production is need of the hour for sustainable development in food production for poverty alleviation, food security and promotion of gender equality. While at global level, there has been a lot of concern and action on empowerment of women in agriculture, efforts in India has been slow on this front. Against this backdrop, the Short Course "Empowerment of Farm Women through Livestock and Poultry Interventions" was organized to orient the participants on different gender issues in agriculture, especially on livestock and poultry sector, to improve the professional competence and upgrade the knowledge of participants in livestock and poultry development and to enable them understand and integrate gender perspective in their research and extension project. The course was designed keeping in view the requirements of the participants with different backgrounds which includes gender issues in Livestock and Poultry Sector, Food and nutritional security through Animal Agriculture, Livelihood improvement of farmwomen through livestock farming, Women empowerment and livelihood security through small ruminant production, Extension strategies for socio economic empowerment of women through livestock farming, Family Poultry for poverty alleviation and gender equity in India, Drudgery and ergonomics in animal farming : Implications for women; Entrepreneurship development through livestock and poultry farming. We hope, the compendium will be useful for researchers and extension professionals working in ICAR Institutes/ SAUs / KVKs and in Agriculture colleges from other universities including agricultural R&D stakeholders.

The financial support provided by the Indian Council of Agricultural Research (ICAR), New Delhi in organizing the short course is sincerely acknowledged. We are grateful to Dr. Jatinder Kishtwaria, Director, ICAR-CIWA for her guidance and support in organizing the short course.

**Course Team**

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# Role of ICAR-CIWA in Addressing Gender Issue in Agriculture

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Higher and sustainable agricultural growth is essential for eradication of poverty, hunger and undernourishment. But agriculture is underperforming in many developing countries and one of the reasons being poor access of women to resources and opportunities needed to make the most productive use of their time. Although women have entered the labour force in large numbers across much of the developing world in the past quarter century, this increased participation has not translated into equal employment opportunities or equal earnings of men and women. Globally, about 42% of economically active women are engaged in agriculture and they comprise about 43% of total work force in agriculture. In developing countries, 52.7% of women workers are in agriculture. In India, a high proportion of economically active women are engaged in agriculture. In 2001, about 72% of women workers were engaged in agriculture as cultivators and agricultural labourers. But after a decade in 2011, about 65% of such women workers and about half of total men workers are engaged in agriculture as cultivators and agricultural labourers. With more men migrating to non-farm sector, the share of women in total agricultural work force may increase in the coming days. In this context human Resource development and management is critical for realizing the potentials of agriculture and our progress would depend largely on the attitude and capacity of the rural women to more effectively participate in and contribute to agriculture. No doubt, during the past three decades efforts have been made in research on women in agriculture. But today there is a necessity for more focused and context specific research in a coordinated way to tackle the prevailing as well as emerging problems.

## Genesis and Progress of ICAR-CIWA

Realizing that the importance of women in agriculture on one hand and dearth of gender related information and technologies on the other, the Working Group on Agricultural Research and Education constituted by the Planning Commission for the formulation of the Eighth Five Year Plan (1992-97) recommended establishment of National Research Centre for Women in Agriculture (NRCWA) to undertake research relevant to the needs of farm women in agriculture and home management. It also focuses on research for generation of jobs involving flexibility in time, duration and place of work for women. Accordingly, the ICAR established the NRCWA in 1996 at Bhubaneswar, Odisha. The Centre was subsequently upgraded as Directorate of Research on Women in Agriculture (DRWA) in 2008 and as Central institute for Women in Agriculture (CIWA) in 2015. The operational and administrative control of All India Coordinated Research Project on Home Science is vested with it. This unique institution is expected to catalyze and facilitate R&D institutions to bring in farm women perspectives in their programmes to achieve gender equity**.** Recently, the mandate of the institute has been revised as follows;

- Research on gender issues in agriculture and allied fields
- Gender equitable agricultural policies/programmes and gender-sensitive agricultural sector responses
- Coordinate research on Home science

**Activities for Gender Mainstreaming in Agriculture**

ICAR-CIWA carries out research programmes in various dimensions related to women in agriculture. These activities are carried out through the in-house, inter-institutional, network or collaborative and coordinated modes of research. The All India Coordinated Research Project (AICRP) on Home Science is operating at 11 centres at ten Agricultural Universities such as, AAU, Jorhat (Assam); PJTSAU, Hyderabad (Andhra Pradesh); CCSHAU, Hisar (Haryana); CSK HPKV, Palampur (Himachal Pradesh); GBPUAT, Pantnagar (Uttarakhand); MAU, Parbhani (Maharashtra); MPUAT, Udaipur (Rajasthan); PAU, Ludhiana (Punjab) and UAS, Dharwad (Karnataka) and UAS Bengaluru (Karnataka). Three more new centres viz., Central Agricultural University, Tura, Tamil Nadu Agricultural University, Madurai and Sardakrushinagar Dantewada Agricultural University, Dantewada have been included in the XII five year plan. The technical plan of the project during XI plan period focused on development of gender specific database and training modules for farm women, technology interventions for drudgery reduction in agriculture, nutritional security & health promotion of farm families, promotion of vocational skills among adolescent girls, value addition to under utilised natural fibre resources and empowerment of rural women for livelihood security.

Since its inception the ICAR-CIWA has focused its R&D activities in following thrust areas:

- **Creating a repository of gender disaggregated data and documentation**

Gender disaggregated information in the field of agriculture and allied areas are scanty and scattered. Such information need to be collected, collated, synthesized and published in order to make it available to the users. Therefore, a web portal 'Gender Knowledge Centre' has been created to share information among stakeholders.

- **Technology assessment & evaluation**

Research efforts in NARES have, by and large, bypassed the needs of women which very often differ from that of men. As a result, there is differential adoption of technologies between men and women. It ultimately affects the productivity of women and agricultural production. Therefore, ICAR-CIWA has identified relevant technologies in the fields of crop production, horticulture, animal husbandry, agricultural engineering and aquaculture and tested them in women perspective, and suggested refinement to make them women friendly. Technologies were assessed through on-farm participatory research involving women.

- **Farming system approach**

In the wake of emerging problems related to sustainability, the focus has been shifted to farming system approach to produce agricultural commodities. Moreover, as farmwomen struggle to meet their diverse needs from different sources, they eventually spend a lot of time and energy in supporting their households. Therefore research on micro-level

farming/agricultural systems has become urgent to develop sustainable livelihood options for women and their households.

- **Drudgery assessment and reduction**

Farmwomen face a lot of drudgery while performing farming operations and household activities. Even women suffer from different health problems, which adversely affect their working efficiency and family welfare. But, data on the extent to which women are affected in the working environment and the effect on their work output are limited. Hence, studies were commissioned on drudgery assessment and development of reducing tools and implements suitable drudgery.

- **Gender sensitive extension**

Access of farmwomen to extension/information is very limited due to various reasons. One reason is lack of required degree of gender sensitivity of our extension system and lack gender focused extension approaches and models for dissemination. Extension modules on various subject matter areas like integrated farming system, post-harvest technology, integrated pest and nutrient management, poultry and fish farming, home garden and homestead farming were be prepared for rural women.

- **Capacity building of R & D functionaries**

Scientists, both in research and extension systems, need orientation to appreciate the vital role of women in agriculture and the areas in which their efficiency of work could be enhanced either by technological intervention in agriculture and allied sectors on important problems or by improving their knowledge and skills for better job performance. In the first instance the scientists of ICAR-CIWA need to be given required training in certain identified areas so that the centre can address researchable issues on priority. Based on the research outcomes, suitable training capsules are being developed according to the need of various stakeholders like, directors, scientists, policy makers, KVK & development functionaries and women leaders.

- **Resource management**

Resources, both natural and household, provide an important base for livelihood of women and their families. The means of livelihood that women adopt depends on resource endowment of a particular region, their households and access to such resources. The resources can be common property resources such as forest, water bodies, fallow lands etc. and household resources like cultivable lands, ponds, livestock and different assets. Lack of adequate resources at household level and poor management of existing resources have made poor in general and women in particular vulnerable to livelihood insecurity. More importantly there is need to improve the resource use efficiency on one hand, and make sustainable use of resources on the other. Hence, studies taken up related to women's role in resource conservation and management; and S&T options to harness sustainable benefits assume immense significance.

- **Gender mainstreaming**

Gender mainstreaming in agriculture encompasses three major aspects. The first and the foremost is Women's Empowerment (human capital formation, exposure, leadership, autonomy, self esteem, and food security), second by Capacity Building in Agriculture (dissemination of information and technology) and Access to Agricultural Inputs as well as technology and resources and services (including land, water and credit besides agri-inputs). Poor implementation of policies and programs and delivery to farm women at different levels are the gaps which have to be taken care of by the researchers in the domain of policy analysis &programs development in gender perspective. There is a need for gender sensitive approaches and methodologies to enhance access of women to critical resources, programs and services. Realization of the full impact of policies and initiatives like gender budgeting and making institutions work for women are some of the challenges faced by policy makers. Lack of reliable data and evidences on women in agriculture and lack of gender sensitivity in the system are the major impediments in engendering agriculture. ICAR-CIWA has taken steps to carry out research on evaluation of existing systems from gender perspective, alternative approaches, models and methods are required to address the information and extension needs of the rural women and for the gender mainstreaming.

- **Nutrition and livelihood security**

Studies and surveys revealed that malnutrition is the complex problem with multifaceted dimensions factors like poverty, purchasing power, health care, ignorance on nutrition and health education, female illiteracy, social convention etc. Poor livelihood leads to nutritional insecurity which manifests into malnutrition. Poor delivery mechanism and implementation of mitigating policies to be addressed the food & nutrition needs through various methods / models to combat malnutrition and livelihood security highlighted the need for more focused in different level involving women. Livelihood security, the poverty line defining inadequate income, consumption, nutritional level, health status, life expectancy and assets of holding people, can be increased by generation of income and ownership of productive assets to reduce vulnerability of marginalized communities. Women from the lower socioeconomic status tend to have a weaker control over household resources, more time constraints, less access to information and health services, poorer mental health, and lower self-esteem. Lack of adequate and sustainable livelihood options and poor asset base make it pertinent to undertake researches on resource based sustainable livelihood interventions and human resource development by ICAR-CIWA.

**Conclusion**

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

# Role of Women in Agriculture: Identifying Gender Issues and Research Priorities

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Role of farmwomen in agriculture is perhaps to an even greater degree than other areas of development because they are active at every point in the food chain throughout the world and are often responsible for protecting the integrity of food and ensuring its wholesomeness and safety. Food security as a national objective is placed on the policy agenda. Now people have started to give emphasis on quality food production (ICAR vision 2050) due to pesticide residues in food chain and increasing demand of WTO. Identifying gender issues and research priorities has gained considerable importance at the national level to streamline technical/extension services for farm women. ICAR - Central Institute for Women in Agriculture is the pioneering organization to identify gender issues and research priorities and refine the agricultural technologies in gender perspective. Rural women entrepreneurs face several risks and problems out of which technical risks is the major one (Srivastava et.al, 2007). Due to increasing migration of man towards urban areas it is forecasted that future agriculture will be in the hands of farm women. Millennium Development Goals adopted in the year 2000 under, the aegis of the UN General Assembly, had set the goals to be achieved by the nations of world by 2015 are empowerment of women and reduction in gender inequalities and improved environmental sustainability. Enormous progress has been made towards achieving the Millennium Development Goals, (MDGs). Even then post- 2015, efforts to achieve a world of prosperity and equity will continue unabated.

Women play a crucial role in agriculture throughout the world, producing and providing the food we eat. Despite of their contribution to global food security they are frequently bypassed various development strategies. Women make up 70% of the world's poor and earn only 10% of its income. Therefore, improving their economic status has now been recognized as an important component for any developmental activity. Rural women face several risks and problems out of which technical risks is the major one. Agriculture, in India is increasingly becoming a female activity due to migration of man counterpart towards urban areas therefore; science should also be used for the benefit of half of the population that is women. Due to repeated indications of pesticide toxicity and women participation in agriculture researchers have been forced to look for IPM with gender perspectives. In deliberations on quality food and safe food, the situation at micro levels in rural areas is often overlooked. The people who are involved in growing our food are probably the people whose health is most affected by the pesticides used in agriculture.

Despite women's contribution to global food security they are frequently bypassed various development strategies. A major population residing in rural areas remains unaware to the modern methods / technologies of agriculture. Due to unjudicious use of pesticides farm families are at risk due to pesticide hazards. Continuous increase in population implies

increasing pressure on our existing land, soil, and water resources. Therefore, we have to increase the production in continuously decreasing area thus improving productivity with women empowerment in agricultural tools , techniques and methodologies. Women experience barriers in accessing technology, more than men and they are going in their own path. Rural women face several risks and problems out of which technical risks is the major one. Therefore, our agriculture policy and programme should not be only pro poor and pro environment but it must be pro women.

According to FAO's estimate for 2014-16, 794.6 million people are undernourished in the world. The proportion of undernourished in total population is now estimated at 10.9 percent worldwide. Today one in eight people are undernourished in the Asia and the Pacific region. However, the region is considered the home to almost 62 percent of such people suffering from chronic hunger in the world. Eastern and South-Eastern Asia, with rapid economic growth and policies to improve agricultural productivity, performed better than Southern Asia. Southern Asia continues to be the sub region with the largest number of hungry people 490 million in the world. These people typically live in extreme poverty, and besides the lack of food and income, they usually have little access to education and health facilities. Many of them are landless and marginal farmers, indigenous people, ethnic minorities, people with disability and their families, members of female-headed households and other disadvantaged groups in society.

Food security a complex issue and it exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and their food preferences for an active and healthy life. From this definition, four food security pillars are identified.

1. Food availability;
2. Economic and physical access to food;
3. Food utilization; and
4. Stability over time of food availability, access and utilization.

Food security is affected by economic and agricultural growth, population growth and changes in demographics domestic market development, consumption patterns, food price volatility, the state of the environment, the impact of bio-energy development, an area's vulnerability to climate change and natural disasters, and other factors. Poverty reduction was particularly impressive in Eastern Asia, where the poverty rate fell by 48.6 percentage points (largely led by China). Sothern Asia (19.8 percentage points) and the Pacific (10.9 percentage points). The relationship between hunger and poverty is not always straightforward, and reduced access to food can result from other factors, such as crop failure and supply disruptions due to conflict. For example, Eastern and Southern Asia, which reduced poverty at faster rates, also reduced food insecurity more rapidly than Sothern Asia. The poor's access to food will be enhanced more rapidly when economic growth is more broadly based and creates more decent and productive employment and income opportunities. In many countries, the rise in inequality can be linked at least in part to slow growth in agriculture, which continues to employ some of the region's poorest people and pays lower wages than

industry or services. Furthermore, when workers particularly women exit from agriculture, they often find employment in low-productivity service with little job security.

In the Southwest Pacific Island Countries, however, agricultural production per capita is declining across the sub region. Traditionally, these countries were generally food secure, as they had a diet of readily available and abundant indigenous food resources, including root crops, fish, fruit and vegetables sourced locally through environmentally sustainable farming and harvest systems. Several challenges to the continuation of the positive trend on food supply have emerged. Climate change is a major source of vulnerability and uncertainty. Vast tracts of fertile land are taken away from agriculture by rapid urbanization. There has been increasing competition between food crops and bio-energy crops for the use of land and water. Moreover, agricultural lands are degraded by unsustainable farming practices. Young, capable and better-educated successor farmers are migrating from rural to urban areas, leaving farms to the elderly particularly to the farm women in India. Therefore, it is called feminization in agriculture.

Access to food is critical for food security. Even if food is physically present in an area, it may not be accessible if people lack of purchasing power. Sometimes even if food is physically present in a house, it may not be accessible equally to the women and girl child in the man headed Indian farm families. Poorer households, with very limited access to savings or credit markets, were especially vulnerable to sudden swings in prices, particularly food-price increases, and the evidence suggests that some of the poorer households particularly women and girls experienced higher food insecurity during the crisis.

Even if the quantity of dietary energy is adequate, the body may not properly utilize the food due to several factors. Food utilization can be accessed through anthropometric indicators, such as wasting, stunting and underweight of children under the age of five. These convey the outcome of the quantity and quality of food intake, access to critical health services and overall environmental sanitation conditions. Wasting, for instance, is the result of short-term inadequacy of food intake, often the result of an illness or infection, whereas stunting is often cause by prolonged inadequacy of food intake, repeated episodes of infections and/ or repeated episodes of acute under nutrition. Other important factors that contribute to effective food utilization include micronutrient deficiencies, food quality and safety during preparation and access to safe water and hygienic conditions.

The people in the Asia and the Pacific region also, suffer significant micronutrient and protein deficiencies also known as hidden hunger. Some of the key micronutrients that are typically deficient are iron (which often plays a role in anaemia particularly in women and girls), vitamin A and iodine. South Eastern Asia and Southern Asia have a high incidence of anaemia among pregnant women and children. Among pregnant women, the incidence ranges from 24 percent in Viet Nam to 51 percent in Cambodia and from 25 percent in Sri Lanka to 54 percent in India in Southern Asia. Pregnant women in DPR Korea, Mongolia and the Republic of Korea in Eastern Asia also suffer from anaemia, with the prevalence rate between 25 to 27 percent. In Southern Asia, the prevalence of vitamin A deficiency (VAD) in the population is very high in India (62 percent in 2003) and moderately high in Nepal, Pakistan and Sri Lanka (above 30 percent). In South-Eastern Asia, VAD is highest in Lao PDR and the Philippines, where it exceeds 40 percent. The prevalence of VAD is quite low in the countries of Eastern Asia. In Eastern Asia, Mongolia has a very high incidence of iodine

deficiency at over 50 percent. In South-Eastern Asia, Lao PDR, Myanmar and the Philippines have incidences exceeding 20 percent. In Southern Asia, Afghanistan has the highest rate of prevalence (72 percent in 2004), while India, Maldives, Nepal, Pakistan and Sri Lanka all have iodine deficiency over 20 percent.

Per capita food consumption per day has grown globally from 2370 kcal per person per day at the beginning of the 1970s to 2770 kcal per person per day in 2005/07. At the global level, it is expected to continue to rise in the future and reach just over 3000 kcal/person/day in 2050. Eastern Asia is expected to approach a plateau, reaching 3225 kcal/person/day in 2050.

Climate change adds significant uncertainty to the future outlook for agriculture.The gradual increase in global temperature projected by climate scientists could lead to a seawater level increase that may result in a reduction of agricultural lands in some countries, as well as large changes in growing conditions for different crops, livestock and fisheries. It might also lead to high acidity of rainfall that could affect soil conditions as well as the forestry and fisheries sectors. Equal sharing of food can lead food security -The world today produces enough food for everybody to have food security, if only it were shared equally. From an economic perspective, hunger and food insecurity are, in most cases, not a supply problem, but rather an access problem caused by lack of purchasing power, lack of physical access or lack of social protection schemes. The challenge, therefore, is not only increasing food production and availability to meet the growing demand in the future, but also ensuring continual access to nutritious and diverse food and its fullest utilisation by the body for a healthy and productive life. Addressing these complex and multi-dimensional food security issues will require pursuing a mix of technological, policy and institutional innovations that ensure growth with shared prosperity and environmental sustainability.

Various national and regional policies, actions, commitments and initiatives viz; National Food Security Act in 2013; Rajiv Gandhi Scheme for Empowerment of Adolescent Girls – Sabla; Development of Women and Children in Rural Areas (DWCRA);Support to Training and Employment Programme (STEP); National Mission for Empowerment of Women (NMEW); Pradhan Mantri Krishi Sinchai Yojana (PMKSY); M-kisan Portal; Small Farmers' Agribusiness Consortium (SFAC); National Livestock Mission (NLM); Farmer First; Mera Gaon, Mera Gaurav; Krishi Dak; Attracting and Retaining Youth in Agriculture (ARYA) and Student READY (Rural Entrepreneurship and Awareness Development Yojana) *etc* are initiated to address issues related to agriculture.

Way forward to ensure food security viz; Reduction in gender gap in agriculture; Promotion of nutritional awareness among women, teachers and community workers, and improve child nutrition; Reform in policy and institutional frameworks; Acceleration in investment and innovation in agriculture, especially in research and development (R&D); Increase in water productivity; Promotion of diversification in food production and consumption; Investment in rural and on-farm infrastructure and agriculture mechanization; Promotion of sustainable natural resource management and conservation; Strengthening of public-sector and community-based social protection and safety nets; Expand access to clean water, sanitation and health care; Ensuring food safety and quality; Promotion of indigenous, underutilized food resource; Promotion of rural employment and income generation by enhancing synergy between smallholder farming and value chain development; Reducing

food losses and food waste; Reducing farmers' risks and uncertainties from weather, market fluctuations and natural disasters; Reducing the impacts of climate change on agriculture and Further strengthening of regional cooperation and collaboration *etc.* are the various points which can be addressed strategically for the enhanced empowerment of women which constitutes about half of the population of the our beloved country India.

# Gender Issues in Livestock Production

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Livestock sector in India has been emerging on its own from being subsidiary to agriculture to being an important source of livelihood together with the agriculture in many parts of the country. It is now being seen as a tool for livelihood improvement of rural people as well as peri- urban livestock keepers. Livestock sector is an source of income and employment to millions of people in rural and peri-urban areas. The nutritional outcomes of the households rearing livestock comes as an additional benefit of the vocation of livestock keeping. In the last decade the dairy and commercial poultry sector have shown impressive growth. The livestock employs 8.8% of the agricultural work force which varies from 3% in North-Eastern states to 40-48% in Punjab and Haryana. The livestock sector also promotes gender equity because more than three-fourth of the labour demand in livestock production is met by women. The demand driven growth in the dairy and the poultry sector has been due to the growth in human population, urbanization and changing dietary habits of the Indian population. The livestock sector in India contributes 3.9 percent of the Gross Value Added (GVA) in 2013-14 which is 26.1 percent of the GVA in agriculture. The milk production now stands at 146.3 million tonnes (2014-15) and it is an important secondary source of income for millions households engaged in dairying. During the 11th five year Plan (2007-08 to 2011-12), the average annual growth rate of milk production was 4.5%. The 70 percent of the workforce engaged in dairying is comprised women. The per capita availability of milk is 307 g per day (2013-14) in India which is higher than the world average. Poultry sector has also shown an impressive growth because of the conducive government policies for commercial poultry production and the focus on family poultry system which addresses livelihood issues. The egg production in India was 74.75 billion in 2013-14. The per capita availability of egg in India is 61 eggs per year. The livestock sector has the potential to provide income and employment and nutritional security to millions of farmers which is yet to be fully tapped. The growth witnessed in the dairy and the commercial poultry sector can be spread horizontally provided it encompasses other livestock species like goats, pigs and backyard poultry which are less capital intensive but have greater impact on the health and well being of the farm families. Although the contribution of women in making the operation flood programme has been immense because they have been shouldering most of the activities related to rearing and management of dairy animals, their abilities and expertise with respect to other livestock species is yet to be fully appreciated especially in the field of small ruminants and backyard poultry.

Women are vital to food security and family well-being and their need for labour saving and income generating technologies are acute. However, until now, most technical solutions have ignored women's actual needs. Studies have shown that livestock contribute significantly to the income of poor households-particularly the income controlled by women, and enables poor and landless women to earn income using common-property resources. The expanding market for livestock products also offers an opportunity for augmenting their income to those who do not have access to land and capital resources. The domestic animals like goats, sheep, pigs, chickens, ducks and rabbits can be reared easily by women while attending to other household activities and they are also important for household nutritional security. Identifying and supporting women's roles as livestock owners and strengthening their decision-making power and capabilities are key aspects in promoting women's economic and social empowerment. Recent review conducted by ILRI shows that if livestock

technologies are developed in ways that consider the needs, interest and concerns of women and men, they can reduce women's work load, increase productivity and contribute to the generation of income.

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

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

**Gender issues in livestock production**

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

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

| Constraints | Needs | Opportunities |
|---|---|---|
| Low women's participation in livestock development programmes and training | • Gender sensitization for more women's participation in formal discussions<br>• Increased access to information, use of visual aids where there are problems of literacy<br>• Include women in training and development programmes-very | • Adoption of improved technology that can suitably be integrate in traditional production system<br>• Raise awareness of potential of livestock in increasing household |

| Constraints | Needs | Opportunities |
|---|---|---|
| | much open to innovations<br>• Organise training programme in those periods and days when women are not involved in other duties<br>• Organise training programme on-site (village)<br>• Introduce leadership development and confidence building measures | food security and household economies and promotion of gender equality.<br>• Conduct training progarmme in villages with flexibility in schedule and venue |
| Time constraint in livestock management during peak labour periods | • Introduction of labour-saving technologies/devices<br>• Introduction of skills on livestock management, e.g. full hand milking, use of locally made crates, revolving stool for milking, use of long handle rack /spade for removing dung<br>• Look at case studies where women play a leading role in livestock production for exposure visits | • Reduce livestock mortality and morbidity<br>• Reduction in women's work drudgery<br>• Development of other small enterprises |
| Low scale of production limiting access to inputs and markets | • Introduction of group approach/ women self help group /farmers' groups or associations<br>• Facilitation of support services at village level (AI, vaccination, deworming, credit etc.) through women self help groups<br>• Training on capacity building of women SHGs for livestock enterprise development | • Improvements in access to inputs, technical assistance and in marketing system<br>• Women's empowerment and increasing gender equity |
| Lack of common pool resource (grazing, water and forest) for livestock production and other micro-enterprises income genration | • Improve access of women's to common pool resources through community participation and management<br>• Develop mechanism at village level for provision of water and fodder during scarcity period | • Improvement in the productivity of CPR<br>• Enhance women's' right to control and manage CPR and livestock<br>• Increasing livestock assets for the landless women |
| Informal and poor marketing system | • Improvements in infrastructure and transport services<br>• Improving women's management and skills in value addition and processing | • Increase demand for livestock products and promote production |

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

**a) Livestock production system**

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

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

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

**b) Ownership of different livestock species**

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

**c) Access to capital and knowledge**

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

**d) Responsibilities and division of labour**

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

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

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

**e) Role of livestock in the household nutrition**

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

**f) Influence marketing of livestock products in the household economy**

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

**g) Training in livestock activities**

Livestock production is generally a joint activity carried out by both men and women but, compared to women, men have easier access to technology and training, mainly due to their strong position as head of the household and greater access to off-farm mobility. The decisions in activities related to livestock sector, such as breeding, handling, feeding and health care, are largely taken by men. Livestock extension services are often controlled by men and the extension personal are primarily men hence, the extension programmes and educational materials are mainly designed by and oriented

towards men. Although in most societies all household members are involved in some way or another in livestock production, the decision making processes within the family and the division of labour for activities such as feeding, milking, health care, processing and marketing differs between regions, societies and households.

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

**h) Role of Self Help Groups**

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

**Gender analysis in livestock production**

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

• Gender should not be an issue of mistrust and prejudice, but of creativity, inspiration and positive spirit for men and women.

- Social and cultural factors (norms and traditions which influence the behaviour of men, women and children, organisation of the daily life of the household members, specific religious rules for men and women)
- Economic factors (poverty level, inflation, infrastructure, income distribution and distribution among family members, etc.)
- Institutional structure (government, extension, education, health care, funding agencies etc., and their gender approach in theory and practice)
- Environmental factors (quantity, quality and availability of land by households and intra-household distribution, water, energy, etc.)
- Political factors (power relationship, system of decision making, legal system, etc., and their influence on the relationship of men and women)
- Demographic factors (migration, life expectancy, infant mortality, etc.)
- Legal parameters (right to ownership, law of succession, etc.)

**Conclusion**

Sustainable development in agriculture can only be achieved through optimum utilization of natural resources. Livestock development interventions must take into consideration the land and livestock ownership pattern. Client-oriented participatory research is needed in developing appropriate livestock technologies for women in order to identify production constraints and to develop techniques that reduce women's workloads while at the same time increasing their productivity. Such

research should take into account women's roles and responsibilities, as well as their workload. The following issues should be considered in designing appropriate technologies for livestock production: (i) their implications for women's labour requirements and workloads; (ii) their suitability in terms of consumption preferences; (iii) their implications in terms of women's control over the means of production; (iv) their expansion and use of women's indigenous knowledge; (v) the participation of women in their trials; and (vi) the importance of incorporating women's physical, social and cultural assets when designing research activities.

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

# Understanding Gender Perspective in Agricultural Research and Development

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Gender has, now-a-days, become an area of immense interest in agriculture and rural development. The term 'gender' describes 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).

**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.

**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.

**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.

**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.

**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 Williams, Janet Seed and Adelina Mwau(1994), The Oxfam gender training manual.

Caroline O.N.Moser(1993), Gender Planning and Development-Theory, Practice and Training'.

# Gender Sensitization: Role in Reforming the Society and Impact

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Despite the spread of education and awareness gender bias is still a glaring reality in our society, more particularly in rural areas, and is manifested in myriads of forms. An array of problems that we face today in realms of social and economic development can, in some way or the other, be linked to gender. It is needless to emphasize that gender issues have become subject of concern in agriculture and other sectors as well. At a time when we are aiming to put our economy on high trajectory growth path, it is important that we address the gender issues because these have implications for development. A bias-ridden society entails high cost for social and economic transactions, accessing and using information in decision making process. Therefore, creating a socio-cultural climate that is free from gender bias and that promotes rational behaviour and action on part of men and women is very significant in this context. To this end, gender sensitization can be seen as an important action point.

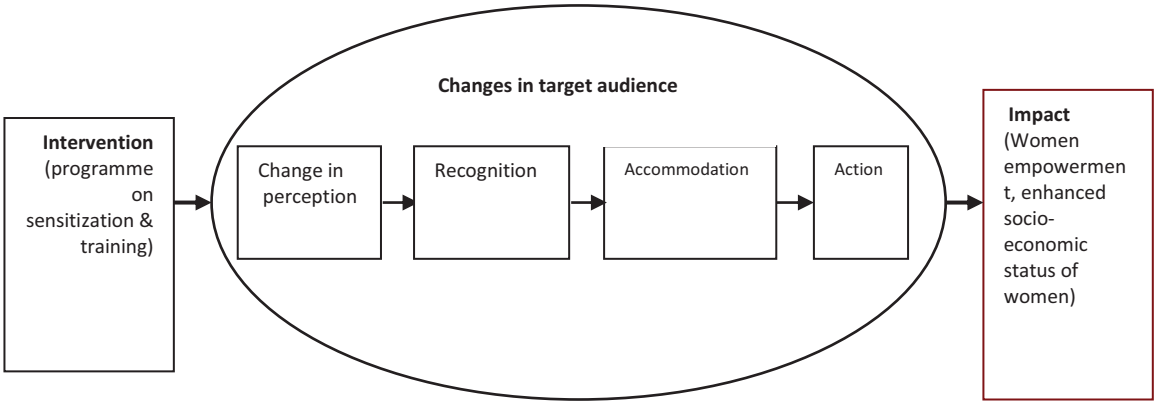
## The Goal

Sensitization is by far an effective and non-confrontationist approach of reforming the society. Gender sensitization is the process of changing the stereotype mindset of men and women; a mindset that holds the view that men and women are 'unequal entities' and therefore, have to function within different socio-economic space.

Gender sensitization increases the sensitivity of people at large towards gender and related issues. It seeks to change not only the attitude of men towards women i.e. the way men think of and treat women, but also the attitude of women i.e. the way women think of men and of themselves and their behaviour in this context. In the process it creates a class of gender responsive functionaries at different level, from policy making to grass root level. The goal is essentially to create a value system in society that accords explicit and spontaneous recognition to the contribution of women in socio-economic development, and respects their wisdom; a system that makes women sensible and courageous enough to recognize their own contribution and make them feel proud of.

## Gender sensitization process

The very aim of gender sensitization programmes is to bring a definite orientation in the attitude, feelings, practices and approach of individuals concerning gender. Insights from monitoring of gender sensitization programmes, extensive PRAs conducted under different gender related projects in rural areas suggests that gender sensitization process generally involves four stages; change in perception, recognition, accommodation and action. These changes take place in response to certain interventions i.e. sensitization or training.




(Fig.1: Gender sensitization process)

### *Change in perception*

Gender sensitization initiates us to think about gender differently. In first instance, it tends to change the perception that men and women have of each other. It creates a mindset in men that no longer sees in women the stereotypical image. Rather, they are seen as responsible and equal partners in socio-economic development.

### *Recognition*

Persons exposed to gender sensitization try to look at the positively endowed qualities of women. At this stage the male folk come around to recognize the virtues of women and their importance to the family and the society. There is spontaneous appreciation for women's involvement in multifarious activities. As a result women's contributions become more and more visible. Further, women's talents and capabilities that were going unnoticed and unexplored become subject of attention. Women too become more conscious of their capability and contribution, and take pride in the same.

Women, cutting across socio-economic boundaries, tend to see their problems in larger perspective of women development and come forward to recognize the efforts of fellow women. They even visualize the important role that men can play in their socio-economic development.

### *Accommodation*

The barrier between men and women starts crumbling down in real sense and the society slowly gets over the perennial problem of adjustment between them. Men tend to rationalize their behaviour by burying their ego as far as gender relations are concerned. Instead of complaining or reacting to the behaviour of women, men learn to exercise patience and restraint, and take the things in a positive way. In the family, women start gaining importance as their opinions and suggestions are counted for overall development and management of family. At community and organizational level too, women are encouraged to play their role in matters of management. Women, on their part, tend to underplay the problems with their male counterpart and wish to solve their problems through dialogue.

***Action***

Gender sensitized persons become instruments of change as far as status of women in the society is concerned. Conscious efforts are made to create a favourable climate that allows nurturing and flourishing of women's talent and provides more flexibility and freedom to women. A number of affirmative actions are initiated to bring improvement in conditions of women. There could be gender sensitive policies and programmes to allow meaningful participation of women in development and decision making process, and foster equitable sharing of benefits. Actions could also be in the form of research and extension initiatives to reach out to the women with appropriate technologies and institutional innovations.

At household level sensitization can bring a greater degree of understanding between men and women while performing their roles. In response to emerging external forces, the normal household functions and concomitant gender roles are poised for a change. This is likely to affect the intra-household gender dynamics and the situation may warrant redefinition of gender roles to achieve new equilibrium. Gender sensitization can make the transition smooth. Ultimately a situation is created where both men and women complement each other within the family and outside and the age old socially ascribed gender roles have to give way to necessity driven gender roles in the changing context.

**Gender sensitization Strategy**

Gender sensitization strategy basically involves three components; selecting the target audience, deciding the content and deciding the methodology.

***Target audience***

Sensitization programmes should target not only the collective consciousness of men in society to create more space for women but also those women who directly or indirectly tend to act against the larger interest of women in their overzealousness to conform to the orthodox socio-cultural norms. For example, elderly women from families can be educated about ill effects of gender bias so that they develop a favourable attitude towards younger generation. Similarly, socially and economically progressive women in village or locality can be sensitized to encourage and support the underprivileged women. Separate sensitization programmes can be designed for researchers, policy makers and personnel associated with social and economic services delivery system.

***Methodology***

We may require gender sensitive modules containing case studies; situation analysis etc. to sensitize planners, researchers and middle level functionaries. Even gender sensitive materials could include leaflets, booklets, posters, and videos on different theme areas. Organization of sensitization camps in rural areas coupled with sustained campaign by mass media, and plays will go a long way in creating a healthy environment in rural areas as far as gender relations are concerned. Even men and women from different age groups and from same households can be involved in participatory discussion in an enabling environment so as to make them realize the adverse effects of gender bias depicting real life experiences.

***Content of the programme***

Content should amply communicate the intended message to the audience, and should be easily understandable by them. Contents of the programme can be decided depending on its very purpose. It could be to sensitize people about ill-effects of gender bias and discriminatory practices on women, men, family and society. Gender sensitization may focus on spreading the message 'how women play important role in family and in the society' and 'how both men and women in their mutually supportive role can contribute immensely to family welfare, growth and development of their villages'. Contents should initiate friendly debate among larger audience on the ill effects of different forms of gender bias and what can be done to remove such biases. It can focus on the conduct of men and women in a household based on case studies and even spread the massage of some kind of affirmative action.

***Sensitization through education***

Topics relevant in the context of gender sensitization should be introduced in school curriculum to sensitize the children on the prevailing gender bias in our society and the way these are impending the socio-economic development. This calls for somewhat higher doses of social science including gender studies in educational institutions. To make students awakened to the realities, both boys and girls can be encouraged to debate and discuss the gender issues and examples from real life experiences. Such an exposure will bring a definite change in attitude and perception of students towards gender. While boys, as they grow, can become more sensitive to and more concerned about issues affecting the girls and women; the girls and women, on the other hand, will become more vigilant against prevailing biases and awakened to the emerging opportunities. At the same time, we can expect more friendly relations between boys and girls or men and women characterized by spontaneity in adjustment and collective efforts to find solutions to gender problems. This would create a long term impact on society by reducing abuses and violence against girls and women.

**Possible Impact**

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

**Conclusion**

Gender sensitization should pervade all levels, from top to down at household level. The good thing is that the persons at top level of management and policy making are becoming more and more sensitized on the issue and this is reflected in increasing number of gender focused progrmmes and policies. Gender budgeting initiated by the government is a testimony to the shift in approach that has taken place in recent years. However, a large part of the system and large segment of our population are not really sensitive to gender concerns. This calls for serious efforts to launch gender sensitization programmes for organizations and agencies involved in rural development programmes and for the people at large to achieve gender equity in sharing of benefits.

As meaningful participation of women is paramount for good outcome of rural development programmes, gender sensitization should be made in-built into the broad framework of rural development process. To begin with, selected persons from different levels involved in research, extension and rural development should be given necessary orientation and training who in turn can carry on such sensitization programmes for men and women in different organizations and in villages. In this way the message of working towards gender equality can be propagated across our social and economic organizations and we can create a situation where both men and women would perceive their needs spontaneously and would act in a more cohesive way to harness their combined potential. In ultimate analysis, gender sensitization is very much required to create gender synergy at household, organizational and community level for producing more output and attaining gender equality.

# Gender Analysis Tools and Their Capacity to Gather Gender Disaggregated Data

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**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; access and control over resources, services, institutions of decision-making and networks of power and authority; and needs, the distinct needs of men and women, both practical and strategic.

**Gender analysis focus:** It focuses on three sets of questions like:

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

**Gender analysis in agriculture:** The data about the gender roles would provide the basic knowledge which will indicate the problems and priorities in gender mainstreaming. The agriculture research projects, extension and training programs must be tailored in a way to provide equal opportunity to both men and women. The analysis of the roles also helps us to draw the gender issues in the field of agriculture and allied fields. The analysis may find ways and means in terms of facilitation, integration, collaboration and capacity building as required for men and women to overcome the constraints in different livelihood projects.

**TOOLS/FRAMEWORKS FOR GENDER ANALYSIS:** Now, the researchers and policy makers have realized the importance of gender equality to understand the gender issues, their roles, responsibilities, needs, etc. Each tool is different with some advantages and disadvantages. Following are some examples.

**Gender analysis frameworks:**

- Harvard Analytical Framework
- Moser Framework
- SEAGA Approach

**HARVARD ANALYTICAL FRAMEWORK:** It is useful for projects that are agriculturally or rurally based, and/or that are adopting a sustainable livelihoods approach to poverty reduction. The Harvard analytical framework is also called the gender roles framework or gender analysis framework. Developed by the Harvard Institute for

International Development in collaboration with the WID office of USAID, and based on the WID efficiency approach, it is one of the earliest gender analysis and planning framework.

It has four interrelated components:

**Harvard Tool 1**

**The activity profile:** This tool assists in identifying the productive and socially reproductive activities of women and men, girls and boys. Other data disaggregated by gender, age or other factors can also be included. It can record details of time spent on tasks and their location.

**Example of Harvard tool 1: Activity profile**

| Activities | Women/girls | Men/boys |
|---|---|---|
| **Productivity activities:**<br>• Agriculture<br>• Income generating<br>• Employment | | |
| **Reproductive activities:**<br>• Water related<br>• Fuel related<br>• Food preparation<br>• Childcare<br>• Health related<br>• Cleaning and repair<br>• Market related | | |

**Tool 2: Access and control profile – resources and benefits:** This tool enables users to list what resources people use to carry out the tasks identified in the activity profile. It indicates whether women or men have access to resources, who controls their use, and who controls the benefits of a household's (or a community's) use of resources. Access simply means that you are able to use a resource; but this says nothing about whether you have control over it. For example, women may have some access to local political processes but little influence or control over which issues are discussed and the final decisions. The person who controls a resource is the one ultimately able to make decisions about its use, including whether it can be sold.

**Example of Harvard tool 2: Access and control profile**

| | Access | | Control | |
|---|---|---|---|---|
| | **Women** | **Men** | **Women** | **Men** |
| **Resources**<br>Land<br>Equipment<br>Labour<br>Cash<br>Education/training etc. | | | | |

| | Access | | Control | |
|---|---|---|---|---|
| | **Women** | **Men** | **Women** | **Men** |
| **Benefits**<br>Outside income<br>Asset ownership<br>Basic needs (food, clothing, etc.)<br>Education<br>Political power/prestige | | | | |

**Adopted from:** Overhalt, Anderson, Cloud and Austin, Gender Roles in Development Projects, Kumarian Press Inc, Connecticut, 1985 (Source: March, 1991, 31)

**Tool 3: Influencing factors:** This tool allows you to chart factors which influence the differences in the gender division of labour, access and control as listed in the two profiles (tools 1 and 2). Identifying past and present influences can give an indication of future trends. Influencing factors include all those that shape gender relations, and determine different opportunities and constraints for men and women. These factors are far-reaching, broad and interrelated. Migration patterns on women and men, and which women or men were most affected.

**Example of Harvard tool 3: Influencing factors**

| Influencing factors | Constraints | Opportunities |
|---|---|---|
| • Community norms and social hierarchy<br>• Demographic factors<br>• Institutional structures<br>• Economic factors<br>• Political factors<br>• Legal parameters<br>• Training<br>• Attitude of community to development workers | | |

**Adopted from:** Overholt, Anderson, Cloud and Austin, Gender Roles in Development Projects, Kumarian Press Inc, Connecticut, 1985 (Source: March 1991, 31).

**Tool 4: Checklist for the project cycle analysis:** This consists of a series of questions. They are designed to assist you to examine a project proposal or an area of intervention from a gender perspective, using gender-disaggregated data and capturing the different effects of social change on men and women. This checklist creates a wealth data for any project.

**Harvard analytical framework: Uses and potential limitations:** This framework is useful for collecting and organizing information that can then be used at any stage of the project cycle. It provides clear information on the gender division of labour and makes women's work visible. It makes a distinction between access and control over resources. The framework is more useful for projects than for programs as it depends on micro-level analysis. The Harvard

analytical framework has a perspective which is efficiency rather than equity oriented, focusing on allocating new resources in order to make a programs more efficient rather than addressing unequal gender relations. It tends to focus on material resources rather than on social relationships. The analysis can be carried out in a non- participative way without the involvement of women and men from a community.

**MOSER FRAMEWORK:** The Moser framework (Gender planning) was developed as a planning tradition in its own right. There are six tools in the framework that can be used for planning at all levels from project to regional planning. It can also be used for gender training.

**Tool 1: Gender roles identification/triple role:** This tool includes making visible the gender division of labour. It can be carried out by mapping all the activities of men and women (can include girls and boys) in the household over a twenty four hour period.

**Productive work:** This is work that produces goods and services for consumption by the household or for income and is performed by both men and women. Women's productive work is often carried out alongside their domestic and childcare responsibilities (reproductive work) and tends to be less visible and less valued than men's productive work.

**Reproductive work:** This work involves the bearing and rearing of children and all the tasks associated with domestic work and the maintenance of all household members. These tasks include cooking, washing clothes, cleaning, collecting water and fuel, caring for the sick and elderly. Women and girls are mainly responsible for this work which is usually unpaid.

**Community roles:** Women's community activities include provisioning and maintenance of resources which are used by everyone, such as water, healthcare, education. These activities are undertaken as an extension of their reproductive role and are normally unpaid and carried out in their free time.

**Tool 2: Gender needs assessment:** Moser's concept is based on the idea that women as a group have particular needs which differ from those of men as a group; not only because of women's triple work role, but also because of their subordinate position to men in most societies. Moser distinguishes between two types of gender needs.

- **Practical gender needs:** Intervention which focus on meeting practical gender needs respond to an immediate perceived necessity in a specific context, often related to inadequacies in living conditions. Women's practical gender needs may include: water provision; health-care provision; opportunities for earning an income to provide for the household; provision of housing and basic services; distribution of food.

- **Strategic gender needs:** The strategic gender needs relate to gender division of labour, power and control, and may include such issues as legal rights, domestic violence, equal wages and women's control over their own bodies to achieve greater equality and challenge their subordinate position, including their role in society.

**Tool 3: Disaggregating control of resources and decision- making within a household:** This tool asks the question; who controls what? Who decides what? How?

**Tool 4: Balancing of roles:** Users of the framework are asked to examine whether a planned program or a project will increase a woman's workload in one of her roles, to the detriment of

her other roles. Women must balance competing demands on their reproductive, productive and community responsibilities. The need to balance these roles determines women's involvement in each of the roles and potentially constrains their involvement in activities which will significantly increase the time they need to spend in one particular role.

**Tool 5: WID/GAD policy matrix:** The WID /GAD policy matrix provides a framework for identifying/evaluating the approaches that have been used to address the triple role, and the practical and strategic gender needs of women in programs and projects. Five different approaches can be identified like welfare, equity, anti-poverty, efficiency and empowerment.

**Tool 6: Involving women, gender aware organizations and planners in planning:** The aim of this tool is to ensure that practical and strategic gender needs are identified by women ensuring that "real needs'' as opposed to perceived needs are incorporated into the planning process

**Moser framework uses and potential limitations:** The Moser framework has a wide appeal and can be used for planning in a variety of settings from NGOs to government ministries. The concept of practical and strategic gender needs is a very useful tool for evaluating the impact of a development intervention on gender relations. The triple role concept is useful in revealing the wide range of work that women engage in. Furthermore it alerts planners to the interrelationship between productive, reproductive and community roles. Other forms of inequality such as race and class are not addressed.

**SEAGA TOOLS:** SEAGA is a technique for gender analysis which has been developed by FAO. It stands for Socio-Economic and Gender Analysis and helps in participatory identification of priorities of women and men to bridge the gap between them. It helps the participants to better understand the ground realities of the women and men, to identify the gender issues with respect to activities, access to and control over resources, decision making, needs and problems and also to formulate projects for gender mainstreaming in research and extension. On the other hand, it is for analysis of the current situation and planning for the future. Broadly, all the tools are classified into three categories of gender analysis as:

**Tools for gender analysis with developmental prospective:** It is used to learn about different patterns that influence rural people livelihoods. The patterns are: environmental, economic, social and institutional.

- **Village resources map:** Helps for learning about the environmental, economic and social resources in the community. This map focuses on available resources like roads, buildings, houses, water bodies, agriculture land, grazing land, forest area, shops, health clinics, educational institutions, religious institutions, bus stop, etc.

- **Transects:** It is sort of one dimensional path of a line. It depicts a cross section of an area along which a number of issues are recorded.

- **Village social map:** It is useful for learning about local definitions of "poor" and "rich" and about population changes (birth rates in-migration, out-migration).

- **Trend lines:** It is a simple graph depicting change over time. It gives a picture of what is getting better and what is getting worse over time. It helps for learning about environmental trends (deforestation, water supply); economic trends (jobs, wages, costs of living),

population trends (birth rates, out-migration, in-migration), and other trends of importance to the community.

- **Venn diagram of stakeholders:** Stakeholder is anyone who has interest in and is going to be affected in any developmental work. It helps us to know who is going to be affected by the proposed development plan. Gives a picture about the insider and outsider stakeholders for each action proposed in the Preliminary community action plan. The extent of interest of stakeholders is determined by the size of their stake in it.

- **Institutional profiles:** Helps to know about the nature of the institutions identified in the Venn

**Tools for gender analysis with livelihood analysis:** Livelihood is composed of aactivities and resources. For livelihood analysis, we start with the individual, we first learn about the roles and responsibilities of each family member.

- **Farming systems diagram:** Helps to understand what are the major on-farm activities (crop production, livestock production, fruit & veg. production), what are off-farm activities (fuel collection, water collection, fishing) and what are non-farm activities (marketing, waged labour) and also helps to know who has responsibility for each activity.

- **Benefits analysis flow chart:** Helps to understand what are the benefits and who enjoys them. For example, the benefits of growing a tree may include fruit, fodder, fuel wood, timber, bark and poles. The Chart shows who uses each of these products, who decides and who controls.

- **Daily activity clocks:** It gives a total picture of activities performed by gender in a day and who does more and also who does less. It helps to identify the workloads and leisure time for the community people including men, women, rich, poor, young and old. The clear picture comes that who works for longest hours and who does little activities.

- **Seasonal calendars:** Helps for learning about the seasonality of women's and men's labour and seasonality of food and water availability and income and expenditure patterns and other seasonal issues important for the community. The calendars can be used to know the changes in income over the time and the work opportunity for the people at different periods of time.

- **Resources picture card:** Help us to learn about the gender-based use and control of resources within the households. How resources are managed and decisions made. Who in a household has access to resources such as land, livestock and food, who is likely to lose and who is likely to gain.

- **Income and expenditure matrices:** It is to know the sources of income and sources of expenditure, to understand the security of different people's livelihoods, to understand their priorities and limitations. Here it is important to see their total income is spent to meet basic needs – food, water, clothing etc. After meeting their basic needs do people have any money left for savings.

**Tools for gender analysis with stakeholders' priorities:** It helps to identify the priority of the problems, stakeholder analysis is needed before plans for development activities to be

finalized, these include policy-makers, planners and other government and non-governmental staff, who have interests in the success or failure of certain development activities.

- **Pair wise ranking:** It helps to know the most important problems of different community members, allows for easy comparison of different people priorities and highlights how the priority of problems of women and men differ and where they overlap.

- **Flow diagram:** It helps to learn about people's understanding of the cause of their problems as well as the effects resulting from their problems; it can be used to identify possible solutions.

- **Problem analysis chart:** It is used for bringing together the priority problems of all the different groups in the community, to explore local coping strategies and to identify opportunities to address the problems.

- **Preliminary community action plan:** It is a tool directly builds upon the problem analysis chart, helps to think about the resources required for implementation, the groups would be involved, helps to take realistic and concrete steps towards participatory development planning.

- **Venn diagram of stakeholders:** It helps to understand who will be affected by proposed development activities, helps to invest the resources to minimize risk and maximize benefits, to know who they are and where they stand before development action plans can be finalized.

**Techniques / tools for field:**

**Daily activity clock**

| Time | Women | Men |
|---|---|---|
| 0 to 1 am | | |
| 1 to 2 am | | |
| 2 to 3 am | | |
| 3 to 4 am | | |
| 4 to 5 am | | |
| 5 to 6 am | | |
| 6 to 7 am | | |
| 7 to 8 am | | |
| 8 to 9 am | | |
| 9 to 10 am | | |
| 10 to 11 am | | |
| 11 to 12 noon | | |
| 12 to 1 pm | | |
| 1 to 2 pm | | |
| 2 to 3 pm | | |

| Time | Women | Men |
|---|---|---|
| 3 to 4 pm | | |
| 4 to 5 pm | | |
| 5 to 6 pm | | |
| 6 to 7 pm | | |
| 7 to 8 pm | | |
| 8 to 9 pm | | |
| 9 to10 pm | | |
| 10 to 11 pm | | |
| 11 to 12 pm | | |

**Pair wise ranking matrix:** Organize two separate focus groups: one of women one of men with a mix of socio-economic groups. Ask the participants to list 6 problems important to them. Write the list of 6 problems on both the vertical & horizontal axis of the paper. Also write the problem in separate six cards, show the participants a pair of problem cards asking them the more important .One with reasons of choice. Record their choice on the prepared matrix.

**Example:**

| Problems | Cost of inputs | Insect pest | Technical knowledge | Climate | Irrigation | Land |
|---|---|---|---|---|---|---|
| Cost of inputs | | Cost of inputs | Cost of inputs | Cost of inputs | Irrigation | Cost of inputs |
| Insect pest | | | Insect pest | Climate | Irrigation | Insect pest |
| Technical knowledge | | | | Climate | Irrigation | Technical knowledge |
| Climate | | | | | Irrigation | Climate |
| Irrigation | | | | | | Irrigation |
| Land | | | | | | |

| Problems | Number of times preferred | Rank |
|---|---|---|
| Cost of inputs | 4 | 2 |
| Insect Pests | 2 | 4 |
| Technical knowledge | 1 | 5 |
| Climate | 3 | 3 |
| Irrigation | 5 | 1 |
| Land | 0 | 6 |

****Source:** *FAO SEAGA field tool kit. Gender analysis for sustainable livelihoods*

# Livelihood Improvement of Rural Farmwomen Through Dairy Farming

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Dairy farming in India is a female dominated enterprise. It is established beyond doubt that women always participated in dairy and animal husbandry activities in addition to their daily household chores. About 75 million women as against 15 million men engage in dairying in India (Thakur and Chander, 2006). In fact dairy farming is becoming feminized. Most of the farm activities such as fodder collection, feeding, watering, health care, management, milking and household-level processing, value addition and marketing are performed by women. Women constitute about 69% of workforce engaged in livestock sector. India is the world's largest milk producing country with a share of about 16 per cent in world's total milk production and rank 1$^{st}$ in milk production with a production level of 132.4 million tonnes of milk growing steadily at a compound annual growth rate of about 6.5 per cent (Anonymous, 2012-17). The major share of the credit for India's position as largest milk producing country in the world and the significant increase in the per capita availability of milk in the country has to go to the largely illiterate rural women dairy farmers. Dairy farming does not demand heavy labour and provides good opportunity for women to develop this activity as an enterprise and ensures steady cash returns throughout the year by selling milk, milk products, farmyard manure and biogas using agricultural by-products. Such mixed farming ensures an excellent nutrient recycling which is an eco-friendly practice. Within this framework, an integrated crop-livestock farming system represents a key solution for enhancing dairy production and safeguarding the environment through prudent and efficient resource use.

## Role of farm women in rural dairy enterprise

Women play crucial and significant role in dairy farming, but their contribution has not been given the due place they deserve and they always remain invisible workers (Chayal *et al*., 2009). In India, majority of dairy farm women participated in the care of newborn calf, milking, cleaning of animal shed, cleaning of utensils, weaning and management of calf, preparation of cow dung cakes and construction of animal sheds but their participation was least in maintenance of farm records. Involvement of farm women in the care of newborn calf and cleaning of utensils and shed (100%), compost making (73%), milking of animals (70%) and weaning and management of calf (67%) is more (Lahoti *et al.,* 2012). Most of the activities of dairy farm were

carried out by women and about 295 minute/day is utilized in different dairy farm activities like feeding, watering, milking, housing, breeding, animal health care and marketing (John Christy and Thirunavukkarasu, 2002).

Fodder management, sale of milk and health care of animals were important areas where farm women played a major role in decision-making. The participation of farm women was least in the economic activities like taking loans, purchase and sale of animals and

choosing animals for dairy. They have less contact with progressive farmers, officials and banks resulting low level of involvement in decision-making (Upadhyay and Desai, 2011). Patriarchal type of society, illiteracy of women and low knowledge and skill also led to low participation in decision making (Lalitha and Seethalakshmi, 2001).

Despite their considerable involvement and contribution, significant gender inequalities also exist in access to technologies, credit, information, inputs and services probably because of inequities in ownership of productive assets including land and livestock. The rapidly increasing demand for livestock products creates opportunities for empowerment of women (Taneja, 2013)**.** Women face greater constraints than men in accessing natural resources, extension services, marketing opportunities and financial services as well as in exercising their decision-making powers. These constraints often prevent women from reaching their full potential within the agricultural sector, including livestock, and therefore compromise the achievement of overall household food security and nutrition. The nature of the work of women and men performed within the livestock sector may expose them to various health and safety related concerns, such as heightened exposure to zoonotic diseases (WHO, 2009). Therefore, there is a need to correct gender bias in livestock sector, veterinary education, research and service delivery systems as to enhance the effectiveness of women-oriented livestock development programs (Anonymous, 2012-17).

**Dairy farming in cooperative mode: A road for improving livelihood security**

Dairying in particular play a vital role in the Indian economy. Millions of people are employed in the livestock sector and women constitute about 70 percent of the labour force. India is the world's largest producer of milk due to the policy initiatives of Government of India (GOI) and contributions by various institutions of animal husbandry and allied sectors. During the late 1960s, the GOI initiated major policy changes in the dairy sector to achieve self-sufficiency in milk production. Producing milk in rural areas through producer cooperatives and moving processed milk to urban demand centres became the cornerstone of government dairy development policy. This policy initiative i.e. Operation flood, gave a boost to dairy development and initiated the process of establishing the much-needed linkages between rural producers and urban consumers. The performance of the Indian dairy sector during the past three decades has been very impressive. The per-capita availability of milk was 128 gms in 1980-81 gradually increased to 232 gms in 2004-05. Despite, it's being the largest milk producer in the world, India's per capita availability of milk is still lower than the recommendations (280 gm per day) of ICMR. The socioeconomic and demographic changes, rising income levels, urbanization and changing food habits and lifestyle, have also reinforced growth in demand for dairy products. Further, on the supply side, technological progress in the production and processing sectors, institutional factors, and infrastructure played an important role to the increased milk production in the country. In late 1980s the National Dairy Development Board placed a major emphasis on women's education as part of our co-operative development programme, an activity designed to strengthen the role of women members in the control and governance of the dairy co-operatives through *ANAND* pattern. Men were educated about the role of women in dairying and about 6,000 out of the 70,000 dairy co-operative societies in India are women's societies (Sheela and Ramegowda, 2013). Because of their direct involvement in animal husbandry, women also know much

more about the care and feeding of dairy animals, identifying first signs of oestrous in cattle and buffaloes, disease and pest problems. Women's dairy co-operatives perform better than men's because women are less political, more loyal to the cooperative concept, more inclined to co-operate with each other and to place their common interests and concerns above the superficial differences of religion, caste and political affiliation.

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

**Strategy to improve livelihood security of rural women through Dairy farming**

**Selection and health care of animals**

The selection of breeds takes into account market requirements, feed availability, resistance to diseases and environmental conditions. **The health of dairy animals should be monitored through p**reventing the entry of diseases into the farm. Construction of boundaries/fencing, avoid direct contact of visitors with animals, taking bio security measures in place to minimise the risk of spread of disease, isolation of sick animals suffering contagious and zoonotic diseases should be emphasized for maintaining health of the herd.

**Vaccination schedule of animals in a dairy farm**

| Disease | Animal | Vaccine | Dose | Immunity | Time of vaccination |
|---|---|---|---|---|---|
| FMD (Foot and Mouth disease) | Cattle and Buffalo | Polyvalent FMD vaccine | 3ml S/C | 1 year | February and December |
| Haemmorhagic Septicaemia (HS) | Cattle and Buffalo | HS vaccine | 5ml S/C | 6 months and 1 year | May - June |
| Black Quarter (B.Q) | Cattle and Buffalo | BQ vaccine | 5ml S/C | 6 months and 1 year | May - June |

| Disease | Animal | Vaccine | Dose | Immunity | Time of vaccination |
|---|---|---|---|---|---|
| Anthrax | Cattle and Buffalo | Anthrax spore vaccine | 1ml S/C | 1 year | May - June |
| Brucellosis | Female cattle and buffalo calf aged 4-8 months only. | Brucella vaccine | 2ml S/C | 1 year | - |
| Theileriosis | Cattle and calves above 2 months of age | Theileriosis vaccine | 3ml S/C | 1 year | - |
| Rabies post bite vaccination | Cattle and buffalo | Rabies post bite vaccination | 1ml S/C | 1 year | 0,3,7,14,28 and 90 days |

- **Milking hygiene, milk storage and milk safety**

In order to harvest good quality milk, appropriate udder preparation for milking, consistent milking techniques, separation of milk from sick or treated animals and hygiene of milking equipments, milkers and clean environment of milking premises must be ensured. Cooling of milk to the specified temperature and/or delivery to a processing plant in a specified time should be undertaken in time.

**Feeding of balanced ration to animals**

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

**Fodder resource management**

Fodder production is a major component of the integrated farming system and efforts need to be made for increasing the forage production in a holistic approach of integrated resource management. Legumes enriching the soil can be grown in mixtures with grasses in grasslands. Indigenous legumes such as clovers (*Trifolium pratens*, *T. repens*), *Medicago denticulata, Melilotus alba*, white clover, red clover have proved successful apart from Lucerne and Berseem.

The grass rangelands exhibited enormous gain in forage production through multi-tier silvipasture and hortipastoral techniques amalgamated with planting of multipurpose trees in wastelands followed by sowing/planting of grasses or legumes in inter-spaces of trees. Under alley cropping system, *Leucaena leucocephala* provide leaf fodder to get better crop production. Foliage of fodder trees could be fed mixed with crop residues and hay which improved their palatability and nutritive value.

**Conservation of fodder resource**

Green fodders of conventional source in excess during rainy season can be conserved as silage and hay making. Silage is the preserved green fodder in succulent form under anaerobic fermentation of carbohydrates. Good silage is yellowish-green in colour with a pleasant vinegar smell. Excellent silage may be made from maize, sorghum, bajra and barely at flowering to milk stage (DM-30-35%) of cereal crops. Hay making is the traditional method of drying and storing of high quality forage by reducing the moisture content to the level of below 15%. Thin stemmed crops like berseem, lucerne, cowpea, soybean, oat and natural grasses at early flowering stage are suitable for hay making.

**Improving quality of crop residues and agro industrial byproducts**

The crop residues especially jowar, bajra, maize stovers, wheat and paddy straw are used as staple diet for dairy animals in our country are highly fibrous in nature with low crude protein and high energy content. But, their lingo-cellulose complex is more resistant for rumen microbial enzymes and reduce the bioavailability of energy source (cellulose and hemicellulose) to animals. Various processing methods like physical (chaffing, chopping, soaking, grinding, pelleting etc.), alkali treatment (sodium hydroxide, calcium hydroxide, urea etc.) and supplementation of trace minerals which improve the rumen fermentation pattern, digestibility and nutritive value of crop residues. Besides physical and chemical treatment, biological treatment with white rot and brown rot fungi also improve the nutritive value of crop residues and agro industrial byproducts.

The feeding value of crop residues and agro industrial byproducts can be improved if they are blended into complete feeds. Complete feeds with desired ratio of roughages, concentrate, molasses and other agro forest based non-conventional feeds including top feeds improve the feed palatability, voluntary DM intake, avoids refusal of unpalatable portion, reduces wastage, increase bulk density thereby reducing transportation cost. The common formulation of standard compact feed block is wheat straw / cellulosic waste/ tree leaves – 55-60 %, concentrate mixture - 30-35 %, molasses - 10%, mineral mixture - 1% and salt - 0.5% (Singh and Singh, 2007)

**Dairy farming in Integrated farming system**

Integrating crops and livestock serves primarily to minimize risk and not to recycle resources. Crops and livestock interact to create a synergy, with recycling allowing the maximum use of available resources. Crop residues can be used for animal feed, while livestock and livestock by-product production and processing can enhance agricultural productivity by intensifying nutrients that improve soil fertility, reducing the use of chemical fertilizers. A high integration of crops and livestock is often considered as a step forward, but small farmers need to have sufficient access to knowledge, assets and inputs to manage this

system in a way that is economically and environmentally sustainable over the long term. An integrated farming system consists of a range of resource-saving practices with integrated resource management that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment. However, technologies and management schemes that can enhance productivity need to be developed to upgrade conventional agriculture along with preserving the natural resource need to be strengthened.

**Community-based extension approach for profitable dairying**

Dairy farm women need to create a horizontal networking to have a platform to share their ideas and strategies for their overall upliftment. In order to provide green forage, year-round alternate land use (Agroforestry) systems need to be developed on private or community lands in the vicinity of villages. The community lands, civil and panchayat lands, serve as potent source for grazing and hay production but do suffer from lack of management. "Every body's property is no one's responsibility", applies well to these areas. Legume and fodder tree/ shrub species and access to fodder minikits programmes need to be prioritised for production of good biomass. Management of natural forest by the community could be improved substantially, ensuring ecological stability and reducing biotic pressure on existing resources.

**Cooperation of government - NGOs for feminization of dairy sector**

It is hightime for the feminization of dairy. The solution lays in the formation of village level women self help groups. Concerted efforts of these SHGs, Govt and NGOs are required to fight against the constraints in each aspect of dairy farming practices. Government and milk federation must take corrective action for formation of village level cooperative societies, so that farmers get proper market for their milk with reasonable cost. In addition to this dairy development department must conduct skill-oriented long term training programs for production of value added milk products, so that they get more prices, from their raw material (milk). Local banks should encourage the rural women for dairy business by easily availability of loans with reasonable interest or providing subsidies to dairy farmers. The animal husbandry department should conduct vaccination/deworming/health care programme with the help of scientists to improve knowledge among farmers about importance of schedule vaccination, deforming and health care of dairy animals and also conduct training programme for milk producers of study area about better management of milch animals coupled with importance and techniques of clean milk production. Government as well as NGOs must take initiative for proper functioning of artificial insemination centres. Veterinary and animal husbandry officers, district dairy development officers and scientists must aware the farmers regarding scientific feeding practices to dairy animals through conducting training. If all suggestive measures taken up by government then only the study area will get momentum in feminization of dairy sector.

**Training needs of dairy farm women:** Training in technologies relevant to livestock management enhances knowledge and skills in animal rearing practices, disease management, and feed management, which eventually improve income to the household (Nirmala *et al.,* 2012). Training on balanced feeding ranked highest in information need as compared to breeding, marketing, management of cattle shed, etc. Training has made tremendous change

and interest among the trainees to gain more knowledge probably due to usage of method demonstration, audio visual aids and also their own different livestock species they could easily understand and remember the technologies taught in the training. Further, training if conducted frequently would increase the level of knowledge, which in turn reflects into better dairy farming and management and ultimately increases production performance of dairy animals.

**Conclusion**

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

**References**

Anonymous. 2012-17. Report of the working group on Animal Husbandry and Dairying, 12th five year plan

Chayal, K., Daaka, B.L. and Suwalka, R.L. 2009. Analysis of role performed by farm women in dairy farming. *Indian.J. Dairy. Sci*., 62: 491-494.

FAO. 2013. Understanding and integrating gender issues into livestock projects and programmes. A checklist for practitioners. E-ISBN 978-92-5-107514-2

John, C.R. and Thirunavukkarasu, M. 2002. Role of farm women in livestock keeping. *Indian Dairyman.,* 54: 35-40.

Lahoti *et al.,* 2012 Lahoti, S.R., Chole, S.R. and Rathi, N.S. (2012). Role of women in dairy farming. *Indian J. Dairy Sci.,* 65(5): 442-446.

Lalitha, N. and Seethalakshmi, M. 2001. Decision making behaviour of women in dairy sector - a micro study. *J. of Ext. and Res.,* 3: 63-67.

Nirmala, G., Ramana, D.B.V. and Venkateswarlu, B. 2012. Women and scientific livestock management: Improving capabilities through participatory action research in semi arid areas of south India. *APCBEE Procedia.,* 4:152 -157.

Sheela, K.S and and Ramegowda, A. 2013. Dairy cooperatives and empowerment of women. International Journal of Advanced Social Science and Humanities. 2(9), pp. 034-042.

Singh, K. and Singh, H.S. 2007. Forage resources development in Uttarakhand. Experiences and observations. Uttarakhand Livestock development board.(Personal communication)

Taneja, V. K. 2013 Women and livestock. http://www.dailypost.in/comments/columnists/3034-women and livestock.

Thakur, D. and Chandar, M. 2006. Gender based differential access to information among Livestock owners and its impact on house hold milk production in Kangra district of Himachal Pradesh. *Indian. J. Dairy. Sci.,* 59(6): 401-404.

Upadhyay, S. and Desai, C.P. 2011. Participation of farm women in animal husbandry in Anand District of Gujarat. *J. Community Mobilization and Sustainable Development.,* 6(2): 117-121.

WHO. 2009. Neglected tropical diseases, hidden successes, emerging opportunities http://whqlibdoc.who.int/publications/2009/9789241598705eng.pdf

# Poultry Production in India: Opportunities and Challenges Ahead

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Poultry industry in India has made considerable growth during last few decades and successfully transformed itself from the age-old backyard farming into a dynamic agri-based industry. Its development is not only been in size but also in productivity, sophistication and quality. Availability of high yielding layer (320-330 eggs) and broiler (2.4-2.6 kg at 6 wks) varieties together with standardized package of practices on nutrition, housing and management, and disease control have contributed to spectacular growth rates in egg (4-6% per annum) and broiler production (8-10% per annum) in India during last three decades. Consistent with increase in productivity, the annual per capita availability also increased to 61 eggs and 3200g of meat. However, it is far below the recommended consumption of 180 eggs and 10.8 Kg poultry meat per person per annum as by the Nutritional Advisory Committee. Thus to meet the nutritional requirement, the egg and poultry meat industry has to grow several folds.

## Current Scenario

Chicken dominates the poultry production in India. Nearly 95% of the total eggs are produced by chickens. India ranks third in egg production (78 billion eggs) and fifth in chicken meat (3.2 MMT) production in the world. The Poultry Industry is contributing about 1% to the national GDP and providing employment to about 5.0 million people. The poultry industry is concentrated in certain pockets of the country. The state of Andhra Pradesh leads the country in poultry production followed by West Bengal in the east, Maharashtra in the west, Tamil Nadu in the south and Punjab in the north. Availability of eggs is highly non-uniform in different parts of the country primarily due to wide variation in the production levels. Much of the eggs produced are consumed by the urban population while the rural and tribal areas have little access to the eggs and meat produced from the industrial sources and the availability is very low. In spite of rapid growth, the poultry industry suffered many setbacks in recent times due to rising cost of feed, emergence of new or reemerging of existing diseases, fluctuating market price of egg and broilers, etc. which need to be addressed to make the poultry sector as a sustainable enterprise.

## Feed Availability

The success of poultry production primarily rests on the quality of the bird employed, good environment and provision for balanced feed, the last being most expensive of all other inputs, deserves befitting attention. Feed accounts for 65-70% of broiler and 75-80% of layer production cost. Besides the provision of balanced feed, its effective utilization by the bird is equally important. Maize is the popular cereal used in combination with protein meal like soybean meal which generally determines the cost of compounded feed. Current demand for poultry feed in India is estimated between 21 and 23 mtes (mt) (Banerjee, 2015) and is expected to increase to 29 mt in 2020 and 39 mt in 2025 at the current growth rate of about 6% in poultry production (Mandal, 2012). Nutritionally, the soybean meal (SBM) is the choice feed ingredient in poultry diet as a protein supplement. India produced 11.95 mt of

soyabean during 2013-14 with an estimated 8-9 mts of soybean meal (SBM) after oil extraction (DAC, 2015). Of this, about 4 mt of SBM is used by poultry industry (Suresh, 2015). Further, the soya production in the country is estimated to be coming down over the years in the recent past (Chaturvedi, 2015). Owing to this stagnant/reducing levels of production and increasing demand for the growing poultry sector, the price of SBM has increased alarmingly over the years. Therefore, efforts are being made continuously in search of alternate energy and protein rich feedstuffs to maize and soybean meal, respectively, in poultry diets.

**Avenues opened to overcome shortage**

In view of the large gap between the demand and availability of feedstuffs for poultry production, a holistic approach is needed to meet the demand of ever growing poultry industry. Some of the approaches in these respects are

- **Identification of newer feed resources-** Since the production of cereals and oil seeds may not increase significantly, the availability of grain and oil seed meal to feed industry is expected to decrease. This would lead to escalation in the cost of feed ingredients and consequently the cost of eggs and meat. To some extent such a situation can be corrected by developing strains that need less feed input. However, feed ingredients that are not related to human consumption and available in plenty should be identified and their suitability should be tested.

- **Utilization of structural carbohydrates and phytate phosphorus-** With the advancement of technology, the reduction in dependency of poultry on the storage plant carbohydrate, protein or other nutrient and to allow them to make greater use of structural carbohydrates and other nutrients to meet the requirement of highly genetic potential stocks. Hence the dimension from research should change from as such providing feed than technologies that utilize feed better. There are many components of feed such as B-glucans, pentosans, mannans, cellulose,lignin and phytic acid which cannot be digested by poultry. These non digestible feed ingredients frequently generate digestive stress in poultry with a consequent reduction in nutrient utilization and wet litter problems. These problems could be largely alleviated by use of feed enzymes.

- **Overcoming limitations of Agro-industrial byproducts and unconventional feed stuff-** The influence of agro-industrial byproducts and unconventional feed ingredients on the performance of industrial commercial layers and broilers needs to be established before they are incorporated into feeds on regular basis. It is also essential to identify suitable easily adoptable and economically viable methodology to inactivate anti-nutritional factors and enhance the nutrient availability. The nutritive value of a variety of maize and soybean meal replacers has been examined and despite their potential, the utilization in practical formulations is negligible due to constraints imposed by several anti-nutritional, technical and socio-economic factors. These constraints need to be resolved by the feed industry utilizing the services of scientists, planners and policy makers.

- **Processing of feeds and their impact on nutritional improvement-**Commercial poultry diets normally involve the admixture of a number of different feed ingredients. Processing is

related to the treatment of materials during or immediately following and mixture with the purpose of providing a balanced diet suitable for consumption of poultry. Many incriminating factors of feed are also destroyed due to processing. The loss of nutrient through excreta and the cost of production can be minimized through processing of feed. This process generally involves some degree of grindings of the material which improves uniformity of admixture provides particles of a size perceived to be suited to the target group and may make nutrients more available for digestion in the birds. Subsequently the feed may be subjected to heat treatment or pelleting. The production of crumbles and pellet feeds, especially for broilers are in increasing trend. Steam pelleting and extrusion is much more effective to reduce microbial contamination in feedstuffs.

**Disease management**

Management of diseases in poultry plays an important role for the progress of the industry. Birds in the commercial farms are reared in open sided houses and maintained under optimum management conditions. Birds are reared under veterinary supervision. Vaccination is regularly practiced to protect the bird against diseases. In spite of all the measures, the poultry industry in India is suffering due to the outbreak of Avian Influenza almost every year. To minimize the occurrence of disease in poultry the three most important components of disease control are Bio-security, Vaccination and Medication. Bio-security refers to all measures taken to secure prevention of all types of pathogens in poultry farms. Effective bio-security and implementation of successful hygienic procedures are increasingly dependent on Hazard Analysis Critical Control Point approach (HACCP). The principles of HACCP such as hazard analysis, critical control points, critical limits, correction, recording and verification should be strictly followed for analyzing risk assessment and risk management. Vaccination should be practiced regularly following the regulatory procedures.

The priorities for effective disease management in making the poultry industry a sustainable enterprise are

- Trans-boundary disease – Many of the diseases which are not endemic to India (Avian influenza, VV+MD) may enter through of germplasm and biologicals. This need strict quarantine measures.
- Food safety – There is a worldwide concern to minimize the use of antibiotics in poultry because of disease resistance and antibiotics residues in food chain. In such case suitable alternatives need to be explored, which could be beneficial and cost effective. Many products of such nature like Probiotics, Gut acidifiers, immunomodulators, etc. are available in the market, but need further research.
- Establishing and strengthening surveillance and monitoring system – The surveillance and monitoring system should be carried out in established laboratories. There is need to establish a National Avian Disease Laboratory with all modern facilities for surveillance and monitoring of infectious disease in poultry.
- Diagnoses through genomic approach – Efforts are needed to develop new diagnostics and biological using genomic approaches for rapid and accurate diagnosis and effective control of poultry disease.

**Marketing**

Though, commercial production of eggs and chicken meat on scientific principles has been well standardized, marketing of eggs and broiler meat is not fully organized except few in urban sectors. Eggs are still transported in open condition and in un-refrigerated vehicles. Eggs are sold as commodity in India and purchased by consumers mostly from shop next door for daily needs. Eggs are channeled through wholesale dealers, sub-dealers, retailers etc. in two to three stages, which raises the cost of eggs by 10-15% over the actual sale price at producer's place. Broilers are sold live or slaughtered at the place of sale. Sometimes the birds are dressed and displayed for sale in the open air without any concern for hygiene. Similarly eggs are sold in open without consideration for preservation of their quality. Seasonal variations in consumption and demand of eggs and meat pose greatest challenge to the stabilization of prices. The fluctuations at times go to the extent of up to 30-40% in a short period of 3-4 weeks. Thus, there is a need to strengthen the marketing system. Some of the approaches in this direction are

- Development of reliable and stable market chain round the year for marketing of poultry products.
- Facilities for hygienic slaughter and preservation of eggs should be made available at market places in both urban and rural areas.
- Formation of producer co-operatives/ Associations and Rural market yards will help in proper marketing.
- National Egg Coordination Committee, a farmers' cooperative agency has been contributing to the improvement in marketing of eggs. However, more systematized marketing strategy and the State's involvement in minimizing the channels are required for making poultry farming remunerative and cost effective in the years to come.
- Because of the location of farms in semi urban and urban areas that too concentrated in few states, availability of eggs and chicken meat are high in these areas only, but in rural areas and rest of the country the availability is low. Thus, there is a vast scope to tap the rural markets and NE states where availability is low.

**Processing**

Trading of chicken in India is primarily done in number and not by weight at the wholesale level. Live and fresh dressed broilers account for the bulk of sales and sale of processed meat is limited (below 5%). However, acceptance of processed chicken is on the rise, particularly in the urban markets. Due to pollution and environmental concerns, slaughtering of birds under unhygienic conditions at open places is being discouraged. Thus, the sale of slaughtered chicken is expected to increase. Hence, there is a need to develop processing facilities. Hence, there is an urgent need of many chicken processing plants in the near future and sale of processed chicken to increase both to cater domestic as well as export markets.

A few plants for processing eggs have been installed using state of the art machinery in some states with an average daily turnover capacity of 0.7-0.8 million eggs. Whole egg

powder, yolk powder, egg weight powder, lysozyme etc. are being produced under high standards of operation. Egg powder from India is well accepted in EU, Japan and Far-east. However, to tap the international market there is a need to establish many more egg processing plants. It has been told that India is geographically ideally located to cater to the middle East and far eastern countries for shell eggs. Therefore vast scope exists to increase the export of shell eggs from India to these countries.

**Poultry Production in rural areas**

India has nearly 70% of its population living in rural areas. However, in the present scenario most of the commercial poultry production is concentrated in urban and peri - urban areas. Just 25% population living in urban areas consumes about 75-80 % of eggs and poultry meat. Non-availability of poultry products and low purchasing power of the rural people devoid them of access to the highly nutritious products like egg and meat, thereby, resulting in malnutrition. Free range and small scale semi-commercial back-yard poultry production can be advantageously promoted in rural areas, as the large commercial poultry production continues to be concentrated in urban and peri - urban locations. It can be used as a powerful tool for alleviation of rural poverty, eradication of malnutrition and creation of gainful employment in vast rural areas.

Adopting small scale poultry farming in backyards of rural house holds will enhance the nutritional and economic conditions of these people. A new avenue for poultry exports is also opening up as a result of the growing worldwide trend towards the consumption of eggs and meat from birds reared under free-range conditions The enormous contributions from the public sectors resulted in development of many chicken varieties suitable for backyard/ rural poultry farming. ICAR - Directorate of Poultry Research, Hyderabad under the aegis of Indian Council of Agricultural Research has developed two such promising crosses namely Vanaraja and Gramapriya. Vanaraja is a dual purpose bird, while Gramapriya is having good egg production potential. The attractive multicolor feather pattern, adaptability under diversified conditions and production potential in backyards made these birds quite popular in almost all parts of this country. Some of the promising varieties of rural poultry developed across the country are given below.

**Chicken varieties developed for rural poultry production**

| Variety | Type | Developing agency |
|---|---|---|
| Giriraja | Dual | KVAFSU, Bangalore |
| Girirani | Egg | KVAFSU, Bangalore |
| Swarnadhara | Egg | KVAFSU, Bangalore |
| Vanaraja | Dual | ICAR-DPR, Hyderabad |
| Gramapriya | Egg | ICAR-DPR, Hyderabad |
| Krishibro | Meat | ICAR-DPR, Hyderabad |
| Srinidhi | Dual | ICAR-DPR, Hyderabad |
| CARl Debendra | Dual | ICAR-CARI, Izatnagar |
| CARIBRO Dhanraja | Meat | ICAR-CARI, Izatnagar |

| Variety | Type | Developing agency |
|---|---|---|
| CARI Nirbheek | Egg | ICAR-CARI, Izatnagar |
| CARI Shyama | Egg | ICAR-CARI, Izatnagar |
| Upcari | Dual | CARI, Izatnagar |
| Hitcari | Dual | CARI, Izatnagar |
| Krishna J | Egg | JNKVV, Jabalpur |
| Narmadanidhi | Dual | JNKVV, Jabalpur |
| Nandanam IV | Dual | TANUVAS, Chennai |
| Gramalakshmi | Egg | KAU, Kerala |
| Kalinga Brown | Egg | CPDO, Bhubaneswar |
| Rajasree | Egg | SVVU, Hyderabad |
| Nicrorock | Dual | ICAR-CIARI, Portblair |
| Nishibari | Dual | ICAR-CIARI, Portblair |
| Kamrupa | Dual | AAU, Khanapara, Guwahati |
| Jharshim | Dual | BAU, Ranchi |

**Conclusions**

Despite of several challenges in the past, the poultry production in India continues to exhibit spectacular growth. With increasing demand for chicken egg and meat, the poultry production in India foresees further expansion and industrialization. Adoption of small scale poultry farming in backyards of rural house holds will enhance the nutritional and economic status of the rural people. With the advent of knowledge in different fields of poultry, the authors believe the future challenges will not be a hindrance and thus sees a bright future for poultry production in this country.

**References**

Banerjee, A. 2015. Future growth potential and economics of poultry feed industry in India. Think Grain Think Feed, 1 (12): 14-16.

Chaturvedi, A. 2015. Securitizing feed for poultry industry. Think Grain Think Feed, 1 (12): 05-06.

DAC. 2015. Pocket Book of Agricultural Statistics 2014. Dept. of Agriculture and Cooperation, Directorate of Economics and Statistics, Min. of Agriculture, Govt. of India.

Mandal, A. B. 2016. Poultry feed industry: Challenges. Proceedings of the XXXIII IPSACON 2016, PP - 53-57.

Suresh, P.J. 2015. Agricultural biotechnology has the potential to boost up the supply of raw material for feed manufacture. Think Grain Think Feed, 1 (12): 12-13.

# Drudgery and Ergonomics in Animal Farming: Implications for Women

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The rural women are the backbone of agricultural workforce but worldwide her hard work has mostly been unpaid. She does the most tedious and back-breaking tasks in agriculture, animal husbandry and homes. They perform various activities in the home as well in the field throughout the day but don't get any chance to take a nap and work like a machine without any break as compare with the man. Still women are considered as secondary workers in the economic scenario. The farmwomen perform almost each and every agricultural activity right from land preparation, weeding, sowing, transplanting to the harvesting and storage of the agricultural produce. The majority of these activities, which are full of drudgery and have not been supported by the mechanical advantages of tool and appliances. The farmwomen perform very heavy tasks along with household work. This is one of the reasons of health problem. They don't avail time for rest also. They were dominated by male counterpart in many of the families.

**Farm women's activities in animal rearing**

Rural women play a major role in animal rearing. They involved in cleaning shed, gathering dung, feeding animal, grazing animal, preparation of animal feed, buying feed, milking, processing of milk, fodder collection and chaffing of fodder. In animal rearing activities, women' s participation is highest in cleaning shed (82.7 %) followed by gathering dung (81.7 %), feeding animal (63.8%), preparation of animal feed (68%), buying feed(26.9%), milking, processing of milk (81.5 %), Fodder collection (69.8%) and chaffing of fodder (13.5%) and lowest involvement (only 1.2%) was found in animal grazing activity by farm women (Nayak, J. et al, 2012). Most of them carry out traditional practices in their household levels. Among different animal rearing activities cleaning shed and gathering dung, milking, collecting fodder and chaffing of it are the tedious activities performed by women are drudgery prone. They used to carry head load for disposal of dung, fodder and feed material. They use traditional tools such as fowda, broom, trolley, bullock cart, sickle in various activities. A study regarding farm women initiation in taking/carrying out animal rearing activities independently without assistance of male workers revealed that gathering and disposal of dung were such activities which were performed by 75.6 and 74.6 per cent women(Nayak, J. et al., 2012). Farm women mostly perform tedious tasks such as cleaning shed, gathering dung, fodder collection & chaffing and milking are drudgery prone. These activities may lead to occupational health hazard if not properly performed with care and precautions. There are several incidence of women injured due to hurt by animal.

**What is 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. Tedious, menial, or unpleasant work also can be termed as drudgery. 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). The main reasons for drudgery perception were monotone, tiring, laborious, repetitive and time-consuming tasks.

**Drudgery of rural women in animal rearing activities**

Drudgery is associated with a worker when he/she is doing a difficult task or a something he/she does not looking forward to doing due to tedious, menial, or unpleasant work. This affects the worker's physical and mental health and decrease the working efficiency or capacity. The worker remains disturbed and doesn't concentrate upon his/her assigned tasks. There are more chances of increasing rate of accidents at work places and absence of workers due to sickness. Women are more vulnerable in all cases because of their poor health condition, nutritional status, poor level of knowledge and skills, lower education, less awareness and exposure to different technologies and working for long duration at unsuitable workplace or working environment with awkward posture and repetitive motion of body parts. These are the factors which are directly or indirectly responsible for leading drudgery in various activities among rural women. In rural India women perform various activities such as household, farming and animal rearing along with rearing of children and caring of old family members. They devote their time according to their priority of the work. Fetching water, collecting fuel and fodder from distance places are very difficult for them. 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. These can be lead to severe drudgery, musculoskeletal disorders and other health related problems. In all the cases drudgery is very common and associated with the rural women in our country.

Rana, K.(2016) conducted a study to determine the physiological and biomechanical stress of women engaged in fodder collection in Mewat region of Haryana. Data was collected from 100 women to elicit information regarding their participation in various animal husbandry operations. Findings revealed that all of them women were agricultural labourers having family income up to Rs. 5000 per month, possessing 1-5 animals, belonging to nuclear family (65.00%) with a family size of 5-7 member (52.00 %). They were mainly engaged in animal husbandry to meet out the family requirements and supplement family income. Farmwomen

collected 30-35 kg of fodder per day, travelling a distance of 2-3 km, spending up to 3-4 hours per day in collection of fodder. Average working heart rate of women increased up to 112.3 beats per minute and 115.8 beats per minute in the two age groups, respectively. Energy expenditure was more in older (9.69 kJ/min) than younger group (9.13 kJ/min). Women perceived heavy exertion after the activity as it was performed under the scorching temperatures ranging between 43-45°C in the month of May and June. Since fodder collection is performed throughout the year, women have to face adversity of weather conditions, especially during peak summer and winter season. The findings of the study suggest that there is an urgent need to reduce drudgery of women in various farm activities including fodder collection. The study warrants an urgent need for promotion of training programmes in villages for addressing the issues of musculo-skeletal problems of women with emphasis on maintaining proper posture during fodder collection and other farm oriented activities. Promotion of improved sickle, especially designed for women, would be an important tool in hand to reduce drudgery of farmwomen. Nayak, D and Sumangala, P.R. (2015) carried out a study on dairy farming of rural women in Dharwad and Kalghatagi taluks of Dharwad district. The study was conducted to know the physiological workload and change the posture so as to reduce the musculoskeletal problems of the women respondents performing milking activity. A representative sample of 35 women were selected as sample under the study for observation and ergonomic assessment of dairy activities viz., milking by using traditional method and drudgery reducing implements. Selection of subsamples for experiment was based on their age i.e., 25-35 years. There was a significant reduction in energy expenditure, physiological cost of work, total cardiac cost of work, time taken and body angles when the activities were carried out by using Drudgery Reducing Tools i.e., revolving stand and stool for milking activity and Gopal khore spade in cleaning of animal shed activity. Kishtwaria J and Rana A (2007 ) conducted a study to design a women friendly fodder collector to alleviate her from back breaking drudgery of continuous bending during collection and bundling of fodder for animal feed. The research was carried out in three phases viz. survey, experimental analysis and field technology-testing trials. The cardiovascular, muscular, physiological and environmental stresses on women (N=30) while fodder collection were studied by employing various parameters viz. anthropometric data of women workers, physical fitness test, total cardiac cost of work, energy expenditure, rated perceived exertion and impact of environmental parameters on work output and health status both in existing practices and while using fodder collector for collection of fodder. The analysis of existing fodder collection practices by rural women showed stress on back and calf muscles, improper posture, lack of any tool/ technology to lessen the workload and drudgery involved. Hence, long handled standing fodder collector was designed to eliminate the repeated bending for collection and bundling of fodder. The results indicated a significant reduction in average and peak heart rate, circulatory and physiological stress of women while using fodder collector. Production per unit and coverage of land under operation was significantly increased. Usage of fodder collector significantly reduced the angle of bend, thereby, improving the posture and reducing the body pains. Therefore, training is suggested in use of both appropriate posture and technology to reduce drudgery, workload and stress on women.

Chauhan D and Dayal R (2008) carried out a study to find out musculo-skeletal problems among the male and female dairy workers in cleaning of cattle-shed. For the study, respondents of higher (40-50yrs) and Lower (30-40 yrs) age groups were randomly selected from three selected villages. The data for different parameters were collected through a questionnaire prepared for the purpose and analysed using statistical methods. It was found that cleaning of cattle-shed is a physically ardous activity and involves various risk factors which may be responsible for the development of various musculo-skeletal disorders among dairy workers. Further, it was noticed that females were more prone to musculo-skeletal disorders as compared to males. Both male and female dairy workers of higher age group were found most susceptible for WMSDs than dairy workers of lower age group. Hence, there is great need for the development of appropriate tools and techniques which may be safer for the health of dairy workers.

**Need for drudgery reduction**

The quality of work life of women in agriculture is characterized by long hours of work, awkward postures and drudgery experiences at work due to work load and unsuitable farming equipments. The education level was very poor and there was less awareness about using different agricultural implements. There were more drudgery and stress among the farm women found in the field. They adopt very awkward static posture squatting, bending, sitting and performed task repetitively which was responsible for musculoskeletal disorders and leads to occupational health hazards. They need more attention for better health and productivity. Above all women friendly ergonomically designed farm tools or implements should be designed to reduce drudgery and health hazards. This also leads in the direction of women empowerment. Human power plays a great importance in agriculture system since agrarian and they are involved in various farm operations. Hence in the design of farm tools and equipment, everything known about operator is very important, as they have to work with the designed/developed equipment. It is reported that many agricultural projects aimed at men with the assumption that they will somehow automatically benefit women though the ergonomical characteristics of women are different than men workers. The contribution of women is very high in the farm sector as they are involved in majority of farm operations and are therefore subjected to extra harsh conditions of work that leads to drudgery. Introducing women friendly improved farm tools and equipment can reduce drudgery in farm operations.

**Risk Factors at the workplace**

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

**Signs and Symptoms**

- Some people recognize symptoms in specific areas, while others feel weakness or tenderness over a large area, such as the shoulder.

- Signs and symptoms of injury may appear suddenly or gradually over a period of weeks, months or years.
- Discomfort, Pain, Numbness, Tingling, Burning, Swelling, Change in color, Tightness, loss of flexibility

**Ergonomics**

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

i) Fitting the demands of work to the efficiency of human in order to reduce stress.

ii) Designing machines, equipment and instalations so that they can be operated with great efficiency, accuracy and safety.

iii) Working out proportions and conditions of work place to ensure correct body posture.

iv) Adopting visual and thermal and acoustic environment to suit human's physical requirements.

**The Ergonomics Study**

- Identify risk factors that can lead to discomfort and pain, and make adaptations to improve work situations.
- Change the way people do their work
- Change the physical environment
- Modify work tasks, tools, equipment

**Principles of Ergonomics**

- Postures
- Force
- Reach
- Heights
- Motions
- Static load
- Pressure points
- Clearance
- Environment
- Stretching & exercise

The importance of ergonomics has been well-established and recognized in industry and military applications. However ergonomics is equally important and relevant in agriculture and related activities also. In most of the developing countries human work constitute as one of the important sources of farm power. In developed countries also human workers operate

various tractor operated/self propelled/power operated machines. Therefore in agriculture also, the application of ergonomics can help in increasing the efficiency and thereby productivity of the worker without jeopardizing his/her health.

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

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

**1. Anthropometry**

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

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

**2. Muscular strength**

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

remaining positions. From bio-mechanical parameters point of view, trunk portion seems to be responsible during hand cranking operation.

**3. Aerobic capacity**

$VO_2$ max (also maximal oxygen consumption, maximal oxygen uptake, peak oxygen uptake or aerobic capacity) is the maximum capacity of an individual's body to transport and use oxygen during incremental exercise, which reflects the physical fitness of the individual. It is considered as an International Reference Standard of cardio-respiratory fitness and depends on age, race, sex, body built-up, training etc. Astrand et al. (1973) reported that the women's power is on an average, 65 to 75% of that of man. Gite and Singh (1997) reported that the aerobic capacity of Indian men workers are about 2.0 l/min while for western workers value comes out to be about 3.0 l/min

**4. Physiological cost of operation**

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

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

**5. Posture**

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

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

**6. Load carrying capabilities**

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

**Safety Issues**

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

**Importance of ergonomics for drudgery reducing technology in animal farming**

Ergonomics is an applied science that deals with the adaptation of work and workplace to the characteristics and capabilities of worker so that he or she may perform the duty of job effectively and safely. It addresses the worker's physical capabilities in relation to the physical requirement of the job (eg. strength, endurance, flexibility, ability to tolerate postures and positions, visual and auditory acuity etc.) as well as his and her mental and emotional status in relation to the way the work is organized (eg. Work schedules, workload and work related stresses). Ideally adaptations are made to the work place, equipment, furniture and tools used by the worker and to the working environment to enable the worker to perform adequately without risk to him/her, co-workers and public. Thus, it is the field of study that examines human behaviourial, physiological and psychological capabilities and limitations. By understanding these, the professionals in this field can design new work environments to maximize productivity, worker's comfort and overall efficiency.

**Women friendly tools required for drudgery reduction in animal farming**

There are various tools and equipment designed by the scientists of AICRP on Home Science and ESA across the country. They have tested those tools and equipment with women's perspective in different locale of the country and refined/ modified according to the suitability of the rural women. Some of these are given following;

| Sl. No. | Name of the tool | Activity |
|---|---|---|
| 1. | Gopal Khore | Cleaning shed |
| 2. | Dung collector | Gathering dung and Cleaning shed |
| 3. | Revolving stool | Milking |

| Sl. No. | Name of the tool | Activity |
|---|---|---|
| 4. | Revolving Milking stand | Milking (to keep container fix) |
| 5. | Chaff cutter | Chaffing fodder |
| 6. | Improved Sickle | Harvesting fodder |
| 7. | Load fetching trolley | For disposal of animal waste |

**Conclusion**

The quality of work life of women in animal is characterized by hours of work, awkward postures and drudgery experiences at work due to work load and unsuitable farming equipments. There were more drudgery and stress among the farm women due to adoption of very awkward static postures and performed task repetitively which was responsible for drudgery, musculoskeletal disorders and leads to occupational health hazards. They need more attention for better health and productivity. Above all women friendly ergonomically designed farm tools or implements should be designed to reduce drudgery and health hazards. It also provides a platform to the researcher to refine the work station at various working environment and fit the worker within the environment. If the workplace will be modified ergonomically then drudgery, health and safety issues of the farmer/farmwomen/ worker can be solved ultimately. This also leads in the direction of technological empowerment of rural women involved various agriculture and allied activities. The suitability of equipment to farm women can be judged in better way using ergonomical studies as ergonomics cover all aspects that deal with anthropometry, assessment of workload, working environment and safety features/mechanism to optimise human-machine environment system. This helps in increasing their working efficiency with reduced drudgery by fitting to the capabilities and limit of human operators/workers.

**References**

Anonymous.(1992). Design of a Safer and Chaff Cutter. Reports on WHO Collaborating Centre for Research and Training in Safety Technology, Indian Institute of Technology, New Delhi.

Anonymous. (2008). AICRP on Home Science, Annual Report 2007-2008. Directorate of Research on Women in Agriculture, Bhubaneswar.

Anonymous. (2009). Visited web site http://en.wikipedia.org/wiki/Occupational _safety _and_ health on 12.8.2009 at 12.45 p.m

Anonymous(2012).Visitedwebsite http://wiki.answers.com/Q/What_is_the_definition_of_drudgery# on 12.8.2009 at 12.45 p.m

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

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

Chauhan, D. and Dayal, R. 2008. An Ergonomics assessment of work Stress of Dairy workers Interms of Musculo-Skeletal Problems During Cleaningo Cattle-Shed. Asian Journal of Home Science.Vol. 3 (1) : 1-3

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 Kot, L. S. (2003). Accidents in Indian Agriculture. Technical Bulletin No.CIAE/2003/103, Coordinating Cell, AICRP on Human Engineering and Safety in Agriculture, Central Institute of Agricultural Engineering, Nabibagh, Bhopal.

Jamal, S.1991. Women in Dairy Development. Concept publishing Company, New Delhi.

Kistwaria, J.; Rana, A.and Sood,S.(2009). Work Pattern of Hill Farm Women-A Study of Himachal Pradesh. Stud Home Comm Sci, 3(1): 67-70

Kishtwaria, J. and Rana, A. 2007. Ergonomic Interventions in Fodder Collection- Impact on Rural Farm Women. Anthropologist, 9(3): 221-224.

Kusum Rana.2016. Ergonomic Constraints Analysis of Women Agricultural Labourers Engaged In Fodder Collection -A Haryana study. *International Journal of Innovative Research in Science, Engineering and Technology.* Vol: 5(9), pp 16374-16381.

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.

Naik, D and Sumangala, P. R. 2015. Ergonomic assessment of women respondents performing dairy activities.*Karnataka J. Agric. Sci*., 28(2): pp 248-251.

Sharma, D and Sharma, S. (1998-99). Ergonomic study on farm women's drudgery. Annual Report. All India Coordinated Research Project. Department of Family resource Management, College of Home Science. G.B. Pant University of Agriculture and Technology.

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.

# Breeding Strategies For Rural Poultry Production

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Poultry production in India has transformed to an industry from a backyard venture over the past few decades. However, it is observed that poultry products are quite expensive in rural/tribal areas mainly due to their non-availability and lack of market chain. Therefore, consumption of eggs and chicken meat in rural areas is far below the national average. Farmers mostly used indigenous birds for rearing whose growth and production potential are low. These birds scavenge in the backyard with very little housing facility and management practices and whatever the hen produced are net profit for the farmers. It is important to note that the chicken variety used for intensive system of poultry farming may not perform well in the adverse environment condition of rural poultry farming. They need expensive infrastructure, balanced feed, housing and health care to show their genetic potential, which is not available in the rural remote areas. So there is need to develop a suitable variety of birds for the rural poultry farming which can perform better than the indigenous birds with little modifications in husbandry practices as practiced by the farmers. It is to mention here that the indigenous birds available with the rural and tribal areas are being kept with many generation of natural selection. By this process they might have acquired genetic potential to adapt the harsh environment of the rural poultry farming. The scavenging chicken in the rural production system remain neglected and not been subjected to any genetic improvement to enhance their performance as they received very little scientific attention. These birds need to be conserved and may be improved further through selection for their use in rural poultry farming. The rural poor farmers did not gain much from industrial type of poultry production system. Major poultry breeding companies do not offer better performing birds suitable for rural poultry farming. To affectively make an impact through rural poultry as an income generating activity research and development efforts required for developing suitable genotypes, with low cost health cover, low cost supplemental feed with available resources in the rural areas for sustaining their production potential. For successful rural poultry production it is necessary to develop a suitable germplasm which posses better production potential, have multicolour plumage, with long leg to escape from predators and resemble locally available desi (native) stocks. They also should posses high level of immunity for survival and should posses best scavenging behaviour to appropriately fit in to the rural condition. Keeping this in view many varieties of chicken for rural poultry are being developed for the rural poultry by various public sector organization and are popular with the rural/tribal people. However, further improvement and development of genotypes for location specific and improvement of local indigenous germplasm is required for rural poultry, which can play significant role in rural development.

**Advantages of Rural poultry farming**

Though the output of rural poultry is lower than that of intensive raised birds but it obtained with a minimum inputs in terms of housing, disease control, management and supplementary feeding.

Table-1.Comparison of village and commercial chickens (Alders and Pym, 2009)

| Feature | Village chicken | Commercial chicken |
|---|---|---|
| Labour inputs | Minimal | Considerable |
| Housing | Chicken houses of local material, en expensive, trees | Housing with conventional material, expensive |
| Nutrition | Scavenging feed resource base, leftover food, cereals, no supplements, in expensive | Balanced commercial ration, expensive |
| Water | Well water, used water, natural resources | Clean water supply essential |
| Production | Low, could improve with better nutrition, disease control and shelter from predators | High but require a high level of inputs |
| Meat quality | Little fat, pleasant flavour, preferred texture | More fat, less flavour, poor texture |
| Adaptability | Good; flight skills, more likely to escape predators, can scavenge for own feed | Limited; poor flight skills, easily caught by predators, less skilled at scavenging |
| Veterinary inputs | None; New castle disease vaccination; HPAI and fowl cholera vaccination in some country | Control of many viral bacterial and parasitic diseases essential for efficient production |
| Environment impact | Minimal: can be positive through provision of organic fertilizer and pest control | Negative: intensive production of cereals for rations; occasional improper use of antibiotics excess ammonia production |

**Breeding approaches for rural poultry**

Research in villages in different countries has revealed that genetic potential of village chicken is generally not the major constraints to their production (Dolberg, 2003). In fact where there is limited supplementary feed, housing and veterinary medication, rural chickens are much more likely to survive and reproduce than commercial chickens. The heavier commercial breeds often have problems escaping from predators, and are poor scavengers with poor broodiness. Therefore the ideal birds which can fit well in the backyard rearing would be those which can withstand the local conditions and are mostly local birds. Therefore, suitable breeding strategies should be adopted to produce a bird with better production potential simultaneously retaining the basic characteristics of the local birds to have good adaptability.

There are many breeds and strains of indigenous poultry, which are well adapted to their environment. There is a need for genetic improvement in order to improve their productivity in the local environment condition. Breeding is more challenging in free range poultry. Identification of poor layers is often unsuccessful and inbreeding is more common due to random mating within a close population. There is clearly a strong negative selection pressure for non- sitting hens. Breeding programme are not present in most free range poultry operations, mating are not planned and even the choice of the breeding rooster was quite arbitrary. Inbreeding among fowls may be possibly concern and fertility may have been quite low in some of the free range birds. There are large number of indigenous or local breeds and many of them are claimed to be unique for a particular zone or eco-zone. In addition defence mechanism against pathogen should be priority significance of threats posed by epidemics and climate change

**Breeding for performance under rural condition**

There are very few reports for breeding programmes for indigenous or local poultry breeds. It is mentioned earlier that under favouarable condition of high input production system no one question the superiority of commercial stock, however, under harsh conditions of low inputs rural poultry production the superiority is less obvious, especially in cost effectiveness. This is a classical example of genotype by environment interaction. (Singh et al, 2004). The utilization of the local germplasm for the development of rural poultry is the best means to ensure that they remain available for future generation. To be sustainable the utilization of rural poultry must efficiently meet current economic and social objectives without compromising the natural environment and resources.

**Breeding goals and criteria**

There is considerable scope for improving the performance of indigenous or local breeds. However, these breeds cannot compete with highly selected commercial hybrids. Thus a breeding programme involving indigenous or local breeds should identify alternative breeding goals and capitalize on the breeds specific attributes. The breeding goals is to improve the efficiency of indigenous population raised for rural poultry. This implies improving performance, reproduction and livability or survival.

Brooding and natural incubation capacity is an important criterion under village conditions as it is not possible to utilize artificial incubation. There is evidence that smaller body weight hens incubate and raise their chicks better than larger ones. The use of dwarfism gene may be of interest in this regard. Under village condition birds are continuously exposed to pathogens. Survival or longevity under these condition is an important indication of the bird ability to withstand bacterial or viral infection and should be used as a selection criterion for increased genetic resistance to diseases especially for comparing the progeny of different parents with different survivability

**Breeding strategies**

**Crossbreeding programme**

a) Indigenous cross hybrid (two way): This programme based on two way cross between an improved exotic and a local breeds with the aim of combining the better production capacity of the exotic with adoptability of local breeds to harsh environment. Such a scheme maximize crossbreeding effect.

b) Indigenous cross hybrid (three away) : In this programme both meat type and dual type birds can be produced with inheritance of 25 % local blood, 75 % exotic blood.

c) Exotic breeds hybrids: Two exotic breeds are used for the hybrids for rural farming.

d) Synthetic hybrids: Two way cross is produced using two synthetic lines (sire and dam lines) simulating characteristics of indigenous fowl but with improved economic pay back.

e) Back crossing: In this case two way hybrid of exotic and local germplasm are crossed again with the exotic lines to get the inheritance of 75 % exotic blood and 25 % local inheritance.

**Cockerel exchange**

This can be achieved by exchange programme of cockerels. Cockerels of improved breeds were distributed to the rural farmers.

**Straight breeding programme**

The nucleus flock is maintained either in a central station or in a breeding farm. This flock could have been established during the on-station characterization of local breeds. In this case, the superior breed according to the outcome of this characterization is maintained, although more birds of the chosen breed or ecotype might need to be gathered to have a sufficiently large base population. All the animals of the breeding nucleus are identified (full pedigree) and recorded for growth and egg production. Sire-pedigreed offspring of candidate sires are produced and distributed among small holders rural farmers in different villages, preferably in different regions, where they are recorded for egg production, market body weight, number of eggs set for natural incubation, number of chicks hatched and survival. The recording should be as simple as possible. Field and on station data are then used to select the best candidate sires to remain in the nucleus. Non-selected sires are sold to small holders rural farmers to disseminate the genetic progress into the local populations. This will also be done through distribution of non-pedigreed offspring of elite animals. These chicks, as well as those produced for testing candidate males, are sold at 2 to 4 weeks of age to ensure that they are vaccinated and have acquired the minimum body weight and vigour needed to survive in village conditions.

**Gaps and challenges in implementing breeding programmes**

Most breeding programmes, aimed at improving the productivity of indigenous chickens, have used cross-breeding. This approach has provided significantly higher productivity, but has resulted in a loss or dilution of the indigenous birds' morphological characters and instinct for broodiness. The best way to improve the productivity of

indigenous chickens, without altering any of the morphological characteristics that are appreciated by the villagers, is to select for production traits within a given population.

The structure of the crossbreeding programmes was too complex for village conditions, where crucial inputs, such as feed and medication, were not readily available. The need for periodic re-supply of cross-bred chicks to the villagers presents a challenge. This has to be carried out either by an NGO or by a government agency, which has to maintain the pure lines of the indigenous birds as well as of the exotic birds on an appropriate selection programme. A mechanism for re-supplying the birds, providing minimum inputs, and marketing the eggs and culled birds, has to be put in place in order to achieve success with programmes of this type.

**Development of stocks for rural poultry**

Since independent efforts in our country made to produce dual purpose breeds and hybrids with the improved production profiles. The exchanges of hatching eggs, introduction of exotic cockerels were adopted. Development of different crossbreds involving exotic breeds with indigenous, exotic breeds cross, synthetic hybrids were released and are very popular in different parts of the country. Both dual purpose and egg type hybrids were used with the pure line are being maintained and selected for further improvement of the hybrids in the rural environment condition. Some of the improved varieties used for rural poultry are presented in table-2.

Table.2. Some improved chicken verities developed by different organizations for rural poultry farming

| Variety | Purpose | Developed by |
|---|---|---|
| A. Development of germplasm by crossing an exotic breed with a synthetic population | | |
| Vanaraja | Dual | Project Directorate on Poultry, Rajendra Nagar, Hyderabad |
| Gramapriya | Egg | Project Directorate on Poultry, Rajendra Nagar, Hyderabad |
| CARI Devendra | Dual | CARI, Izatnagar |
| Kuroiler | Dual | Kegg farms, Delhi |
| B) Development of germplasm by crossing an indigenous breed with an exotic breed | | |
| CARI Nirbhik | egg | CARI, Izatnagar |
| CARI Shyma | egg | CARI, Izatnagar |
| Hit CARI | egg | CARI, Izatnagar |
| Nicorock | Dual | CARI, Portblair |
| Nishibari | Dual | CARI Portblair |
| Up CARI | egg | CARI, Izatnagar |
| C) Synthetic Crosses | | |
| Giriraja | dual | KVAFSU, Bangalore |
| Nandanum | dual | Vety. College, Chennai |

| Variety | Purpose | Developed by |
|---|---|---|
| Krishna J | egg | JNKV, Jabalpur |
| Satpura Desi | dual | Yashwant Agro Tech, Jalgaon |
| D) Exotic breed Crosses | | |
| AVM coloured | Meat | AVM hatchery coimbatore |
| CARI Gold | dual | CARI, Izatnagar |
| Gramalaxmi | egg | KAU, Mannuthy |
| Gramasree | Dual | KAU, Mannuthy |
| Kalinga Brown | egg | CPDO, Bhubaneswar |
| Krishnapriya | Dual | KAU Mannuthy |

(Source: Sharma *et al*., 2008 and Khan, 2008)

Keeping the importance of rural poultry production Indian Council of Agricultural Research (ICAR) increased the number of centres of AICRP on Poultry Breeding to develop location specific germplasm for rural poultry.

Besides chicken in some coastal areas of the country duck farming is an important activities. Ducks are reared for the meat and egg production. Indigenous ducks are mainly used for duck raring. However, exotic breeds like Khaki Campbell and White Pekin are also available for the rural poultry farming. Ducks are less prone to many poultry diseases and produced larger egg size compared to chicken. It is reported that the growth and egg production increases in crossbreds of Indigenous and Khaki Campbell ducks (Padhi *et al*, 2009). Some farmers of our country in different states are also using guinea fowl and turkey for rural poultry production.

Poultry is the only industry where modern technology co-exist with traditional poultry keeping. Rural poultry production constitutes important component of agricultural economy in India. Small poultry holders are practically capable of more significant contribution to alleviate malnutrition, poverty and unemployment from the country with the use of improved rural poultry germpalsm. Genetic improvement of rural indigenous population is a challenging but not impossible task. Guidelines for the design and implementation of improvement programme need to be developed. It is also important to increase awareness of the values of rural poultry among all the stake holders and policy makers.

**References**

Alders, R.G. and Pym, R.. A. E.(2009)Village poultry: still important to millions, eight thousand years after domestication. World'Poultry Science Journal. 65:181-190.

Dolberg, F.(2003) review of household poultry production as atools in poverty reduction with focus on Bangladesh and India. FAO propoor livestock Policy instiative Working paper No.6.

GOI (Goverement of India). (2006), Report on basic Animal Husbandry Statistics. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, AHS series-10.

Khan, A.G. (2008). Indigenous breeds, crossbreds and synthetic hybrids with modified genetic and economic profiles for rural family and small scale poultry farming in India. World's Poultry Science Journal.64:405-415.

Padhi, M.K., Panda, B.K., and Sahoo, S.K.(2009). Comparative performance of Khaki Campbell, Desi ducks and their crossbreds. Indian Veterinary Journal.86:942-945.

Sharma, R.P, Chatterjee, R.N., Rama Rao, R.V. and Sharma, S.R. (2008). Poultry Production in India. ICAR, New Delhi.

Singh, D.P., Johri, T.S., Singh, U.B., Narayan, R and Singh, D. (2004). Impact of constaraints minimization on productivity and populatrity of traditional backyard poultry production. Proc. Of XXII World's Popultry Congress, Istanbul, Turkey

# Government Programmes and Policies for Promoting Poultry Production

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Regional Poultry Farm was established during 1959-60 with an objective of acclimatizing multiplying two exotic strains of White Leghorn and Rhode Island Red. Scientific breeding programme was envisaged in 1970 to improve genetic potentiality and the Regional Poultry Farm was re-designated as Central Poultry Breeding Farm. Consequent upon merger of the Random Sample Poultry Performance Testing Centre (Established in 1977) and Regional Feed Analytical Laboratory (Established in 1981) with the Central Poultry Breeding Farm, the Central Poultry Development Organization (CPDO) came into existence from 19th June, 2003.

**Vision**

"Premiere organization and knowledge centre for supply of quality rural chicken and low input technology birds for Rural Poultry Development in the region.

**Mission**

CPDO(ER) is committed to produce, supply poultry products including chicks and quails, test livestock feeds and train farmers/ entrepreneurs as per the requirements

**Services of CPDO**

The role and services of CPDO (ER) is enormous in the field of rural backyard poultry and industrial poultry development in agricultural country like India. As per 18th livestock census, the population of rural poultry and industrial poultry are equal.

- Out of 28 states and 7 UTs, CPDO(ER), Bhubaneswar supplying parent as well as commercial day old chicks and hatching eggs of low-in-put technology birds of 11 poultry breeds and 6 verities of Japanese quails to all 8 North Eastern States (backward states), 4 eastern states ( West Bengal, Chhattisgarh, Odisha & Jharkhand) and, UT (A&N), other states like Bihar, MP, UP, Maharashtra etc. for rural poultry development which is a number one livelihood program in the country. Overall CPDO(ER) is catering more than half of the country under this program.
- This Organization produces a valuable Layer Breed named as "KALINGA BROWN" which is very popular across the nation.CPDO(ER) is imparting poultry training in the above states and UTs under which it enhances nutrition and reduces the vulnerability of poor, landless labourers, women, unemployed youth, marginal and small scale farmers. Under this program Intensive Tribal Development(Govt. of Odisha) has been specially benefitted by this training programme and right now producing more than one lakh broiler per week by their tribal beneficiaries and the production is self sufficient to meet the demands of tribal school and Ashram's of six Districts.

- So far as food safety and traceability is concerned, CPDO(ER) analyzing feed and feed ingredients of poultry, fish, lab animals, wild animals and other livestock received from all over the country.
- CPDO(ER) is playing vital role under the Government of India Centrally Sponsored Poultry Schemes like **Assistance to State Poultry Farms, Rural Backyard Poultry Development and Poultry Estates.**
- This institutes supply quality eggs to Odisha Biological Products Institutes (OBPI) for production of poultry and other livestock vaccines.
- CPDO(ER) is also supply quality eggs to Frozen Semen Banks of the states for dilution and preservation animal semen.
- Eggs, DOC and grown up birds are used as source of food for zoo animals at Nandankanan.
- The embryonated eggs and DOC of this institute are being used for research by the zoology students of science colleges of the state.
- Provide poultry intensive training to veterinary graduates of the state.
- Provide facilities to post graduate and doctor of philosophy students of life science, zoology, & veterinary science for their research program.
- This institute is closely associated with village poultry farmers through Kishan Call Centre (KCC) to solve day-to-day problems and provide all types of technical services.

**Policies for Poultry Development**

Poultry has been the fastest growing sector in providing employment and income to a significant number of people in the state of Odisha. The backyard poultry also plays a vital role in supporting livelihoods of million poor people particularly the tribal and the scheduled caste. As per the available statistic about 62 commercial layer farms having 40.5 lakh birds are running in the state with production of 36.36 lakh eggs per day. Presently, about 4,792 broiler farms with commercial broiler bird strength of 85.63 lakh are in operation. The broiler placements are 20 to 25 lakh day-old – chicks per week and 18 to 23 lakh adult broiler birds per week are entering to the market for meat purpose. The per capita availability of egg is 56 per person per year in the state as against of 180 eggs as advised by the nutritional advisory committee. Similarly the poultry meat availability is around 3kg per person per year.

The poultry sector in Odisha is divided into traditional and commercial poultry production system. The rural based traditional system constitutes 60% of the total poultry population in the state and supplies most of the eggs and meat consumed by the rural area. Backyard poultry rearing is widely accepted in the rural areas of the state due to low investment in terms of infrastructure. It also provides supplementary income to small and landless farmers and is taken care by the family, especially by the women. It also provides 10% of the poultry products in urban and peri-urban areas where commercial poultry production is practiced. The dual purpose varieties developed by various organizations which are coloured, phenotypically similar to desi birds but grow faster and produce more number of eggs are the choice of birds for backyard poultry rearing. The backyard poultry production scheme is proposed through rearing of low-input technology birds such as Vanaraja, Gramapriya,

Giriraja, Girirani, Rainbow roosters, Kuroilers etc. for alleviating rural poverty and protein hunger by the Government.

Odisha is one of the leading states to have declared as agriculture and initiated many promotional efforts such as

- Reduction of electricity tariff for poultry farming
- Reimbursement of VAT on maize and broken rice used for poultry feed
- Supply of egg in mid day meal scheme at primary schools.
- The dual purpose parent stocks developed by various organizations under Indian Council of Agricultural Research (ICAR) are being maintained by the State owned poultry breeding farms for supply of chicks to the farmers for backyard poultry.
- Poultry hatcheries have been established in all the districts of the state to supply day old chicks of dual purpose birds suitable for backyard poultry farming.
- Central Poultry Development Organization (CPDO), Govt. of India, Bhubaneswar is also collaborating with the State Govt. to supply hatching eggs and parent stock-day old chicks.
- Stamp Duty exemption of 100% will be allowed on purchase of land in any part of the state (maximum 10 acre for one layer unit and 6 acre for one unit of broiler parent bird) after furnishing bank guarantee and certificate from the Chief District Veterinary Officer

**Schemes for Poultry farming**

**Commercial layer farming**

The state Government is proposed to take up bankable projects for establishment of 60 lakhs commercial birds in next 3 years.

- Expansion of existing commercial layer units: Capital investment subsidy is available for establishment of Commercial layer poultry unit. It is planned to encourage existing poultry layer units for additional expansion of 10 lakhs over a period of 4 years.
- Setting up new commercial poultry layer farms: It is planned to encourage prospective entrepreneurs to set up new commercial poultry layer units for an additional capacity of 50 lakhs over a period of 4 years.

The financial assistance in shape of loan will be available from commercial and co-operative banks for taking up the poultry farming. The technical officers of the Fisheries& Animal Resource Department, Krishi Sahayak Kendra and banks (NABARD) will provide guidance to the entrepreneurs for preparing the project to submit to bank for loan.

**Commercial broiler farming**

It is planned to establish or expand existing commercial broiler units to an additional capacity of 40 lakhs over a period of 4 years. The broiler farming can be undertaken either

individually or through integrators. Subsidy will be provided to the farmers for setting up the new broiler unit or expansion of existing unit under Poultry venture Capital Fund through NABARD and State agriculture Policy-2013 (40% of the fixed capital excluding the land cost & 50% for SC/ST/Women/Graduates of Agriculture and Allied Disciplines subjected to al limit of 50 lakhs).

**Backyard Poultry Farming**

The backyard poultry production scheme is proposed through rearing of low-input technology dual purpose birds such as Vanaraja, Gramapriya, Giriraja, Girirani, Rainbow roosters, Kuroilers etc. which grow faster and produce more eggs than country chickens. As per Government of India Rural Backyard Poultry Scheme Guidelines, 20 chicks will be given initially, followed by 15 and 10 chicks with interval of 16 weeks each. Each unit will get assistance for construction of night shelter for birds and for procurement of 45 numbers of four-week old chicks.

# Women Empowerment and Livelihood Security Through Small Ruminant Production

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Livestock play an important role in the economy of India and sustainable livelihood of rural poor. In India, about 75 % of rural households are small and marginal farmers, who own 56 % of the large ruminants and 62 % of the small ruminants (World Bank 1999). Small ruminant production in India contributes to 4.8 and 3.4% of total world meat and milk production (Karim and Sahoo, 2012). Small ruminants contribute 15 to 27 % of family income of smallholders and provide gainful employment of 180 to 330 man-days per annum depending on the size of the flock. It has also been shown that irrespective of flock size, women and children contribute to labour force to the extent of about 90 % (Misra et al., 2000). Women form the backbone of agriculture and play a significant role in animal husbandry especially small ruminant farming. Despite the fact that women in India do most of the work in animal production, their work remains mostly invisible. Gender divisions in agriculture are stark, with all activities involving manual labour assigned to women, while all operations involving machinery and drought animals are generally performed by men. Therefore, the challenge is to develop novel mechanism involving all stakeholders (researchers, extension workers, NGOs and farmers) to provide a better environment to enable that developed technologies are need based and women friendly and hence increase the likelihood of adoption by the farm women for their upliftment.

In small ruminant production system, goats are among the main meat-producing animals in India, whose meat is one of the choicest meat and has huge domestic demand. Besides meat, goats provide other products like milk, skin, fibre and manure. They provide food and nutritional security to the millions of marginal and small farmers and agricultural labourers. However, the productivity of goats under the prevailing traditional production system is very low as they are maintained under the extensive system on natural vegetation on shrinking degraded common grazing lands and tree lopping. Moreover, adoption of improved production technologies/ management practices in the farmers' flock is very low. Therefore, rearing of goats under intensive and semi-intensive system using improved technologies for commercial production has become imperative not only for realizing their full potential but also to meet the increasing demand of meat in the domestic as well as international markets. Goat production system in India has been slowly moving from extensive to intensive system of management for commercial production and entrepreneurship development by farm women. However, inadequate availability and poor quality of feed and fodder, high incidence of diseases and inadequate knowledge on appropriate management of livestock were identified as the major problems in small ruminant production system. A favourable policy environment in terms of access to micro-credit, assured market and veterinary services will have to be provided and socio-economic and technical constraints needs to be addressed to enable farm women for livestock development.

**Issues and Scope in improving small ruminant production system**

Several large and progressive farmers have adopted commercial farming which help in increasing the productivity of small ruminants and bridging the demand-supply gap. However, use of improved technologies, particularly prophylaxis, superior germ plasm, low cost feeds and fodders, and innovative marketing of the produce would be the pre-conditions for successful commercial production. Since sheep and goats are very well adapted to harsh environmental conditions, producers use them to diversify their livestock management portfolio and to decrease their risk in case of adverse weather conditions such as drought. Small ruminants protect the producer's capital against inflation and enable to restock his farm when the environmental conditions improve. Another factor that decreases the investment risk in sheep and goats is their much shorter reproduction cycle that gives them the capability to rebuild population numbers much faster than cattle after any kind of reversal.

Under crop-livestock production conditions small ruminants compete for the available resources (land, capital, and labour) with the other farm enterprises. Lack of improvement in the productivity of sheep and goats is often attributed to the lack of skilled labour. Most of the labour is provided by the family. The person responsible for the day-to-day care varies widely depending on cultural factors, the number of animals, the production system (extensive or intensive) and other reasons. The role of women in the case of sheep and goats varies considerably depending on the country, region, ethnic groups, etc. In many places women not only take care of the animals but also own them and market them. As production systems become more sophisticated, so do management skills. This is one of the most serious constraints in achieving higher production rates. Training and technology transfer, adapted to women's schedules covering all aspects of production management may solve the problem.

During the initial phases of the animal farming, high mortality in sheep/goats due to PPR, diarrhoea, pneumonia, tetanus, etc. is a major concern of the farmers due to lack of knowledge about package of practices of improved goat farming, poor prophylaxis, non-availability of vaccines, etc., poor preparedness of the farmers, lack of personal attention of the entrepreneurs and poor access to veterinary doctor with experience of small ruminants. Difficulty in getting good quality breeding animals is also a major constraint. The best male animals from the traditional flocks were sold for slaughtering to traders resulting in scarcity of good quality breeding animals. Lack of organized efforts for breed improvement has been compounding this problem. Since large flocks of different breeds under commercial production are only few, the entrepreneurs had to select the breeding animals from the available traditional flocks mostly through middlemen. Therefore it takes a long time to establish a good flock. Non-availability of vaccines, especially PPR, was another major constraint. The trade of live animals which is unorganized and is in the hands of a large number of middlemen, traders and butchers, does not favour farmers. The live animals were sold not on the basis of their body weight in the livestock markets resulting in under-estimation of the value of live animals. The availability of institutional credit was relatively easy for large projects, but was another constraint for the small entrepreneurs with projects of 50-100 sheep or goats and had limited capital for collateral security.

**Strategy to improve livelihood security of farm women through improved farming**

Small ruminants are widely distributed and are of great importance as a major source of livelihood of the small farmer and the landless in rural communities. Indications, however, are that the productivity of small ruminants in this system is low and that there is ample opportunity for improvement. Age at first parturition, parturition interval and litter size determine lifetime production as well as efficiency of production. Several of these production parameters can be improved because they are under the influence of environmental and ecological factors. Of paramount importance to economic productivity and reproductive efficiency in small ruminants is mortality. All of these effects are clearly related to nutrition, health and management. For starting and maintaining a profitable and successful small ruminant farming, strategic planning is required being detailed as follows.

**Selection of Breed :** Breed selection is the main asset which give farmer's business a boom and a good uplift. Based on the region and climate pure breed (Sirohi, Jamnapari, Barbari, Beetel, Black Bengal) and cross breed (sirohi and black bengal, jamnapari and sirohi, beetel buck and black bengal) are best suited. Based on the geographical situation, 3 types of sheep in India like Gurez, Karanah, Bhakarwal, Gaddi, Rampur-Bushiar (Temperate Himalayan region), Lohi, Bikaneri, Marwari, Kutchi, Kathiawari (Dry western Region) and Deccani, Nellore, Bellary, Mandya, Bandur (Southern Region) are most suitable.

**Selecting farm area and housing :**The site having great source of fresh and clean water supply, availability of all types of equipment, easily available food source, fertile field for crop, grasses and other green plant production should be selected. House should be neat, clean, dry with proper ventilation and drainage system inside facilited with good transportation and veterinary service along with proper marketing facility. Goats do not thrive on marshy or swampy ground. Goats should be provided with a dry, comfortable, safe and secure place, free from worms and affording protection from excessive heat and inclement weather. The space requirement for adult sheep/ goat is 4.5 to 5.4 sq.m.

**Feed resource and feeding :** Feeding management is also very essential for commercial farming. Goats were maintained on grazing in harvested fields, along the roadside and on other uncultivated/ barren lands. The natural ability of goat to eat a wide variety of vegetation and waste has been, in fact, a big motivating factor for small, marginal and landless laborers to rear small number of goats. Stall-feeding in goats was very limited. So an integration of forage legumes into the cropping system of small stock owners would go a long way to improve the productivity of their animals (Shalander and Upadhyay, 2009). By introduction of legumes like Siratro *(Macroptelium atropurpureum), Stylosanthes hamata, S. scabra, Glycine javanica, Dolichos auxilaris, Desmodium spp and Centrosema pubescens* etc., the quantity as well as quality of herbage production can be substantially increased. Indigenous legumes such as clovers (*Trfolium pratens*, *T. repens*), *Medicago denticulata, Melilotus alba*, white clover, red clover have proved successful apart from Lucerne and berseem. *Leucaena leucocephala* and even perennial pigeon pea etc. are pruned frequently to provide leaf fodder to get better crop production. For augmenting fodder availability, emphasis needs to be given to cultivated fodder crops on large area. Foliage of fodder trees could be fed to the livestock in mixture with crop residues and hay to improve their palatability and nutritive value.

She goats are given kitchen waste and the males are given inferior quality grains and grams for fattening purposes. Goats eat 4-5 times that of their body weight. They eat more of tree fodder and hence 40-50% of green fodder should contain tree leaf fodder in roughages. Goats should be fed with concentrate mixture consisting of maize, wheat, horsegram, groundnut cake, fish meal and wheat bran. Sheep are excellent gleaners and make use of much of the waste feed. They consume large quantities of roughage, converting a relatively cheap food into a good cash product. A sheep requires about 1-2 kg of leguminous hay per day depending on the age of sheep and its body weight. Proteins may be supplied through concentrates such as groundnut cake, sesame cake or safflower cake when the pastures are poor in legumes or when scarcity conditions prevail. Normally 110-225 g of cake is sufficient to maintain an average sheep in good condition. Feeding a mixture of common salt, ground limestone and sterilized bone meal in equal parts is required to alleviate deficiency of minerals in the feed. Abundant clean fresh water should be made available to goats. Water should be changed every morning and evening. The mineral mixture may be included in the concentrate ration at the rate of 2 per cent. Lumps of rock salt are should be hung up in some suitable place where sheep and goats can easily get at them, or else they may be kept in the manger. The provision of salt licks and supplementation of vitamins A, D and E is also essential for optimum production.

**Breeding and management:** Indiscriminate breeding is prevalent in the area. No efforts seem to have made to improve the stock through selective breeding or by introducing high potential breeds. Male goats are taken better care of than the female ones as these fetch good price to the owners. Many do not like goat milk; hence, less priority is attached to milk traits of the goats. Genetic improvement and or efficiency of production can be more easily ameliorated in small ruminants because they have a faster population turnover rate. Such progress would be achieved if increased selection pressure is effectively applied. Use of same buck for mating with numerous does at same day should be avoided and artificial insemination should be encouraged providing door-to-door service and to serve as a training centre to promote entrepreneurship among the unemployed youths. For effective health, animals should not be provided contaminated food or polluted water. For commercial production, arrangement of separate housing of kids, bucks and does and extra care to the breeding bucks, kids and pregnant does should be provided.

**Prevention and control of diseases:** Since goat production is only a fringe activity for most of the farmers, the health problems of goats were hardly paid any attention. However, goats suffered mainly from worm load, mange, mineral deficiency, anorexia, contagious ecythyma, diarrhea, mastitis etc. Various types of viral diseases like PPR, goat pox, foot and mouth diseases and bacterial diseases like anthrax, brucellosis etc. are very harmful for goats. Proper scheduled vaccination is a must to prevent this type of diseases to overcome the mortality rate in goats. The does which was not vaccinated PPR, goat pox, brucellosis vaccines previously should be vaccinated at the fifth month of gestation. Kids should be vaccinated with PPR vaccine at 5 months of age.

| Diseases | Animal | Vaccine | Dose | Immunity | Time of vaccination |
|---|---|---|---|---|---|
| PPR | Goat and sheep | PPR | 1 ml S/C | 3 year | - |

| Diseases | Animal | Vaccine | Dose | Immunity | Time of vaccination |
|---|---|---|---|---|---|
| FMD | All cloven footed animals | Polyvalent FMD vaccine | 3 ml S/C | 1 year | February & December |
| Anthrax | All species of animals | Anthrax spore vaccine | 1 ml S/C | 1 year | May-June |
| Enterotox aemia | Goat and sheep | ET vaccine | 5 ml S/C | 1 year | May-June |
| CCPP | Goat and sheep | IVRI vaccine | 0.2 ml S/C | 1 year | - |
| Rabies | All species of animals | Rabies post bite vaccine | 1 ml S/C | 1 year | 0,3,7,14,28,90 days |

*Before vaccination, deworming is compulsory to get better results

Helminthiasis and ectoparasitosis are widespread in tropical countries and both seriously affect the productivity of small ruminants. Helminthiasis is a serious problem towards the end of the rainy season while ectoparasitosis inflicts heavy damage during the rains to early dry season. Vaccination programme would be even more viable in the pastoral and agro-pastoral regions. An efficient, well-planned animal health service is a pre-requisite for increasing small ruminant production. Any improvement in animal health services must go hand in hand with an adequate improvement in the provision of feed to achieve expected improvements in productivity**.**

**Marketing :** Marketing is the most important but easiest step of small ruminant farming business. Commercial producers can target the international market and export the products in foreign countries. Total expenditure and profit from goat farming business depends on the farming system, location, breeds, feeding cost and some other factors. By good planning and proper management farming business can be profitable. Small scale farming require less investment and profit can contribute regular income. Small ruminant especially goats offer a strong opportunity to development agencies for suitable interventions including micro credit, extension, technical and marketing support especially to women farmers.

**Small Ruminants : Role in improving household social & financial security of farm women**

The importance of small ruminants in income generation and households' social and financial security are well established. The small size of sheep and goats has distinct economic, managerial, and biological advantages. The coefficients of educational level, extension contact, membership of cooperatives and flock size are positively related to income realised from small ruminants rearing. The coefficients of age, household size and poverty status are negatively related to it. Higher the educational status and the higher the flock size of respondents, the higher the income realisable from small ruminants rearing, because education enhances adoption of better management practices that can boost productivity and sales of farm produce. Thus, increased/enhanced income is assumed to be a precursor of

being able to meet household financial obligations. Small ruminants described as the 'village bank' are of economic importance to small-holder farmers and especially women. Women are better managers of household resources than men. Thus, an improvement in the financial security of rural women through rearing small ruminants would inevitably translate to better living conditions for households. Some policy and support services are required to ensure improvement of livelihood security of farm women are:

- ✓ Effort should be intensified at building capacity of rural farm women through education which can enhance their productivity through better adoption of technology that will invariably enhance output and increase revenue.
- ✓ Governments should intervene to encourage women to engage in cooperative activities by providing the initial take-off capital needed and fostering an enabling environment for cooperative activities to thrive.
- ✓ Government efforts should also be intensified at making more extension agents available and accessible to these women through employing more hands to complement available personnel and giving them all necessary incentives.
- ✓ Village based institutions should be enabled to handle the term loans for livestock production, as this is the simplest solution for accessing loans and repaying them. In addition, women self help groups as institutions for cash/micro credit for livestock production should be promoted as a part of livestock schemes under rural development programmes.
- ✓ Extension approach should be need-based with problem-solving dimensions and participatory in nature. The exposure visits and training were essentially aimed at strengthening the human capital of the individuals i.e ethno-veterinary training provided to traditional healers to upgrade their skill and capacity; groups with specific needs for training on fodder production be imparted fodder technology.
- ✓ A massive campaign required to launch capacity building and empowerment of village communities that will act as the harbinger of change and technology adoption and to establish the foundation for a farmer-to-farmer livestock extension mechanism and need for the Government to continue to protect the interests of livestock producers.
- ✓ The need for appropriate policy about small ruminant breeding and delivery services (credit, health, market and extension) and steps to improve feed and fodder situation are strongly recommended for sustainable development.

  Management of scientific lines should be encouraged to become the centres of production of superior quality breeding animals. Considering good economic potential in commercial sheep/goat production, some large industrial houses such as Hind Agro Industries (a major meat exporter of the country) are entering into goat farming business, especially for the export market. However, for availing the benefits of lucrative export market, food safety standards will have to be developed. In the longrun, vertical and horizontal integrations would have to be evolved for achieving sustainability of commercial production and remaining competitive in the global market. Service centres will have to be established to provide technical knowledge,

recommended inputs and market information. Small size modern slaughterhouses need to be established near the production centres to maintain commercialization of small ruminant production. The private sector may be encouraged to create such infrastructures through appropriate policy support and incentives to enable the farmers to enhance their productivity and reduce cost of their production.

**Conclusion**

Small ruminants as a source of supplementing household income is getting increasing attention especially among the landless agricultural laborers and small and marginal farmers. Women are increasingly finding it as a potential source of earning cash income to meet their personal requirements. The tradition bound communities currently not rearing goat though economically poor should be motivated through educational and incentive based developmental interventions to take up goat husbandry in entrepreneurship mode for their upliftment. Education through training on improved practices of goat farming may develop access to resources, skill and marketing channel, improve decision making ability and women empowerment which in turn improve socio economic status, self sufficiency, welfare of the rural farm women.

**References**

World Bank 1999. India: Livestock Sector review: Enhancing growth and development. The World Bank and Allied Publishers: New Delhi

Karim, S.A and Sahoo, A. 2012. Small ruminant production: Role in food security of India. In proceedings of 8th Biennial ANA conference, 28-30 Nov P11-19.

Misra A.K, Rama Rao, C A, Subrahmanyam, K V., Babu M V S., Shivarudrappa, B., Ramakrishna, Y S. 2007. Strategies for livestock development in rainfed agro-ecosystem of India, Livestock Research for Rural development. LRRD news

Shalander Kumara and Upadhyay A.D. 2009. Goat Farmers' Coping Strategy for Sustainable Livelihood Security in Arid Rajasthan: An empirical Analysis1 *Agricultural Economics Research Review*. 281-290.

# Fish Based IFS for Empowering Farm Women

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## Introduction

Fishery is an important sector of food production in India, It is also a source of income and livelihood to many millions of people around the world. Women account for more than 19 percent of all people directly engaged in the fisheries and aquaculture primary sector. Globally, women make up half of the workforce of the combined primary and secondary fishery occupations. Women have assumed a leading role in the rapid growth of aquaculture around the world with their participation along the aquaculture value chains.

Integrated fish farming is a system of producing fish in combination with other agricultural/livestock farming operations centered around the fish pond. It is a sustainable agriculture technology widely practiced in Asia including India and other regions of the world. IFF systems typically involve a combination of fish polyculture and integration of agriculture production (Livestock and /or crops) with on farm waste recycling. As it is mostly followed by the marginal and small land holding people and less labour intensive, women are actively getting acquainted and taking part in this production system. It is often perceived as an extension of the women's household chores, which makes it easier for women to combine the two activities

## Advantages of integrated fish farming

- Efficient waste utilisation from different culture practice for fish production.
- It reduces the additional cost for supplementary feeding as well as fertilisation.
- It is an artificial balanced ecosystem where there is no waste.
- It provides more employment avenues.
- It reduces the input and increases output and economic efficiency.
- The integrated fish farming provides fish along with meat (chicken, duck, beef, pork etc.), milk, vegetables, fruits, eggs, grains, fodder, mushroom etc.
- This practice has potential to increase the production and socio-economic status of weaker section of our society
- Amelioration of household and women nutritional status

## Agriculture based integrated fish farming

Agriculture based systems include rice-fish system, horticulture-fish system, mushroom-fish system, seri-fish system etc.

**Rice-fish system**

A rice-fish culture system is an integrated rice field or rice field/pond complex where fish are grown concurrently or alternately with rice. Rice-fish systems allow for the production of fish and other aquatic animals as well as rice from the same rice field area, and generally without causing reductions in rice yields. The source of animal protein also aids household nutrition as well as enhance farm income. In Asia the potential areas of rice-fish are around 10.2 m ha under irrigated and rainfed lowland ecologies. Among the Asian countries, China shares almost half of the potential areas followed by India, Indonesia, Bangladesh, Vietnam, Thailand, Philippines, Korea and Malaysia. Around 1.08 million ha in Asia are under rice-fish farming of which China occupies 91% followed by Indonesia with 8.7% area. In India, this farming is practised in the states of Bihar, West Bengal, Orissa and Assam where enough water is present in the paddy fields. In the N'orth -Eastern states of India, the potential rice-fish areas have been reported as 55,400 ha in the states of Manipur, Tripura, Nagaland, Arunachal Pradesh, Meghalaya and Mizoram with Manipur sharing 72% area followed by Tripura and Nagaland each having around 9% area. In the country around 3.1 m ha of coastal saline areas are available in coastal states and union territory. Out of these areas, around 44, 000 ha are under mostly traditional rice-fish culture with the state West Bengal having 30,000 ha.

Rice-fish farming has many other advantages including the control of weeds, insects and pests resulting in increased rice yield. In the event of a sudden drought, the rainwater harvested in the refuge pond can be used to irrigate the rice and other crops. Other benefits are economical utilisation of land and savings on labour cost towards weeding and supplemental feeding. The rice fields retain water for 3-8 months in a year. The culture of fish in paddy fields, which remain flooded even after paddy harvest, serves an off-season occupation and additional income to the farmer. This system needs modification of rice fields, digging peripheral trenches, construction of dykes, pond refuge, sowing improved varieties of rice, manuring, stocking of fish at 10,000/ha and finally feeding of stocked fish with rice-bran and oilcakes at 2-3% of body weight.

This practice can be done in following types of paddy plots-

i) Perimeter type- paddy grows in the middle.

ii) Central pond type- paddy growing area is on the perimeter.

iii) Lateral trench system- trenches are provided on either one or both sides of the moderately sloping field.

The variety of rice used in this culture is Panidhan, Jalmagna, CR26077, Tulsi etc. as these varieties not only possess strong root systems but also are also capable of withstanding flooded conditions. The fish spp. Suitable in rice fish integration are are Indian major carps, *Channa spp, Oreochromis mossambicus, Clarias batrachus, Anabas testudineus,* silver carp, grass carp, common carp. The total production in such practice is approximately 90 quintal from 2 paddy crops while the fish production is about 1000 kg from 1 ha. Fish culture in rice fields may be attempted in two ways, viz. simultaneous culture and rotation culture. In the former, rice and fish are cultivated together and in the latter; fish and rice are cultivated alternately.

**Horticulture-fish system**

The dykes of ponds as well as adjoining areas can be best utilized for horticulture crops. Pond water is used for irrigation and the pond silt, which is a high-quality manure is used for crops, vegetables and fruit bearing plants. The plants should be of dwarf type, less shady, evergreen, seasonal and highly remunerative. The plants on the embankment strengthen the dykes. Dwarf variety fruit bearing plants like mango, banana, papaya, coconut and lime are suitable, while pineapple, ginger, turmeric, chilli are grown as intercrops. Plantation of flower bearing plants like tuberose, rose, jasmine, gladiolus, marigold and chrysanthemum provide additional income to farmers. Residues of vegetables cultivated could be recycled into fishponds, particularly when stocked with grass carp. Grass carps can be stocked @ 1000/ha and stocking of common carps are beneficial for utilizing feacal debris in the ponds. In mixed culture of grass carps along with rohu, catla and mrigal, in 50: 15: 20: 15 ratio at a density of 5000 fish/ha could get an yield of 3t/ha/yr. Larvivorous air-breathing fish species such as snakeheads *C. marulius* and *C. striatus* and tilapia, *O. mossambicus* are ideal species for culturing in this system. This integrated system fetches 20-25% higher return compared to aquaculture alone

**Livestock fish system**

The basic principles for livestock-fish integrated farming system are full utilization of livestock farm wastes as fish feed and pond manure and conversion of waste in to valuable fish protein. The spilled over feed or feed derived from livestock manure may be utilized as direct feed or the manure from livestock helps in production of planktons which form the feed for fishes in the pond. Livestock excreta is rich in Nitrogen (N), Phosphorous (P) and Potassium (K) and also contains micronutrients. Thus, it makes the soil fertile. In domestic animals like sheep, goat, cattle, buffalo, pig and poultry manure production is 0.15, 0.15, 1.10, 1.35, 0.25, and 0.014 tonnes/ animal/ year, respectively on dry weight basis. The N, P, K level in excreta varies in different species of animals. Like sheep/ goat 0.65, 0.50 and 0.03%, cattle 0.15, 0.01 and 0.05%, pig 0.60, 0.50 and 0.20%, poultry 0.76, 0.63 and 0.22%, duck 0.91, 0.38 and 0.36%, respectively.

**Management of pond**

At least there should be 1.0 m of water and ideal is 1.5 to 3.0 m. Soil pH should be within the range of 6.5 to 7.5. If the soil pH is not up to the desired level, the pH may be corrected by application of lime and the quantity of lime is 2000 kg/ ha for 4.0 to 5.0 pH, 1200 kg for 5.1 to 6.0, 1000 kg for 6.1 to 6.5 (mild acidic), 400 kg for 6.6 to 7.0 (more or less neutral) and 200 kg/ ha for pH 7.1 to 7.5, which is mildly alkaline. Lime helps in maintaining pH, kills and decomposes parasites. The lime should be applied in 3 to 4 split doses. The basal dose of lime and cow dung application in per hectare of water bodies is 1200 kg and 5000 kg, respectively. The pond should be regularly cleaned from aquatic plants which prevents sunlight penetration and oxygen circulation in water as well as shelter fish predators. The weeding can be done by manually, mechanically, biologically, chemically or by increasing the water depth in the pond. To kill predatory fishes Mahua (Bassicala tifolia) may be applied at the rate of 2500 kg/ ha of water bodies. By repeated netting unwanted fishes may also be removed. The ammonia, tea seed cake and bleaching powder also can be applied to remove enemy fishes

**Stocking and harvesting time of fishes**

June and July is the best suitable months for stocking of fingerlings. The stocking time varies depending upon the climate in different regions of the country and also the availability of optimum water level in pond. Below 18 to $20^0$ C growth of the fishes restricted. It is advisable to stocking fingerlings after winter months i.e. in rainy season and harvested before the water scarcity in pond. Generally, fishes are harvested after 12 months of stocking. But, where water bodies remain functional for 8 to 9 months fingerlings may be stocked in April and harvested in the month of November/ December. In composite fish culture 3 species, 4 species or 6 species may be stocked depending upon the availability of fingerlings in the market. In integrated livestock cum fish farming considering the surface, column and bottom feeder the ratio of fishes viz. Catla, Rohu and Mrigal should be 4: 3: 3 (3 species), in 4 species Catla, Rohu, Mrigal and Common carp ratio 3 : 3 : 3 : 2 whereas, in 6 species Catla, Rohu, Mrigal, Silver carp, Grass carp and Common carp ratio should be 1.5 : 2.0 : 1.5 : 1.5 : 1.5 : 2.0, respectively. For example, as Catla and Silver carp are surface feeder, the combined stocking density should not be more than 30 to 35%, but for Rohu which is column feeder grows well in ponds with 3 to 4 m water depth should be stocked at the rate of 15 to 20%, whereas, bottom feeder like Mrigal and Common carp the ratio may be 40 to 45%. Grass carp should not be more than 5 to 10%, which can be fed with land grasses, vegetable refuse, banana leaves or with aquatic plants. Central Inland Fisheries Research Institute and ICAR Research Complex for NEH Region, Barapani recommended 6000 fingerlings/ ha for duck-fish integrated system and 6000 to 7000 fingerlings for integrated and non-integrated pig-fish farming system, respectively. Some fish attain marketable size within a few months. After harvesting partially, the pond should be restocked with the same species and the same number of fingerlings. Final harvesting is done after 12 months of rearing. Fish yield ranging from 3500-4000 Kg/ha/yr and 2000-2600 Kg/ha/yr are generally obtained with 6 species and 3 species stocking respectively.

**Fish-Dairy system**

Fish-cum-Dairy Farming is considered as an excellent option for the use of organic wastes. Use of cow/buffalo manure in fish farming is a commonly prevailing practice. Livestock excreta contain about 70 to 80% water and 20 to 25% dry matter. A cow produces 15 to 18 kg dung/ day. The cattle faeces and urine are beneficial to the filter-feeding and omnivorous fishes as it enhances the growth of plankton in the pond. On an average, 3-4 cows/buffaloes can provide sufficient manure to fertilize one-hectare pond. In this system, farmer gets milk, fish and calf as well, which increases revenue and reduces input costs. The system gives a net profit of Rs.317000/- per year from one-hectare land.

**Fish-pig system**

The pig dung as an organic manure for fish culture has certain advantages over cattle manure. A pig of 50 kg can produce 2.5 kg dung per day. The pigs are fed largely on kitchen waste, aquatic plants and crop by-products. The popular races are the white Yorkshire, Berkshire and Landrace. The pigsties should provide adequate protection from adverse weather conditions. A run or courtyard adjacent to the pig house is essential. The size of the pig house depends on the number of pigs to be reared. Floor space is provided @ 3-4 $m^2$ for every pig weighing 70-90 kg. The pigsties are built mostly at the pond sites or even over the ponds. The washings from the pigsties containing dung and urine are either channelized

directly into the pond or composted before its application. The boars, sows and finishing stocks are housed separately. The excreta voided by 35-40 pigs are found adequate to fertilize one hectare of water. Integrated fish-pig farming is a viable and feasible scientific approach to augment fish production at low cost. The net income in this integration from one hectare of pond is Rs.2,60,000/-.

**Fish poultry system**

Poultry raising for meat (broilers) or eggs (layers) can be integrated with fish culture to reduce costs on fertilizers and feeds in fish culture and maximize benefits. Apart from eggs and chicken, poultry also yields manure, which has high fertilizer value. In integrated fish-cum-poultry farming the birds are kept under intensive system. The birds are confined to the house entirely. The intensive system is further of two types - cage and deep litter system. The deep litter system is preferred over the cage system due to higher manurial values of the built up deep litter. In deep litter system 250 birds are kept and the floor is covered with litter. Dry organic material like chopped straw, dry leaves, hay, groundnut shells, broken maize stalk, saw dust, etc. is used to cover the floor up to a depth of about 6 inches. The birds are then kept over this litter and a space of about 0.3 - 0.4 square meters per bird is provided. The litter is regularly stirred for aeration and lime used to keep it dry and hygienic. In about 2 month's time it becomes deep litter, and in about 10 months time it becomes fully built up litter. The fully built up deep litter contain 3% nitrogen, 2% phosphate and 2% potash. The poultry shed can also be constructed above the ground so that the droppings will fall directly to the pond. But one disadvantage is if the manuring is excess, it will result in oxygen depletion and subsequent mortality. As such 500 birds with 450 kg as total live weight may produce wet manure of about 25 Kg/day, which is adequate for a hectare of water area under polyculture. The poultry birds under deep litter system should be fed regularly with balanced feed according to their age. Grower mash is provided to the birds during the age of 9-20 weeks at a rate of 50-70 gm/bird/day, whereas layer mash is provided to the birds above 20 weeks at a rate of 80-120 gm/bird/day. Each pen of laying birds is provided with nest boxes for laying eggs. One nest should be provided for 5-6 birds. The birds are usually kept as layers up to the age of 18 months. Each bird lays about 200 eggs/yr. The stocking rates vary from 8000 - 8500 fingerlings/ha and a species ratio of 40 % surface feeders, 20 % of column feeders, 30 % bottom feeders and 10-20 % weedy feeders are preferred for high fish yields. Fish yield ranging from 3500-4000 Kg/ha/yr and 2000-2600 Kg/ha/yr are generally obtained with 6 species and 3 species stocking respectively.

Pigs can be used along with fish and poultry in integrated culture in a two-tier system. Chick droppings form direct food source for the pigs, which finally fertilise the fish pond. Depending on the size of the fish ponds and their manure requirements, such a system can either be built on the bund dividing two fish ponds or on the dry-side of the bund. The upper panel is occupied by chicks and the lower by pigs.

**Fish-Duck system**

This system is very popular and widely practiced in our country particularly in Assam, West Bengal, Bihar, Orissa, Andhra Pradesh, Kerala and in North Eastern States. It is one of the best livestock – fish integration system.

Benefits of fish cum duck farming

- Water surface of ponds can be put into full utilization by duck raising.

- Ducks feed on predators and mosquitoes and help the fingerlings to grow.
- Duck raising in fish ponds reduces the demand for protein to 2 – 3 % in duck feeds.
- Duck droppings go directly into water providing essential nutrients to increase the biomass of natural food organisms.
- The daily waste of duck feed (about 20 - 30 gm/duck) serves as fish feed in ponds or as manure, resulting in higher fish yield.
- By virtue of the digging action of ducks in search of benthos, the nutritional elements of soil get diffused in water and promote plankton production.
- Ducks serve as bio aerators as they swim, play and chase in the pond. This disturbance to the surface of the pond facilitates aeration.
- Survival of ducks raised in fish ponds increases by 3.5 % due to the clean environment of fish ponds.
- Ducks keep aquatic plants in check.
- No additional land is required for duckery activities.
- It results in high production of fish, duck eggs and duck meat in unit time and water area.

The stocking density of 200-300 ducks/ha gives 10,000 - 15,000 kg of droppings and are recycled in one hectare ponds every year. For commercial farming or for maximum profit high egg producing ducks like Khaki Campbell or Indian Runner is preferred instead of local ducks. About 200 to 240 eggs/ duck/ year is expected for commercial farming. A centralised duck shed can be constructed in the vicinity of fish ponds with a cemented area of dry and wet runs out side. The average stocking density of duck is about 4 - 6 ducks/sq.m. area. The dry and wet runs should be cleaned once a day, draining the waste water to the pond. In an alternative method, ducks can be raised in the fish pond. The embankments of the ponds are partly fenced with net to form a wet run. The fenced net is installed 40-50 cm above and below the water surface, so as to enable the fish to enter into the wet run while ducks cannot escape under the net. 2 - 4 months old ducklings are kept on the pond after providing them necessary prophylactic medicines as a safeguard against epidemics. A mixture of any standard balanced poultry feed and rice bran in the ratio of 1:2 by weight can be fed to the ducks as supplementary feed at the rate of 100 gm/ bird/day. The feed is given twice in a day, first in the morning and second in the evening. The ducks start laying the eggs after attaining the age of 24 weeks and continue to lay eggs for two years. The ducks lay eggs only at night. It is always better to keep some straw or hay in the corners of the duck house for egg laying. After two years, ducks can be sold out for flesh in the market. About 18,000 - 18,500 eggs and 500 - 600 Kg duck meat are obtained.

Rural women who are often confined to childcare and household chores due to cultural and social barriers, can gain a lot of benefit from the improved income, protein availability and roles in economic decision-making associated with participation in integrated fish farming. According to the UN, an income generating women spend 90% of their earnings on family needs, like healthcare and education, while men on average spend a mere 35% of their income on the family. Hence empowering rural women with technologies of integrated fish farming will contribute a lot in efficient resource utilization and improved income and nutritional security of their families.

# Mitigating Malnutrition Through Inclusive Agriculture in India

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India is one of the fastest growing countries in terms of population with 1.3 billion people and with an annual growth rate of 1.25%. As per the World Bank estimates, India is one of the highest ranking countries in the world for the number of children suffering from malnutrition. The prevalence of underweight children in India is among the highest in the world, and is nearly double that of Sub Saharan Africa with dire consequences for mobility, mortality, productivity and economic growth. Despite India's 50% increase in GDP since 1991, more than one third of the world's malnourished children live in India. One of the major causes for malnutrition in India is gender inequality. Due to the low social status of Indian women, their diet often lacks in both quality and quantity. India ranks 67$^{th}$ position on the Global Hunger Index among the 80 nations having the worst hunger situation which is worse than nations such as North Korea or Sudan. In India, 44% of children under the age of 5 are underweight, 72% of infants and 52% of married women have anaemia. Research has conclusively shown that malnutrition during pregnancy causes the child to have increased risk of future diseases, physical retardation, and reduced cognitive abilities. The Rapid Survey on Children (RSoC), a survey performed between the year 2013 and 2014 revealed 38.7% are considered stunted (low height for age), 29.4% are considered underweight (low weight for age) and 15% are considered wasted (low weight for height).

**What is Malnutrition?**

Malnutrition is a condition that results from eating a diet in which nutrients are either not enough or are too much such that the diet causes health problems.[4][5] It may involve calories, protein, carbohydrates, vitamins or minerals.[2] Not enough nutrients is called undernutrition or undernourishment while too much is called overnutrition.[6] Malnutrition is often used specifically to refer to undernutrition where there is not enough calories, protein, or micronutrients. There are two main types of undernutrition: protein-energy malnutrition and dietary deficiencies. Protein-calorie malnutrition (PCM) has two severe forms: marasmus (a lack of protein and calories) and kwashiorkor (a lack of just protein). Common micronutrient deficiencies include: a lack of iron, iodine, and vitamin A. Undernutrition is more common in developing countries like India. Certain groups have higher rates of undernutrition, including women—in particular while pregnant or breastfeeding—children under five years of age, and the elderly. In the elderly, undernutrition becomes more common due to physical, psychological, and social factors.

According to National Family Health Survey and UNICEF Reports, 46% of preschool children and 30% of adults in India suffer from moderate and severe grades of protein-calorie malnutrition as judged by anthropometric indicators. Though severe clinical forms of PCM – kwashiorkor and marasmus have become rare, they persist in some less developed states like Uttar Pradesh and Orissa. Over 50% women (particularly pregnant women) and children suffer from iron deficiency anaemia (IDA), aggravated by helminthic infections. Deficiencies

of other micronutrients like some B-complex vitamins particularly riboflavin, folic acid and perhaps vitamin $B_{12}$ are also common. Rickets has become rare, but recent studies from North and South India show that vitamin D deficiency as judged by serum levels of 25-hydroxy vitamin D2 exists in adults. This, besides low intake of calcium, may be responsible for the high prevalence of osteoporosis particularly in women.

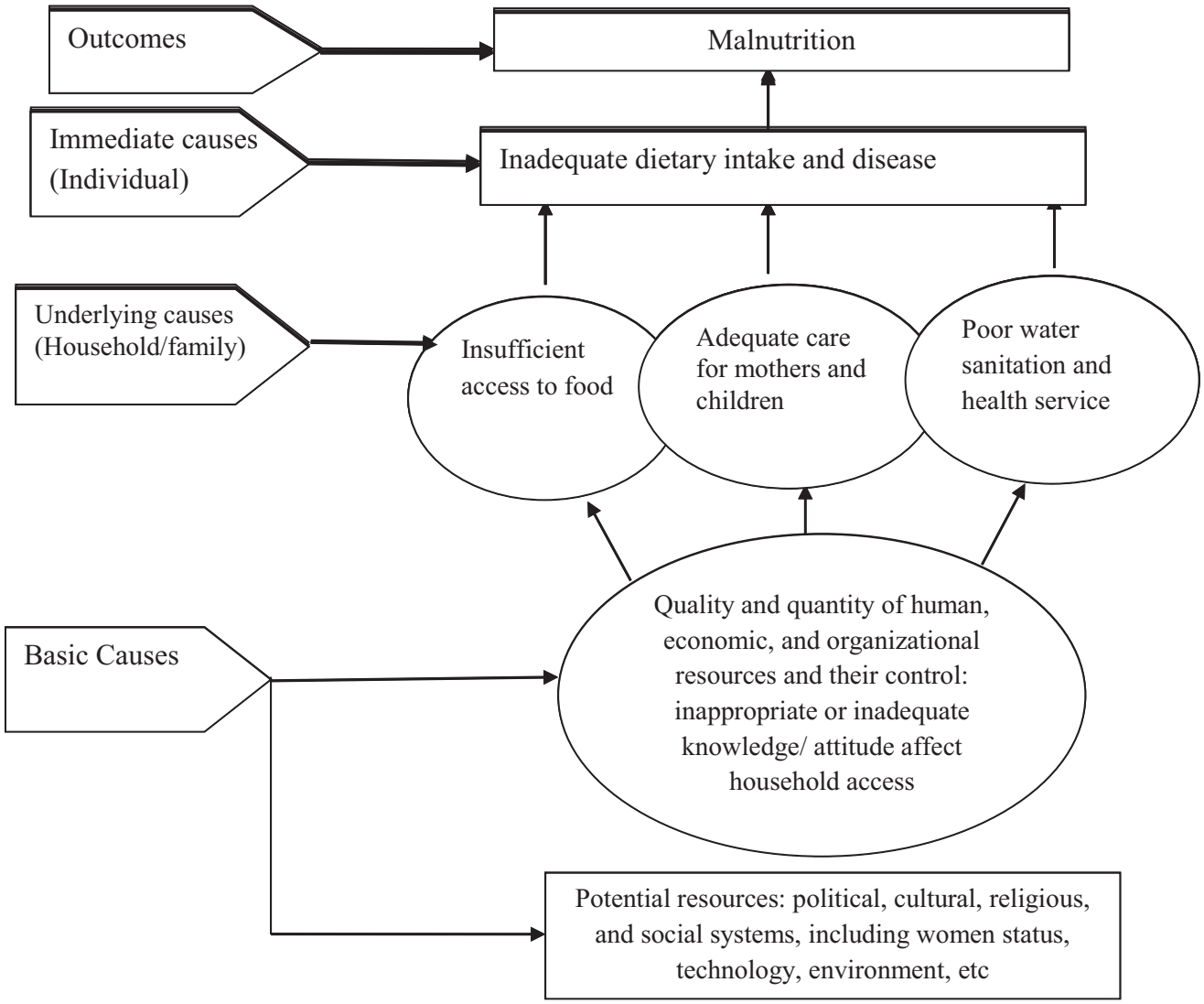


**Fig. 1. Causes of malnutrition**

**Nutrients for healthy life**

Humans need a wide range of nutrients to lead a healthy and active life. The required nutrients for different physiological groups can only be derived from a well balanced diet. Components of the diet must be chosen judiciously to provide all the nutrients to meet the human requirements in proper proportions for the different physiological activities. A healthy diet provides nutrients in the proportions needed for bodily function and development, with sufficient quantities of essential nutrients and limited exposure to harmful substances. Nutrient needs vary over time and across people, and include adequate fluid and total calories, protein and fats, as well as a range of vitamins, minerals and other micronutrients.

These needs can be met from a variety of plant-based and animal-based foods, in proportions tailored to each person's activity levels and developmental circumstances. The amount of each nutrient needed for an individual depends upon his/her age, body weight and physiological status. Adults need nutrients for maintenance of constant body weight and for ensuring proper body function. Infants and young children grow rapidly and require nutrients not only for maintenance but also for growth. In physiological conditions like pregnancy and lactation, adult woman needs additional nutrients to meet the demand for foetal growth and maternal tissue expansion in pregnancy and milk secretion during lactation. These extra intakes of nutrients are essential for normal growth of infants *in utero* and during early post-natal life. The nutrient requirement of an individual and the dietary allowances for a group or a population are distinctly different. The former depends upon the age, body weight and physiological and metabolic status of the individual. The latter must also take into consideration individual variation within the group, quality of the diet, effect of cooking and processing and bio-availability of the nutrient from the diet.

**Post green revolution scenario**

The introduction of Green Revolution in 1967-68 in India has resulted in phenomenal increase in the production of agricultural crops especially in food-grains (wheat and rice, mainly). It is widely agreed that higher-yielding varieties of rice and wheat have had a positive impact on cereal supplies and farmer incomes. Now, more than three decades into the Green Revolution, agriculture growth is not in pace with population growth. The supplies of nonstaple foods such as pulses, fruits, vegetables, fish, and animal products have not kept pace with population growth and consumer demands generated by aggregate income growth. The prices of these nonstaple foods have risen—with the consequence that dietary quality for the poor either has worsened. Increasing the supply of a wide range and large number of nonstaple foods will be much more difficult and expensive than increasing the supply of a relatively small number of cereals, roots, and tubers. The Nutrition has taken a different dimension over the period and scientific evidence showing that micronutrient malnutrition affects a high proportion of developing-country populations, especially children and women, and (b) an adequate supply of minerals and vitamins is necessary for food security, defined as reliable access to food of a sufficient quantity and quality to sustain a healthy and productive life.

**Malnutrition and Agriculture**

Is there any relation between economic and agricultural growth and malnutrition? Can better agricultural performance contribute to bringing down malnutrition levels? Agricultural performance is usually assessed in terms of agricultural income or agricultural productivity. Today, India's agricultural sector has been underperforming. Although this sector that engages 49 percent of the workforce of the country, its share in the Gross Domestic Product (GDP) was 17.4 per cent in 2014-15. During the last three years, the growth rates in agriculture have been fluctuating at 1.5 per cent in 2012-13, 4.2 per cent in 2013-14, and (-) 0.2 per cent in 2014-15. Te gross capital formation in agriculture, which was 18.3 percent of agri-GDP in 2012-13 has fallen to 14.8 percent in 2014-15. The grains output was also dropped from 265.6 million metric tonnes (MMT) in 2013-14 to 257.1 MMT in 2014-15. Oilseeds and pulses have also suffered decline in production, putting pressure for their larger imports. The need of the hour is to invest more in water, agri-R&D, farm mechanisation, etc.

Studies have revealed that higher levels of income and income growth, along with improvements in healthcare, feeding practices and diets, etc., can contribute to malnutrition reduction.[12] As seen earlier, a large proportion of the poor and malnourished live in rural areas where agriculture remains the primary occupation. From this perspective, augmenting incomes from agriculture is one of the most critical avenues through which agriculture can impact nutritional outcomes of farm households via increased access to quality food. Improvements in agricultural performance can also increase food availability at the local and national levels (home production, local markets, and national food availability), bring down food prices, and stimulate the development of the rural nonfarm sector. Another observation is the status of a woman's nutrition and her position in the household and society are significant not only for the well-being of the woman but also for the short- and long-term nutritional status of her children. It was observed that the number of underweight children drops significantly if women and men have equal status in society.

Agriculture faces many challenges today, making it more and more difficult to achieve its primary objective of feeding the whole world. Population growth and changes in diet associated with rising incomes drive greater demand for food and other agricultural products, while global food systems are increasingly threatened by land degradation, climate change, and other stressors. Uncertainties exist about regional and local impacts of climate change, but the overall global pattern suggests that the stability of the food system will be at greater risk in future. Agriculture must change to meet the rising demand, to contribute more effectively to the reduction of poverty and malnutrition, and to become ecologically more sustainable. This transformation will be crucial for achieving many of the post---2015 Sustainable Development Goals (SDGs). The majority of the India's poor people live in rural areas, and agriculture growth has proven effective in lifting rural families out of poverty and hunger. Managing the linkages between agriculture, poverty and nutrition is critical to alleviate malnutrition in the country.

The strategies for alleviating malnutrition should target the areas where poor people live and the activities on which their livelihood depend. It must begin by recognizing that agriculture is at the heart of the livelihoods of rural people. Agriculture is the principal driving force of the rural economy in India. Rural households generate income from agriculture or employment in non-farm rural activities. Agricultural income originates from subsistence production, revenues from the sale of produce or employment in agriculture. The rural non-farm sector provides goods and services linked to agriculture, such as input preparation, repair of machinery and implements, output processing, transport and marketing. Income earned from agricultural activities creates demand for the output of small rural enterprises. It takes few skills to establish or work for such enterprises, so they are readily accessible to the poor. Initial productivity-induced growth in agricultural output will create multiplier effects in non-farm economies, increasing the incomes of those involved. It will also raise the incomes of those directly engaged in farming. Most of the capital for development of the agricultural sector comes from private sector investment, especially from farmers themselves. However, public investment in agriculture is an essential element in attracting private-sector investment. National investments in irrigation, research and rural infrastructure, technology generation and dissemination, natural resource conservation and standard setting and monitoring are necessary to increase productivity, reduce transaction costs and improve the competitiveness of agriculture in developing countries.

**Augmenting production through sustainable agricultural intensification (SAI)**

The objective of SAI is to provide sufficient, accessible, nutritious food, while enabling economic and social development in rural areas and treating people, animals and the environment with respect. In other words deliver more product (food and other agricultural goods) per unit of resource, whilst preventing damage to natural resources and ecosystem services that underpin human health and wellbeing both now and in the future.76

The major focuses are

- The need to produce more food, and more nutritious food.
- Increased production primarily through higher yields, to limit conversion of forest, wetlands or grasslands to agriculture.
- Re---thinking and transformative changes of food systems to achieve greater resilience and major reductions in environmental impact.
- Formulation of context---specific strategies and solutions for SAI that are integral components of accelerating economic and social development in rural areas.

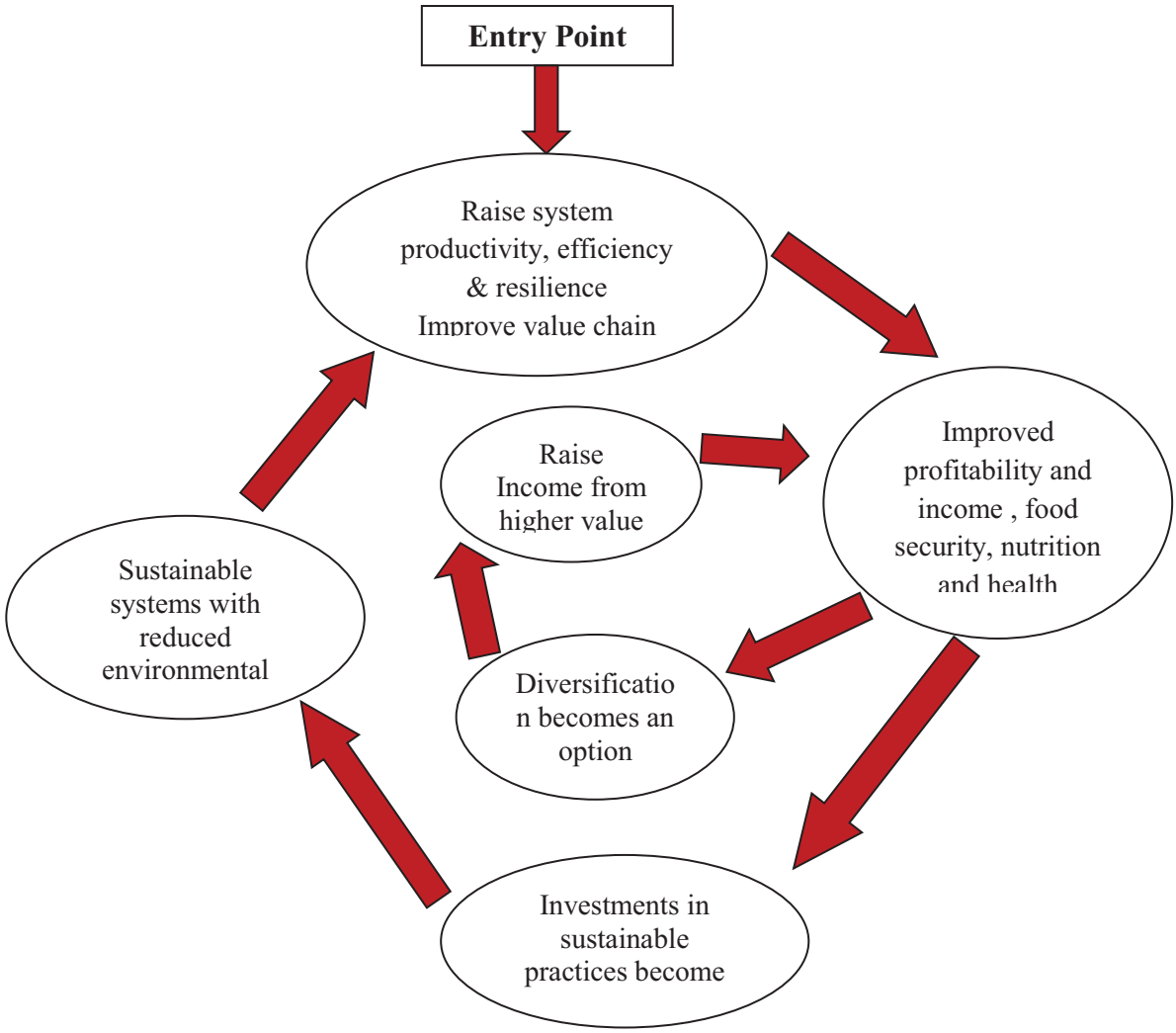


**Fig. 2. Sustainable agriculture production and livelihood**

Augmenting the food production, resource efficiency and sustainability of crop production systems includes the following principles

- Access to quality seed of well-adapted varieties that meet local preferences or market demands
- Planting at the right time to maximize the attainable yield
- Maximizing the capture and efficient utilization of available water for high water productivity (**more crop per drop**)
- Precise, integrated use of mineral fertilizers and available organic nutrient sources to meet crop nutrient requirements with high efficiency and sustained soil quality
- Integrated pest management strategies that include host-plant resistance, functional biodiversity, biological control and the judicious use of pesticides
- Harvesting at the right time
- Optimizing recycling and use of biomass and agricultural by-products, including better use of crop residues for livestock feeding or other purposes

Increasing the productivity, resource efficiency and sustainability of livestock systems includes following principles such as

- Increasing animal productivity and efficiency through genetic improvements and better feeding, including adoption of age-specific, balanced feed rations
- Adopting management practices that improve animal health and welfare
- Decreasing pollution by optimizing critical metabolic and nutrient cycles (e.g., nitrogen, phosphorus, methane gas emissions)
- Enhancing diversity within animal production systems to strengthen their resilience
- Improving rangeland productivity, diversity and grazing management
- Adapting management practices that preserve biological diversity in" livestock agro-ecosystems
- Using manure within comprehensive nutrient management systems while recognizing and mitigating its associated health and contamination risks

**Use biotechnology to increase agricultural production**

Will technology-led agriculture succeed in producing more from the less? New innovations will have to be developed and up scaled in order to match Indian agriculture sector's growth with other sectors. "The emergence of new science like biotechnology, information technology, nanotechnology, bioinformatics etc. provides new hope. In addition to climate smart agriculture and precision agriculture, India needs a conducive policy ecosystem that fosters agri-innovation including GM and non-GM technologies that are supported by the right policies and development related activities. The relevance of selective development of GM crops that are relevant to India's farmers to accelerate the agri-economy is the need of

the hour. GM Crops have the potential to increase crop yields while simultaneously having the potential to mitigate climate change and bring down the overall cost of farming, thereby helping the farmer and ultimately the nation. The challenge to foster greater adoption of bio-technology is linked to creating a mission mode approach; strengthening of the public research system; enhancement of private sector investments on GM technologies; and finally enabling a wider public debate keeping the farming community at its epicenter.

**Biofortification with micronutrients**

Micronutrient malnutrition is known to affect more than half of the world's population and considered to be among the most serious global challenges to humankind. Micronutrient malnutrition or the hidden hunger is very common among women and preschool children caused mainly by low dietary intake of micronutrients, especially Zn and Fe. The "green revolution" in India had helped to alleviate the crisis of food insufficiency by introducing high-yielding varieties of wheat and rice. Now the time has come to address the issues concerning food quality. Modern plant breeding has been oriented towards achieving high production yields rather than nutritional quality. Biofortification, the process of increasing the bioavailable concentrations of essential elements in edible portions of crop plants or animal tissues through genetic selection or supplementation may be the solution to malnutrition or hidden hunger mitigation. The Consultative Group on International Agricultural Research has been investigating the genetic potential to increase bioavailable Fe and Zn in staple food crops such as rice, wheat, maize, common beans, and cassava. Millions of people do not find adequate nutritious foods in their diets, especially foods that are affluent in vitamins and minerals. A high proportion of marginal and landless farm families undergo malnutrition because of too little income and affordability to purchase quality foods. For example, the pulses supplying dietary protein are too expensive for the poor. Here comes the role of nutri-farms. It ensures biofortified food crops that are enriched in critical micronutrients. These foods essentially provide the critical nutrients such as iron and zinc besides supplementing protein and essential vitamins.

**Reducing food losses and waste and shifting to healthier diets**

According to the United Nations Development Programme, up to 40% of the food produced in India is wasted. According to the agriculture ministry, Rs. 58,000 crore worth of food produced is wasted every year in India. From production of food grain, until it reaches the end consumer, the food grain has to pass through several intermediate stages. Crop losses are often associated with the earlier stages of the food chain (i.e., pre---harvest, harvest and post harvest losses), whereas food waste mainly occurs at the market, retail and consumer ends. In India, the natural calamities, ineffective pest and disease management, poor harvest practices, poor storage facilities, poor transport facilities and inadequate infrastructure, further aggravate the losses. This needs major interventions like substantial investments in infrastructure and improved technology. Reductions of postharvest losses often require significant capital investment to improve storage and transportation systems. However, many less costly technologies can also help to reduce losses at different stages of the food chain, including packaging at pre---consumer stage; breeding crops with longer shelf life, using micronutrient---enriched fertilizers prolong the shelf life of fruits and vegetables, improving harvest practices, and low---cost drying and hermetic storage solutions.

**Strengthening the Research System**

The weaknesses of state agriculture universities (SAU) imply that extension systems critical for the diffusion of new agricultural innovations and practices, or even dissemination of information about public programs such as MSP, are unable to achieve their intended objectives. Urgent intervention in this respect is therefore currently required of the states. Second, investment in public agricultural research in India needs to be augmented. Given the large externalities, the centre needs to play a more important role. India's current spending on agriculture research is considerably below that of China and as a share of agriculture GDP even less than that of Bangladesh and Indonesia. Third, resource augmentation can go only so far unless accompanied by changes in incentives. There is a strong need to take steps to enhance research productivity among the scientists in public agriculture research institutes.

Similarly, private sector innovation and high yielding variety in seeds can result in productivity gains. India should also fully leverage new low cost technologies that have wider benefits for agriculture. Cellphones have been creatively used by countries like Ghana, Kenya, Nigeria and Thailand to provide information on prices and cultivation to farmers which has led to massive increases in farm incomes. Since the costs of drones have fallen sharply, they can be used by SAUs to provide crucial information on crop health, irrigation

problems, soil variation and even pest and fungal infestations that are not apparent at eye level to farmers. Small efforts can go a long way in mitigating farm losses and risks and maximizing income.

**Integrating nutrition into agriculture education: Strengthening human capacity to promote nutrition sensitive agriculture**

The lack of nutrition training of agricultural workers is acknowledged globally as a significant barrier to combating malnutrition through agriculture and food systems. Without social and behavioural changes, improved dietary diversity and consumption patterns, food storage, hygiene and preparation practices, the high prevalence of malnutrition may continue, even if incomes, production and productivity increase. Recently the term "nutrition sensitive agriculture" has emerged as a way to define agriculture investments made with the purpose of improving nutrition. The overall objective of nutrition-sensitive agriculture is to make the global food system better equipped to produce good nutritional outcomes. Increases in food production do not necessarily guarantee to improve diets or nutrition.

**Conclusions**

Agriculture is the right tool to overcome the curse of malnutrition in India. Agriculture should be primarily aimed at producing enough quality food to sustainably feed the ever growing human population. This needs a holistic approach and can be achieved through enhancing crop and animal productivity, reducing food losses and waste, improving storage facilities, dietary diversification, and promoting foods that include vitamins and micronutrients, and encouraging women's participation in intra-household food security. To meet the future food demand will require shifts in behaviour as well as shift towards more sophisticated technologies, information and knowledge management systems for farming systems and whole value chains, but also policy---making, and market and incentive systems for investment in ecosystem services.

# Utilization of Fruits and Vegetable Waste as Livestock and Poultry Feed

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India ranks is second in the production of fruits and vegetables in the world but at the same time, wastage of production is massive. In India 35% of fruits & vegetables of total production are being wasted due to traditional supply chain, which is more than the total consumption of UK. Agriculture is the backbone of Indian economy for socio-economic development since independence, however, the level of food processing and post harvest management are very low in comparison to other countries. Due to lack of proper management of the produce post-harvest wastage at different stages have been extremely high ( Table 3). Post harvest losses in India may cross Rs. 2.50 lac crore by 2013-14. One of the most important challenges facing by the country is providing remunerative prices to the farmer for their produce and consumer without incurring the additional burden of the subsidies. This challenge could be addressed if the postharvest management, level of processing and value addition can be enhanced to meet the growing demand for agricultural products. In addition to the above, there is need to sensitize the people for utilization of fruits and vegetables wastage as animal feed to reduce the cost of feed. Livestock play an integral role in the livelihood of poor farmers by providing economic, social and food security. Taking 2010 as the base year, the world would need 73 percent more meat and 58 percent more milk in 2050, while these values for developing countries will be 109 percent and 116 percent, respectively (FAO, 2011). To meet this demand, huge quantity of feed resources will be required; challenging sustainability of the feed production systems. Already there is a considerable shortage of feed availability in most developing countries. Taking some examples from Asian countries, Bangladesh faces a deficit of 49.4 and 81.9 percent of roughages and concentrates (Uddin, 2013), while in Pakistan a shortage of 43.9, 49.7 and 44.2 percent of dry matter (DM), crude protein (CP) and total digestible nutrients (TDN), respectively has been recorded (Habib, 2008). In China, there was a deficit of 10, 30 and 20 million tonnes of protein feed, energy feed, and aquatic feed, respectively, and in India a shortage of 25, 159 and 117 million tonnes of concentrates, green forages and crop residues, constituting respectively a shortage of 32, 20 and 25 percent of the requirement has been estimated (Ravi Kiran et al., 2012). The area under fodder production cannot be increased due to increasing human population and urbanization and the industrial intensive model of livestock production has severe limitations due to increasing cost of fossil fuels, competition for food-feed-fuel and other biophysical limiting factors. The global price of feed ingredients such as maize, wheat, fish meal and soybean meal has increased by 160, 118, 186 and 108 percent, respectively in the last decade, while the price rise in livestock products such as poultry meat, pork and lamb was only 59, 32 and -37 percent respectively, while that of beef was 142 percent. Under these conditions, to meet the nutrient requirements of livestock and to sustain their productivity and profitability seem only possible if non-conventional, alternate feed resources are explored. The ongoing shift in the cropping pattern from cereals to more remunerative fruit and vegetable crops in many Asian countries will lead to decreased supply of cereals and crop residues for animal feeding. A strong shift in this

direction has already been observed in north India, for example. This change has resulted in generation of huge quantities of fruit and vegetable by products and wastes. For example, fruit and vegetable processing, packing, distribution and consumption in the organized sector in India, the Philippines, China and the USA generate approximately 1.81, 6.53, 32.0 and 15.0 million tonnes of fruit and vegetable wastes (Table 2). These are either composted or dumped in landfills or rivers, causing environmental hazards. Alternatives to such disposal methods could be recycling through livestock as feed resources and/or further processing to extract or develop value-added products. Such an approach will convert "wastes to opportunities for development" in addition to contributing to sustainable intensification of livestock industry.

**Commonly used methods of managing fruit and vegetable waste are:**

- Return fruit and vegetable waste to the field on which it was grown
- Store the culled fruit and vegetables in a pile or burned area for a limited time
- Feed fruit and vegetable waste to livestock
- Process fruit and vegetable waste to separate juice from pulp\
- Dispose of fruit and vegetable waste in landfill areas.

**Table1.Production of fruits and vegetables (million tonnes) in India and world in 2013−14**

| | Production | Contribution | Rank |
|---|---|---|---|
| **Fruits** | | | |
| Banana | 29.72 | 29.80 | 1 |
| Mango | 18.43 | | 1 |
| Citrus | 11.17 | 6.5 | 4 |
| Grapes | 1.73 | | 10 |
| Apple | 2.58 | 4.10 | 3 |
| Pineapple | 2.49 | 7.30 | 6 |
| Guava | 3.66 | | |
| | | | |
| Papaya | 5.63 | | |
| **Vegetables** | | | |
| Potato | 41.55 | 12.80 | |
| Tomato | 19.41 | 11.00 | 2 |
| Onion | 18.73 | | 2 |
| Brinjal | 13.55 | | |
| Cabbage | 9.03 | 13.40 | 2 |
| Cauliflower | 8.57 | 36.70 | 2 |
| Pea | 3.86 | 22.04 | 2 |
| Sweet potato | 1.08 | | |

Source: NHB2014

**Table2. Fruit and vegetable wastes generated after processing, packing, distribution and consumption in organized sector**

| Country | Production million tonnes | | | F and V processed (percent) | Losses and wastage ( percent) | | | Waste generated (million tonnes) |
|---|---|---|---|---|---|---|---|---|
| | Fruits | Vegetables | Total | | Processing | Distribution | Consumption | |
| India | 88.97 | 162.89 | 251.86 | 2.2 | 25 | 10 | 7 | 1.81 |
| China | 154.36 | 583.32 | 737 | 23 | 2 | 8 | 15 | 31.98 |
| Phillipines | 15.34 | 6.30 | 21 | 78 | 25 | 10 | 7 | 6.53 |
| Malaysia | 1.07 | 1.21 | 2.2 | 80 | 25 | 10 | 7 | 0.68 |
| Thailand | 10.27 | 3.81 | 11.0 | 30 | 25 | 10 | 7 | 1.57 |
| USA | 26.98 | 34.28 | 61 | 65 | 2 | 12 | 28 | 14.95 |

**Table-3. Wastage of Fruits & Vegetables at Difference Stages in Percent**

| Stages | Losses (%) |
|---|---|
| At farm level | 50 |
| APC level | 10 |
| Local trader level | 3 |
| Whole sale level | 3 |
| Broker level | 7 |
| Retail level | 25 |
| Total | 35 |

Sources: Annual Report Ministry (2012-13) of FPI

**Banana (*Musa acuminata*):** Although bananas and plantains are mainly used as human food, a considerable amount of rejects fruit could be fed to livestock, particularly to pigs. The vegetative part of the plant, the pseudo-stem and leaves, contain more than 60% of the dry matter of the whole plant and could be used as meals for pigs in concentrate ration. Ripe bananas are very palatable to the pigs, and studies have shown that the growing pigs will consume up to 8-10 kg per day. There are two main types of bananas: i) when ripe consumed as a fruit and ii) "plantains" used for cooking or making chips or starch. These two types of bananas represent 56 and 44 percent of the world banana production, respectively. The underground stem and male flowers of both the types can be eaten as a vegetable. About 30−40 percent of the total banana production (Table 1) is rejected for failing to meet quality standards and is potentially available for feeding to livestock. Banana wastes include small-sized, damaged bananas, banana peels, leaves, young stalks and pseudo stems, which can be fed to livestock. Fresh plantain and banana fruits may be ensiled with molasses, grass, legumes, rice bran etc. Green fruits are easier to ensile than ripe fruits.

**Composition:** Banana leaves contain about 15 percent DM and 10−17 percent CP, while pseudo stems contain 5−8 percent DM and 3−5 percent CP. The NDF and ADF vary between 50−70 percent and 30−40 percent, respectively. Banana leaves contain 8 percent polyphenols, but very few condensed tannins.

**Ruminants:** The organic matter (OM) digestibility of pseudo stems is higher than that of leaves mainly because the erectness of pseudo stems is primarily due to the presence of water in the cells, and not because of the presence of lignin in the cell wall. The high tannin content of leaves may also be responsible for low digestibility. Dried banana pseudostem have been fed to goats and sheep at levels of 20−50 percent in diets with no adverse effects, but daily weight gains were depressed.

**Non-ruminants:** Banana leaf meal could be used up to 15 percent in the diet of growing pigs, resulting in satisfactory average daily gain and feed conversion efficiency. Rabbits can be fed up to 40 percent banana leaves without adverse effects on growth, feed intake and digestibility (Rohilla and Bujarbaruah, 2000). After weaning, young rabbits were fed diets containing either 30 percent dry banana leaves or plantain leaves, fresh leaves or a mixture of dry and fresh leaves (1:1). Dry leaves were more effective with respect to increase in weight gain. Net returns over feed costs were highest in rabbits fed dried leaves. Dried plantain leaves replacing 10 percent of a standard conventional diet in broilers did not affect feed efficiency or feed conversion.

**Banana peels**: Banana peel constitutes about 30 percent of fresh banana by weight. These can be fed to livestock as fresh green, ripe or dried.

**Composition:** Ripe banana peels contain up to 8 percent CP and 6.2 percent EE (Table 3), 13.8 percent soluble sugars and 4.8 percent total phenolics. Banana peels are rich in trace elements, but Fe, Cu and Zn contents are much higher than the maximum tolerance limit for ruminants. Green peels have approximately 15 percent starch which gets converted to sugars as the fruit ripens and the ripened peel has approximately 30 percent free sugars. Green plantain peels contain 40 percent starch. Lignin content also increases from 7 to 15 percent with ripening. Tannins mostly present in the peels are responsible for the astringent taste of immature fruits, which adversely affect their palatability in monogastric animals, while there is no palatability problem with peels of the mature/ripened fruit. Ripening causes migration of tannins to the pulp or they get degraded by polyphenol oxidases and peroxidases.

**Ruminants:** Banana peels are widely used by small, marginal and landless farmers as complementary feeds for ruminants in the tropics. Their nutritive value is similar to that of cassava or citrus peels. Dairy cows fed 14−21 kg of fresh ripe banana peels increased milk production. In goats, dry ripe plantain peels can replace up to 100 percent maize without adversely affecting growth performance, and were found to be an economical source of carbohydrates.

**Non-ruminants:** Dried ripe banana peels can be fed to growing pigs up to 20 percent in the diet without depressing growth. Sun dried ripe plantain peels could replace 75−100 percent of maize in weaned rabbit diets with positive economic returns. Inclusion rates beyond 30 percent in the diet adversely affected daily weight gain and feed conversion efficiency.

**Mango (*Mangifera indica* L.)** The edible pulp makes up 33–85 percent of the fresh fruit, while the peel and the kernel amount to 7–24 percent and 9–40 percent, respectively, on a fresh weight basis. The by-products/wastes available after processing of mango includes cull fruits (fresh fruits unsuitable for human consumption), mango kernel meal (containing 6−16 percent mango oil on DM basis), deoiled mango kernel meal and mango peels.

**Mango peels**

**Ruminants:** Mango peels can be fed fresh, dried or ensiled. Due to the high sugar content (13.2 percent) they are palatable and considered as an energy feed, but the high moisture and acidity of fresh peels may limit their use in ruminants. Because of their low protein content, addition of a source of nitrogen or protein is necessary to allow efficient utilization of the energy in the diet. In order to produce good silage, mango peels were mixed with rice straw and legume to facilitate fermentation. Ensiled mango peels and rice straw had 60 percent DM digestibility, which increased when Leucaena leaves were included in the diet.

**Non-ruminants:** Dried mango peels up to 10 percent in the diet of finishing pigs had no deleterious effect on feed conversion ratio or performance and economized feeding cost.

**Pineapple (*Ananas comosus*)** The post-harvest processing of pineapple fruits yields skins, crowns, and waste from fresh trimmings and the pomace after extracting the juice. Fresh pineapple cannery waste can be preserved either by drying or ensiling. Pineapple bran is the solid residue of the pressed macerated skins and crowns. It can be fed either fresh, ensiled or after drying to the animals.

**Composition:** Raw pineapple waste (on DM basis) contains 4−8 percent CP, 40−75 % soluble sugars (70 % sucrose, 20 % glucose and 10 % fructose) as well as pectin, but it is poor in minerals. Therefore, it should be supplemented with protein and minerals in order to prevent detrimental effects on productivity and health.

**Ruminants:** Pineapple wastes can replace the roughage portion in the diet partly or completely and partly the cereals in the diet of meat animals. Pineapple wastes are highly palatable and digestible (73−75 percent OM digestibility) in cattle, sheep and goats. Fermented pineapple waste is less acidic than fresh waste and animals prefer the former . Pineapple waste mixed with rice straw could replace up to 50 percent of roughage in the total mixed ration of dairy cattle without affecting milk production.

**Other fruit wastes and their comparative evaluation as livestock feed**

The nutritional worth of banana peels, musk melon peels and water melon peels revealed that musk melon peels had the highest CP and cell wall constituents except cellulose which was highest in banana peels. All the tested fruit wastes were very rich in macro- (Table 4) and micro-elements (Table 5) and could meet the daily requirements of ruminants. However, the concentration of Mg in MMP, Fe in BP, Cu in BP and MMP and Zn in BP were higher than the maximum tolerance limit, and can be used as source of organic minerals. None of the fruit wastes contained the heavy metals above the maximum tolerance limit.

It is concluded that most of the tested fruit wastes, especially banana foliage and peels, mango peels and seed kernels, citrus pulp and pineapple waste either fresh, dried or ensiled could serve as excellent alternate feed resources for livestock and poultry.

**Vegetable wastes as livestock feed**

**Bottle gourd** ( *Lagenaria siceraria*) pulp

**Ruminants:** The residue after extraction of juice is called bottle gourd pulp. It can be conserved by sun drying and then ground to pass through a 1 mm screen. It is a rich source of CP (24.3 percent) and has a low concentration of cell wall constituents. The in vitro gas production studies revealed that the graded levels in the iso-nitrogenous and iso-caloric concentrate mixtures (0, 25, 50, 75 and 100 percent) depressed digestibility of nutrients, VFA production and ME availability. The in vivo studies on bucks fed with a diet containing 0, 25 and 50 percent bottle gourd pulp in iso-nitrogenous and iso-caloric concentrate mixtures supplemented with green fodder (50:50) revealed that fungal population in the rumen had increased ($P<0.05$), while that of bacterial and total protozoal population was depressed ($P<0.05$) with the increasing level of 'lauki' pulp in the diet. However, it did not affect the daily DM intake. The digestibility of CP was depressed, whereas that of ADF and cellulose improved ($P<0.05$), without affecting the N-retention in bucks. It was concluded that 'lauki' waste can be incorporated up to 50 percent in the concentrate mixture of adult ruminants (Wadhwa, Saini and Bakshi, 2013).

**Carrot (*Daucus carota*)**

Feed carrots are usually cull (grade-out) or surplus carrots obtained during glut season of production. These can be fed fresh (whole/chopped), ensiled or dehydrated. Other carrot products that occasionally are fed to livestock include the carrot tops and carrot pomace after extraction of juice.

**Composition:** Fresh carrot contains 10 percent CP, 1.4 percent EE up to 60 percent sugars, mostly sucrose (on DM basis). A rich source of vitamin C (300−700 mg/ kg DM) and carotene, depending on the carrot variety; orange carrots contain 200−1000 mg/kg DM of β-carotene. Carrots also contain harsh turpentine-like flavors associated with the presence of total volatiles especially γ-terpenine and elicit a negative organoleptic response and decrease in palatability when in high concentration.

**Non-ruminants**: Carrot is a staple diet of horses. Dehydrated carrots and carrot flakes are common commercial treats for horses. Fresh carrots are used in low amounts (2−3 kg/day) for working horses, and these are mostly used to maintain appetite and facilitate the consumption of dry feeds. Clean and well-preserved carrots can be fed up to 10 kg/day to resting or convalescent horses. They should be chopped into 5 mm thick rings or sliced into long thin slivers before feeding to reduce the risk of choking.

**Ruminants:** Carrots are highly palatable and readily consumed by cattle. Carrots are a rich source of ME (3.29 Mcal/kg DM) and NE (1.94 Mcal/kg DM) for lactating dairy cows. Fresh carrots can be fed up to 20 and 25 kg/day to young bulls and dairy cows and can be included up to 40 percent in the diet of steers, without any adverse effects. Due to high fermentable sugars, fresh carrots should be combined with fibrous feeds to prevent acidosis and scouring, and should be introduced progressively in the diet (8−10 days). The mixture of carrots and concentrate feed should not exceed 50 percent of the diet DM and ad libitum feeding must be prevented. Prolonged use of carrots in the diet of dairy cows increased the carotene content of the milk and produced yellow coloured milk fat. A significant

improvement in the reproductive performance of high-yielding cows fed 10 kg/day fresh carrots in the diet was observed; a decrease in the calving interval from 167−185 days to 110−171 days, a decrease in the number of inseminations necessary for successful fertilization (1.8−2.7 to 1.0−1.8) and an increase in the calving rate (84.5 to 92 percent). The milk yield and fat content were not affected. The gestating and lactating ewes fed 3.3 kg/day fresh carrots during the last month of gestation and 5 kg/day (27 percent of the dry matter intake, DMI) during lactation were well accepted by the animal. It could be included up to 80 percent in the diet of ewes at maintenance. Goats can be fed up to 2−4 kg/ day of fresh carrots.

Boiled, dehydrated and ground carrots have been tested successfully in the prophylaxis of diarrhea of weaning piglets. Carrots can provide carotenoids to laying hens. The yolk colour of the egg was improved significantly when 4−8 percent dried carrot meal was used in the diet of laying hens compared with a wheat-based control diet. Body weight gain, egg production and feed conversion were not affected. Giving egg-laying hens access to maize silage, barley-pea silage and carrots as forage materials decreased pecking behaviour, thus improving animal welfare.

**Carrot pomace**

**Ruminants:** After extraction of juice, approximately one-third of the raw material remains as pomace. It contains 7−8 percent CP and 1.8 percent EE (Table 3). It is a rich source of total sugars (64.3 percent) and contains about 4.3 percent total phenolics. The fractionation of true protein revealed that like other cannery wastes, it is rich in albumin, followed by glutelin, globulin and prolamin (Table 5). It is also a rich source of macro- and micro-elements (Tables 6 and 7). The digestion kinetic parameters for DM revealed that about 97 percent is degradable, with very high effective and true degradability and low rumen fill resulting in high potential DM intake.

**Non-ruminants:** Dried carrot pomace could be used up to 50 percent in growing rabbit's diets without any adverse effects on the productive performance, nutrient digestibility and blood components.

**Potato (*Solanum tuberosum* L.)**

During the peak production season, it becomes a problem for the farmers to dispose of the surplus and the cull potatoes. These cannot be dumped, even in the waste land, because of the legal implications. Also, such potatoes cannot be kept in the cold stores because of the cost involved. The only option for the farmers is to feed them to the livestock. Raw potatoes are not very palatable and have a laxative effect and, therefore, should be introduced gradually in the diet of animals. To get the most value from the starch present in potatoes, these should be boiled or steamed. Potato sprouts contain an alkaloid, solanine, and it is advisable to remove the sprouts before the potatoes are fed to pigs or poultry. Fungal infested potatoes should never be used as feed.

**Composition:** The fresh potatoes contain 65−75 percent starch (depending on the variety), 9.5 percent CP and 0.4 percent EE on dry matter basis. Potatoes contain negligible quantities of fibrous fractions like NDF, ADF and cellulose.

**Ruminants:** Potatoes have high ME (3.16 Mcal/kg DM) and NE (1.87 Mcal/kg DM) for lactating dairy cows. Dairy and beef cows can be fed up to 15−20 kg/day of raw potatoes without any adverse effects on the health of the animals. Potato tubers can be chopped with forage and ensiled. The heat generated during the fermentation is sufficient to cook the potatoes. The haulm can be ensiled for feeding to cattle.

**Non-ruminants**: Pigs are usually given only cooked potatoes, which are efficiently used by fattening and breeding animals. Pigs can be fed up to 6 kg a day. Potatoes produce firm pork. Cooked potatoes can be used for poultry up to 40 percent of the total ration.

**Table 4.Macro mineral content (percent DM basis) of vegetable and fruit wastes**

| | Botanical name | Fe | P | Mg | Na | K | S |
|---|---|---|---|---|---|---|---|
| Cauliflower leaves[1] | *Brassica oleracea B.* | 2.17 | 0.34 | 0.44 | 0.39 | 0.60 | 0.56 |
| Cabbage leaves[1] | *Brassica oleracea C.* | 2.38 | 0.23 | 0.68 | 0.43 | 0.44 | 0.68 |
| Pea vine[1] | *Pisum sativum* | 1.28 | 0.22 | 0.49 | 0.15 | 0.45 | 0.28 |
| Radish leaves[1] | *Raphanus sativus* | 1.79 | 0.28 | 0.46 | 1.01 | 0.61 | 0.89 |
| Banana peel[4] | *Musa acuminata* | 0.29 | 0.18 | 0.30 | 0.01 | 1.11 | 0.27 |
| Musk melon peel[4] | *Cucumis melo* | 0.62 | 0.44 | 0.43 | 0.49 | 0.44 | 0.29 |
| Watermelon peel[4] | *Citrullus lanatus* | 0.47 | 0.43 | 0.36 | 0.21 | 0.74 | 0.18 |

[1]Wadhwa and Bakshi (2005); [4]Bakshi and Wadhwa (2013); NRC (2001)

**Table 5.Micro mineral content (ppm) of vegetable and fruit wastes**

| | Botanical name | Fe | Cu | Zn | Mn | Mo | Co |
|---|---|---|---|---|---|---|---|
| Cauliflower leaves[1] | *Brassica oleracea B.* | 387.0 | 4.0 | 40.8 | 40.8 | 2.7 | 3.7 |
| Cabbage leaves[1] | *Brassica oleracea C.* | 894.0 | 9.4 | 48.3 | 54.6 | 3.1 | 5.9 |
| Pea vine[1] | *Pisum sativum* | 1587.0 | 10.9 | 53.6 | 49.8 | 2.1 | 6.7 |
| Radish leaves[1] | *Raphanus sativus* | 638.0 | 6.6 | 34.0 | 54.4 | 1.7 | 4.4 |
| Banana peel[4] | *Musa acuminata* | 2947.0 | 386.0 | 1138.0 | 522.0 | 3.3 | 6.0 |
| Musk melon peel[4] | *Cucumis melo* | 226.0 | 54.4 | 40.0 | 20.4 | 2.5 | 6.0 |
| Watermelon peel[4] | *Citrullus lanatus* | 185.0 | 4.8 | 39.3 | 14.36 | 0.8 | 3.8 |

[1]Wadhwa and Bakshi (2005); [4]Bakshi and Wadhwa (2013); NRC (2001)

**Sweet potato (*Ipomoea batatas*)**: Sweet potatoes are often grown on small farms. In the fresh state, the tubers contain approximately 32% dry matter and are best used as a feed for pigs. When dried and ground, the meal is similar in energy content to corn but very low in protein.

**Moringa (*Moringa oleifera*):** All parts of the moringa tree are used for food, oil, fiber, and/or medicine., the most important products are pods and leaves. Leaves are readily eaten by cattle, small ruminants, pigs and poultry and can also be used as food for fish. Protein content of leaves is 20-30% on a dry weight basis. Most important is that the protein is of high quality having significant quantities of all the essential amino acids. Leaf fresh weight yield is 1-5kg per tree/year. Cattle feed consisting of 40-50% moringa leaves is mixed with molasses, sugarcane, and grass.

**Sarson saag waste:** Sarson saag, a vegetarian dish, is prepared by steam cooking of leaves of Mustard (*Brassica campestris*), Spinach (*Spinacea oleracea*) and Fenugreek (*Trigonella foenum-graecum*) in a 95:4:1 ratio. The chopped leaves are steam cooked after thorough washing. The contents are then transferred into a pulper for making pulp. The pulp is cooked with butter oil, condiments and then packed in sterilized cans while hot and is used as a delicacy for human consumption in India and abroad. The waste material left after extracting the pulp (which constitutes about 50 percent of the original leafy vegetables) is called 'Sarson saag waste'. It is dumped on the waste land posing great threat to the environment. SSW contains 14.5 percent CP and is a good source of water-soluble sugars (6 percent). Adult buffalo can consume 50−55 kg fresh SSW/day. The nutrient digestibility of SSW in male Murrah buffaloes is comparable to that of conventional green fodder, Avina sativa . It is concluded that SSW supplemented with mineral mixture is highly palatable, can serve as an excellent source of nutrients for ruminants and can be fed as a complete feed.

**Other vegetable wastes as livestock feed:** Cauliflower (*Brassica oleracea* Botrytis) leaves with stem (obtained after removing curd for human consumption) and cabbage (*Brassica oleracea* Capitata) leaves with sugar beet (*Beta vulgaris* L.) leaves, pea (*Pisum sativum* var. arvense) vines, radish (*Raphanus sativus* L.) leaves and summer squash (*Citrullus vulgaris*) vines are to be utilize as a livestock feed as they are rich source of nutrients like Ca, P, Na, K, S, Zn, Mn, Mo and Co.

**Advantages:** Low transportation cost to livestock area, The sale of fruit and vegetable waste for feed can produce income.

**Disadvantages** are Livestock may not eat rotten fruit and vegetable waste, Transportation cost may be high, High labor costs of unloading intact fruits and vegetables.

**Conclusion**

Fruit and vegetable wastes like cauliflower and cabbage leaves, pea pods, sarson saag waste, culled peas and tomato pomace; citrus, carrot and bottle gourd pulp; banana and mango peels etc. are a rich source of nutrients and these can be fed either as such, after drying or ensiling with cereal straws, without effecting the palatability, nutrient utilization, health or performance of livestock. These can also be used for the production of value-added products like essential oils, poly-phenols, edible oil, pigments, enzymes, etc. The effective and efficient utilization of fruit and vegetable wastes will reduce the cost of animal feeding

thereby increasing farmers' profits, generate an value-added products and help in waste management and reduction of environmental pollution.

**References**

FAO. 2011. World Livestock 2011 – Livestock in food security. Rome, FAO.

Habib, G. 2008. Best practices in animal feed production and management in Pakistan. In Shadidul Huque, Wais Kabir & Nasrin Akter eds. Best Practices in Animal Feed Production and Management in SAARC Countries. SAARC Agriculture Centre, Khaka-1215, Bangladesh.

Ravi Kiran, G., Suresh, K.P., Sampath, K.T., Giridhar, K. & Anandan, S. 2012. Modeling and Forecasting Livestock and Fish Feed Resources: Requirements and Availability in India, National Institute of Animal Nutrition and Physiology, Bangalore.

Rohilla, P.P. & Bujarbaruah, K.M. 2000. Effect of banana leaves feeding on growth of rabbits. Indian Veterinary Journal, 72: 902−903.

Uddin, M.M. 2013. Feed inventory in Bangladesh, preliminary data (Personal communication).

Wadhwa, M., Saini, J.K. & Bakshi, M.P.S. 2013. Potential of bottle gourd pomace as feed for goat bucks. Small Ruminant Research, (submitted).

# Family Poultry Production for Poverty Alleviation and Gender Equity in India

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Agriculture remains a critical component of India's economy and it accounts for about 17 per cent of GDP. Poultry production is one of the fastest growing sectors of Indian agriculture, with annual growth rates of 5.57 percent and 11.44 percent in egg and meat production, respectively. The sector is providing direct or indirect employment to 6.5 million people. About 80 percent of the employment is generated directly by poultry farms; the rest by the feed, pharmaceutical, equipment and other support services required by poultry. Egg production in India has gone up from 2.88 billion in 1961 to 65 billion in 2014, while poultry meat production increased from 0.081 million tonnes to 3.6 million tonnes during the same period. The value of output from the poultry sector was US$10 billion in 2014 (Rajendran et al., 2014). It accounts for about one percent of India's GDP and 11.70 percent of the GDP from the livestock sector. The organized poultry sector is contributing nearly 70 percent of the total output, with the rest from the unorganized sector. A substantial proportion of India's poultry production still comes from the unorganized poultry production system mostly in the rural areas.

Today poultry production for egg and meat is one of India's most innovative industries. Having evolved from the backyard to a vertically integrated and organized sector it has achieved unprecedented growth during the last four decades. Though considerable growth has taken place in poultry sector, the consumption of egg and meat is far below the recommended (Nutritional Advisory Committee) consumption of 180 eggs and 10.8 kg poultry meat per person per year. India has nearly 70% of its population living in rural areas. However, in the present scenario most of the commercial poultry production is concentrated in urban and peri - urban areas. Just 25% population living in urban areas consumes about 75-80 % of eggs and poultry meat. The per capita consumption of egg is 100 and poultry meat is 2.2 kg per person per annum in urban areas. However, in rural areas it is restricted to only 15 eggs and 0.15 kg poultry meat. Non-availability of poultry products and low purchasing power of the rural people devoid them of access to the highly nutritious products like egg and meat, thereby, resulting in malnutrition. The Government of India is launching many schemes from time to time to improve nutritional and socioeconomic status of the rural poor. Poultry production in rural/backyard areas is one such promising strategy to enhance the nutritional and economic conditions of population in rural / tribal areas and women empowerment. In order to meet the rural demand for poultry eggs and meat it is imperative that production for the masses should catered by the mass scale adoption of poultry farming in rural areas using low input cost technologies.

The rural people are practicing backyard poultry keeping since time immemorial in India and other Asian and African countries. Small and landless farmers as well as those belonging to weaker sections, including tribal and scheduled castes people traditionally keep local breeds for their subsistence. These birds forage and scavenge for their food in the back yards of human dwellings and provide eggs and meat at insignificant cost. They provide rich nutritional food and regular source of income for the rural / tribal poor. Rural poultry keeping can be used to reduce poverty among women and children in rural areas. By increasing women's income, poultry farming also enhances women's social status and decision making power in the household. Therefore, the need of the hour is to promote free range and backyard poultry farming in rural, tribal and underdeveloped areas of the country.

**Why Poultry is the choice?**

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

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

| Foodstuffs | Biological value | Protein efficiency ratio | Net Protein utilization | Chemical Score | Digestibility% |
|---|---|---|---|---|---|
| Egg | 96 | 4.5 | 93 | 100 | 97 |
| Milk | 85 | 3.0 | 81 | 65 | 94 |
| Meat | 80 | 2.8 | 76 | 70 | 82 |
| Chicken | 82 | 2.9 | 78 | 71 | 85 |
| Fish | 85 | 3.0 | 72 | 70 | 85 |

| Foodstuffs | Biological value | Protein efficiency ratio | Net Protein utilization | Chemical Score | Digestibility% |
|---|---|---|---|---|---|
| Soybeans | 64 | 2.0 | 54 | 57 | 73 |
| Peas | 56 | 1.6 | 45 | 42 | 72 |
| Potato | 60 | 1.8 | 49 | 48 | 82 |
| Rice | 64 | 2.0 | 57 | 60 | 90 |
| Wheat | 58 | 1.7 | 47 | 42 | 90 |
| Maize | 45 | 1.3 | 34 | 35 | 85 |
| Bajra | 62 | 1.8 | 52 | 52 | 88 |

**Why Rural Poultry Production?**

- Studies in neighbouring countries like China, Bangladesh and Sri Lanka have shown that rural poultry farming has a useful role and is worth studying to take up appropriate steps to improve the productivity (Dattatrya and Sangeetha, 1996).
- Adoption of commercial exotic breeds in rural / backyard system of rearing is a difficult scenario because of the limited resources.
- The lack of basic infrastructure, compounded feed and proper health coverage still make, it a dream to go for organized poultry production in rural areas.
- On the other hand, high mortality rate, malnutrition and adverse climatic condition in many areas are stumbling blocks to the successful raising of high producing germplasm.
- A new avenue for poultry exports is also opening up as a result of the growing worldwide trend towards the consumption of eggs and meat from birds reared under free-range conditions. The demand for these products is largely from the developed countries and is rising steadily in response to the concern for animal welfare.

**Poultry production and poverty alleviation**

The United Nations Food and Agriculture Organization (FAO, 2014) estimates that about 805 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic hunger or undernourishment, of which791 million people are from the developing countries, representing 13.5 percent, or one in eight, of the population of developing countries. Poultry represent an important system to feed the fast growing human population of developing countries of South Asia and to provide income to poor small farmers, especially women. Increased production of poultry, both commercial and rural, is a vital contribution to food security at both the household and community levels. Rural poultry production continues to make a significant contribution to poverty alleviation and household food security in many developing countries (Alders and Pym, 2009; Guèye, 2012). Village poultry production is ideally suited to rural areas where the conditions for a successful commercial poultry sector are rarely met. Indigenous poultry breeds are excellent scavengers, transforming feed resources considered unsuitable for human consumption into high quality

products such as poultry meat and eggs. The ability of indigenous breeds to scavenge, to flee predators, to lay and hatch their own eggs and to contribute to pest control results in a production system that complements other farm activities without directly competing with humans for cereal crops. Village poultry are generally owned and managed by women and children and are often essential elements of female-headed households.

**Gender and Poultry**

Gender is defined by FAO as 'the relations between men and women, both perceptual and material. Gender is not determined biologically, as a result of sexual characteristics of either women or men, but is constructed socially. It is a central organizing principle of societies, and often governs the processes of production and reproduction, consumption and distribution' (FAO, 1997). Despite this definition, gender is often misunderstood as being the promotion of women only. However, as we see from the FAO definition, gender issues focus on women and on the relationship between men and women, their roles, access to and control over resources, division of labour, interests and needs. Gender relations affect household security, family well-being, planning, production and many other aspects of life (Bravo-Baumann, 2000). The role of family poultry in poverty alleviation, food security and the promotion of gender equality in developing countries is well documented. Family poultry production represents an appropriate system to contribute to feeding the fast growing human populations and to provide income to poor small farmers, especially women.

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

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

locally available grains, tender leaves, worms, insects and other material available for scavenging. The production potential of the native chicken breeds is very low. Realizing the importance of backyard poultry farming in India and the need for high yielding varieties, research efforts were initiated in the recent past at ICAR Institutes and SAUs for developing new strains suitable for rural farming. Crosses like Vanaraja, Giriraja, Gramapriya, Girirani, Krishna J, Gramalakshmi, CARI Gold, Niocbari etc. have been evolved and being raised in different parts of the country.

The role of family poultry in poverty alleviation, food security and the promotion of gender equality in developing countries is well documented (Guèye, 2000). Family poultry production represents an appropriate system to contribute to feeding the fast growing human populations and to provide income to poor small farmers, especially women (Gujit, 1994; Alders, 1996; Kitalyi and Mayer, 1998). It makes good use of locally available resources, requiring low inputs. Though generally considered secondary to other agricultural activities by smallholder farmers, poultry production makes an important contribution to supplying local populations with additional income and high quality protein. Poultry products can be sold or bartered to meet essential family needs such as medicine, clothes and school fees. Village chickens are active in pest control, provide manure, are required for special festivals and are essential for many traditional ceremonies (Alders, *et al.*, 2003).

**Major issues and approach**

While going for rural poultry production, it is essential to understand the local production system, their limitations and opportunity, the circumstances under which such traditional system came into existence and how they can be improved further. The focal points for rural / backyard poultry production is

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

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

**Development and adoption of appropriate technology**

There is a need to develop suitable germplasm for rural / backyard production with improvements in the economic traits in the existing native breeds or the development of new

stock with infusion of native blood. The productivity of these stocks should be 120-150 eggs per annum and around1kg meat in 10-12 weeks of age. Upgrading and cross breeding are the most easy and quickest method for improvement of indigenous germplasm for traits of economic importance. Genetic characterization and breed description of indigenous fowl breeds like Kadaknath, Assel Naked neck and Frizzle have received priority in research conducted so far. Some important genes, already proved for their special utility in the tropics are naked neck and Dwarf gene. Introduction of naked neck gene into broiler genome is receiving considerable attention in recent years for tropical broiler production because of its superior heat tolerance, adaptability and protein conversion efficiency. Many institutions are working hard to develop varieties of chicken suitable for rural poultry farming and some of them are Vanaraja, Gramapriya, agiriraja, Krishna J, Gramalakshmi, CARI – Gold, CARI-Shyama, CARI-Nirbheek, Nicobari, etc.

**Utilization of locally available resources**

In the backyard poultry keeping, it is difficult to know the activity of the birds for their picking up habits and availability of feed ingredients. It is therefore suggested to provide some diets to satisfy their nutrient requirements for optimum production for egg and meat. The availability of common feed ingredients for poultry is becoming a scarce as sizable human population depends on grains like maize, sorghum and other coarse millets for their sustenance. It has become necessary to identify the alternative feed resources available locally and evaluate their nutritional value for poultry. This will not only help in reducing the cost of production but also proper utilization of the local produce.

**Disease control**

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

**Marketing system**

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

**References**

Bravo-Baumann, H. 2000. Capitalisation of experiences on the contribution of livestock projects to gender issues. Working Document. Bern, Swiss Agency for Development and Cooperation.

FAO. 1997. Gender: the key to sustainability and food security. SD Dimensions, May 1997 (available at www.fao.org/sd).

Food and Agriculture Organization, International Fund for Agricultural Development, World Food Program. 2014. "The State of Food Insecurity in the World 2014. Strengthening the enabling environment for food security and nutrition." Rome: FAOhttp://www.fao.org/publications/sofi/2014/en/

FAOSTAT. 2006. Statistical data base. “http:/www.fao.org”. Food and Agricultural Organisation, accessed June 2006.

Kumtakar, V.A and Kumtakar, P. 1999. Rural poultry scenario in tribal areas of central Madhya Pradesh, India, - A socio-economic analysis. The First INFPD/FAO Electronic conference on Family Poultry.

# Duck Production as an Alternate-Poultry Enterprise for Women Empowerment

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Despite the popularity of Commercial poultry production in current century, its growth is still being hampered due to many reasons, across rural livestock sector compared to the urban scenario. While in International arena, India currently ranks as the third largest producer of eggs *vis a vis* its twelfth position held in the 1980s, the scope for growth of poultry remains very high, as ever. Considering the value of table eggs constituting the cheapest and most-qualitative animal protein for masses, the per-capita consumption of eggs has sharply gone up to 68 from a paltry single digit (5), realized in fifties. India also remains the fourth-largest chicken producer after China, Brazil and USA. The per capita chicken meat consumption also has shot up to 2.5 kg from the figures of 400 gm a few decades before. Human nutritionists however, recommend a per person consumption of 180 eggs & 10 kg chicken per year. There is scope for enhancing the production. Accordingly, the poultry Production in India is getting more organised and moving ahead of consumption, resulting in optimum prices and with minimum profits.

However despite these statistics, the country's farming community remains largely engrossed with chickens, as the most productive poultry, while focus on other poultry species has been minimum. For example, the waterfowls: Ducks (*Anas platyrhynchos*) and geese which constitute 6 to 7% of the total domesticated poultry of India, [similar to World-statistics: constituting ~ 7% of total poultry], possessing equal or better production abilities compared to chickens, have hardly received the deserving-attention for their potentials. Again, among waterfowls, the ducks remain the most popular compared to the latter, for their productivity and mass acceptance. Let us then review, where and how the Ducks stand *vis a vis* chickens for their worthiness.

In many ways, Duck production emerges as a real alternate to chicken production which can contribute substantially to food, income, employment and social security in our country. However, duck production in India, is still in unorganized form which is largely being carried out in limited scale. Marshy lands and adverse climatic conditions of coastal areas which are not suitable for chicken production can be effectively utilized for duck production. Ducks can grow well with locally-available feedstuff and less manpower is needed to raise them even by using meagrely-equipped facility. In rural areas, even the women folk and aged people can easily be able to manage production of ducks. Small-scale farms remain enormously important because of the large number of rural households they support. They also make a useful contribution to the food-supply chain of urban populations using the recycled resources effectively. While the global Duck population is around 1300 million, India's duck population is just 26 million in number (FAOSTAT, 2012). With this germplasm-base, India produces around 38 million tonnes of duck meat and 2.0 billion numbers of duck-eggs

annually. In India, ducks are concentrated in coastal regions, especially southern and north-eastern states.

Of the current duck population of the country, 90 to 95 percent belong to indigenous or non-descript breeds/varieties, viz. Chara and Chemballi of Kerala; Sylhet mete and Nageswari of eastern region; Aarani ducks of Tamil Nadu; Desi variety of West Bengal; Pati, Deo, Cinahanh and Raj Hans varieties of Assam; Kuzi and Moti ducks of Odisha, which are not only hardy, but also are suitable for extensive system of rearing. Although semi-intensive and intensive duck raising systems have been developing, the extensive system is the most-commonly practiced way to raise ducks. Despite mediocre productivity (~116 eggs/year for native ducks versus 60 eggs/year for native chickens) the rural duck production remains as an important means of social security promising a significant income security and a protective instrument against poverty. And thus, Duck farming qualifies for receiving maximum government support for raising self-employment and income-generation in rural condition.

**Overall Advantages of Backyard Duck production**

In our country, considering the need for boosting *per capita* egg production needs, the easiest means for promoting poultry production, by rural household is backyard duck rearing. As starting a backyard-Duckery may need a small investment, say in few thousand rupees, in contrast to the funds-intensive chicken production, which may need lakhs of rupees per unit of poultry, it can be adopted by most sections of society, especially the womenfolk, in view of following inherent advantages.

- Ducks can lay good number of eggs and can produce substantial quantity of meat. Duck meat and egg are usually tasty and liked by most consumers.
- Ducks are the second largest source of table eggs in rural area.
- By rearing ducks, one will be able to supplement qualitative nutrition to his/her family.
- Ducks are easy to rear. They need less care than chickens. Ducks are strong and hardy.
- Ducks do not get sick easily. One does not need to vaccinate for more than 2-3 vaccines in total for ensuring high liveability in commercial duck rearing.
- With very little labour and attention, one can start a small flock of ducks..
- They supplement their feed requirement by foraging, eating fallen grains in harvested paddy fields, insects, snails, earthworm, small fishes and other aquatic materials in lakes and ponds. Hence duck-farming incurs reasonable feeding cost
- Duck eggs have importance throughout coastal India
- It is best reared by small farmers, marginal farmers, agriculture labourers / land less as well as poorer section of the community.
- Duck lays 40-50 eggs more than desi chickens.
- The duck egg is heavier than the hen egg by 15-20g.
- Ducks lay 95-98% of their eggs early in the morning, before 9 A.M. Thus, it saves a lot of time and labour for managing collection of eggs and their sale.
- Duck have a longer profitable life and they lay well even in the second year.
- Duck don’t require elaborate house like chicken, thus reduces the capital investment.

- Ducks flourish well in low wet land or low areas around ponds.
- Ducks have no cannibalism or pugnacious behaviour.

**Various Duck production systems prevalent in our country/ communities**

There are many prevalent Duck farming systems in this country, which can be briefly discussed in terms of their merits and superiorities, below. Though, most duck rearing practices in India, are associated with water bodies etc., it is a myth that duck farming cannot be done without a swimming facility in particular. The intensive modes of duck farming can be done anywhere, similar to chickens or turkey rearing by confining them to sheds and feeding them with balanced diets coupled with supply of sufficient water, just for supporting their growth. It may just be a fact that: ducks being natural waterfowls, may love to play with water and may have a tendency to consume little more water compared to chickens (say water-requirement may be double the quantity used for chickens), besides spilling some amount of water because of their fondness for water.

While in India, the preferred system of duck rearing and management is: a semi-intensive system of management, the 21st century's commercial Duck management is more of an intensive system which can be dealt in nut shell here.

**Care and requirements of ducks in an Intensive System:-**

Duck eggs require about 28 days to hatch, which is just a week more than that of chickens. Soon after hatching, the ducking require a brooding management. In practice however, it is seen that: ducklings need to be brooded little longer than chickens, sometimes for upto 5 weeks of age, in winter months when the regular feathers take more time for replacing the down feathers. This requirement might not be severe in southern parts of India, where the impact of winter is not that severe. Ducklings drink copious amounts of water, probably to push their food along their digestive tract and consequently produce watery excreta. This has some direct impact both in quality of litter and its management. Litter is usually managed by rice hulls, sawdust or wood shavings and even by sand, although many of these are known to cause foot ailments and breast blisters. As ducks tend to drink water frequently and spill a lot, placement-location of waterers is important. Litter should be turned or renewed on a regular basis. Ducks tend to drink more in the summer months than in winter. Many studies have shown on average a water to feed ratio of 3.3:1 in summer months and 2.7:1 in winter, which is same for most breeds of ducks and both sexes alike. It is better, that the water could be provide in founts, having grills, where the ducklings might not be able to spill much water and still be able to immerse their heads and eyes (as a matter of habits with ducks) for keeping the eyes healthy.

**As regards to Disease-management of ducks, they are often** hardier and more resistant to disease than chickens and accordingly they have less disease outbreaks. Newcastle or Ranikhet disease, which is common in chickens, is rarely seen in ducks. However, highly pathogenic avian influenza (HPAI, e.g H5N1 flu etc.), which has eliminated many chicken farms/ flocks, especially in our country including Govt. Sector farmers, does not affect the ducks. They could however be silent carriers of the H5N1 virus, and be potential source of for infecting chickens and humans. This has somehow created a major hurdle in propagation of ducks in different states. A scientific approach to this problem, may however be to

frequently sample the farm-managed ducks (including sera and faecal sample monitorings), which have little chance of contaminating the HPAI and thus, be promoted on priority. Escherichia coli then forms the most common disease in ducks. Poor farm hygiene is a common cause. Infections with Pasteurella multocida and also Rimerella (Pasteurella) anatipestifer are usual, especially across different Asian countries, which is known to cause duck cholera in ducks.

Hygiene and biosecurity are early precautionary measures. Ducks are highly susceptible to mycotoxins, especially aflatoxin and particularly when young. This is a perenial problem in most coastal Indian states and might not always get diagnosed properly, as ducks may not always die but suffer from high morbidity including performance-losses. As a routine to handle this problem, a toxin binder should be invariably be incorporated in duck-feed in intensive system of rearing. As cited earlier, there has been much discussion about allowing ducks access to bathing water. Although, in consensus it is 'not essential', adult breeding-ducks may normally be given access to water, as is practised across most Asian duck farms. This allows the ducks to remain cool and probably helps to maintain feed intake. As the ducks lose heat mainly through its bill and feet, rearing ducks using water channels, which can also solve the problem of waste disposal besides keeping them cool and clean.

As regards to Housing needs, rearing ducks on slatted, mesh-wire or synthetic weave floors located over pits with draining facility can be hygienic and advisable. A mixture of slatted (30 per cent) and litter floor (70 per cent) from 2 weeks onwards could be ideal for organized farms. An all-slatted floor is usually not advisable on longer terms. In most of our coastal Indian states, using paddy husk and saw dusts can be used as ideal litter materials for floor rearing, where replacement of litter should be frequently carried out, even at 3 to 5 days intervals.

Considering the thin webbed feet of ducks, foot lesions can occur on mesh-wire floors with higher chances of Injury, as a result of which rearigng ducks in cages is not advisable without proper improvisation. Where it may be required to keep the ducks exclusively in cage, the wire-mesh can be additionally be lined up or covered up with one layer of soft rubber mats or plastic mesh, which can reduce chances of injury to the adult ducks. Good ventilation is also important, as ammonia production is high and can cause metal corrosion. It should be kept below 15ppm. Climate wise, comfort zone of mature ducks is about 15 to 26°C. In commercial practice after housing the ducks for breeding a temperature range of 21 to 25°C is the most ideal ambience for ensuring good egg production. Fan ventilation may be necessary to reduce shed temperature and ammonia levels in dense- housing systems.

**The various Semi-intensive systems of duck-rearing, can be summarized as per following.**

**A. Foraging System**

It is a one of the oldest biological system for duck-rearing which utilizes the natural resources through foraging mainly in paddy fields after harvest. This system of management, however, is a low input technology. Its merits are nevertheless about making use of all those left-over or non-harvestable grains of the farmers/producers, trapped in the mud and clay which can be well-utilized by the ducks very neatly. In this way, not only that these fractions of the grain harvest gets used, but also, the ducks are able to meet part of

their cereal requirements saving a good amount of cost for the duck-growers. Foraging the ducks in various ecosystems viz. ponds, rivers, canals, lakes, miscellaneous water bodies and post harvest paddy fields is advantageous in many ways.

**B. Backyard Rearing System**

This backyard duck husbandry system primarily concerns small and rural farmers. This system is recommended for the section of farmers, who are resource-poor and don't have much capacity to go for farm-feeding of ducks. Ducks can even mingle with chickens and other species, throughout the area. They are mainly confined to the farm premises, but may roam around the village. Under this, Duck needs little care and scarce supplementary feeds, where they are usually kept enclosed near to farmer's house, at night. Flock-size in this system could range from 5 to 20 ducks. While, during day-time, the ducks are free to roam outside in search of feed, they are brought inside at night, by putting some extra feed in the night-shelter and nests for laying eggs. An advantage of this system is that: ducks go out to harvest their feed themselves. Among the various duck breeds of India, the improved Kuzi breeds of ICAR-CARI is one such germplasm, which ideally fits into this system, where with the least nutritional inputs by the farmers, the ducks are able to yield in range of 175 to 200 eggs per biological year. Although the performance under this backyard-system is generally lower than that of intensive production systems, its hallmark of low or no-cost feed can compensate the disadvantage of lower performances.

**Figure**: Ducks in a backyard system. Need for water body is not obligatory though

**C. Integrated System involving Duck and Rice farming**

The duck-rice integrated system has been practised in India since long. Although this duck-raising method accounts for a relatively limited volume of the duck industry, it has attracted more attention in recent years, owing to its connection to organic farming. The rice-duck system provides a measure to benefit both the paddy field and ducks. Insects, snails and weeds constitute the major food sources for ducks, and in turn, the duck's excreta become the fertilizer for the rice paddy. Water stirring caused by the ducks' activities inhibits the growth of weeds through photosynthesis reduction when the water becomes turbid. Their activities also enhance the rice root, stalk and leaf development, thereby accelerating rice growth. In addition, a reduced application of pesticides and fertilizers can benefit the ecological system. In usual practice, an optimum population of 200-300 ducks/ hectare of paddy field can be recommended to obtain a good rice and duck harvest. This number can be adjusted based on other feed sources (weeds, insect and snails) which are available in the

paddy field. The other points that need consideration in this practice could be as follows. (a). Ducklings at 2-4 weeks of age are introduced into the field after transplanted seedlings become rooted, and before introduction they must be trained to get into the habit of flocking and oiling their feathers. (b) A protective fence is required to protect the ducks from predators such as dogs, wild-cats and hawks and to prevent them from escaping. (c) Water by planning, should be kept at a level in which ducks can both swim and walk.

**Figure above**: Ducks in growing-paddy field in Duck-rice integration

***Duck Raising in Post-harvest Rice Fields***

Along with laying ducks, the table ducks (ducks for meat) are reared in the rice fields post-harvest. Generally farmers purchase ducklings from the hatcheries 3-4 weeks before the rice harvest. The ducks usually selected are the native meat type, local meat type and or crossbred local x exotic varieties. After 3 weeks of age when the ducklings can consume whole rice grains, they are permitted to enter the newly harvested rice fields. They forage the whole day on leftover or fallen rice grains, insects, shellfish, small-frog and fish, and water plants. In the late afternoon, they can be moved to pens or sheds near the household until next morning. The ducks raised at this time are usually finished at 2.5-3 months of age, and achieve live weights of 1.6-2.0kg for the crossbred varieties. Now-a-days, since mainly high yielding varieties of rice are planted and harvested within a short period, only a limited time can be available for the duck-flocks to scavenge. As the result, this traditional system of post-harvest duck rearing is becoming less feasible.

### D. Duck-Fish Integrated System

This system is very popular and widely practiced in our country particularly in Assam, West Bengal, Bihar, Orissa, Andhra Pradesh, Kerala and in North Eastern States. It happens to be one of the best livestock – fish integration system. Duck droppings directly fall in water or collected and used for fertilization in pond. Fish gather duck droppings as direct food or consume spilled feed. Ducks consume mosquito larvae, tadpoles, dragon fly larvae and snails which also serve as vector for certain parasites. The frequent-dabbling habit of ducks, resulting in churning of the water surface, increases the available oxygen in pond water. For commercial farming or for maximum profit, it is recommended to introduce high egg producing ducks like Khaki Campbell or crossbred ones for this system of rearing instead of local ducks. About 200 to 240 eggs/ duck/ year is expected for commercial farming and on an average 250 ducks/ hectare is recommended for duck cum fish farming.

As regards to the advantages, this system of duck rearing is rather straight-forward system of mixed farming. duck-fish integrated system is employed by many farmers, in which ducks have access to water for drinking and heat-stress alleviation. Ideally, It is a real-symbiotic system of rearing two agriculturally important species. Fish on the other hand, benefit from the ducks: as the manure of the ducks fertilizes the pond and increases fish feed (algae, plankton). Ducks, in this system, only need shelter for resting. Generally speaking, a minimum area of 0.5 square meter per duck is required. Ducks can be housed in a variety of ways. A pen can be built which floats on the water, or resting on stilts above the water or can be fixed on the bank of the pond. Most fish species under this system take about 6 months to reach market weight. In order to ensure that manure supply remains constant, it is best to keep different (duck) age groups at the same time. Once the fish has been harvested the pond will be empty of fish. When one can think of growing a batch of small fish before the old stock is harvested. Again after 4 to 5 years of rearing, the ponds need cleaning. The manure remaining in the pond can be taken out and be used for crops or added to compost. Alternatively, the manure in the pond can be utilized by growing some crops in the dry pond. The fish for stocking in the pond, under such of a system, must be at least 10 Cm in length, otherwise they could be eaten up, by the ducks. It is however, difficult to prescribe the exact numbers of fish and ducks because the numbers are dependent on many other factors.

**Figure**: (left) Ducks being engaged in a fish pond in a Duck-fish integration system.
(b) on right : ducklings maintained on Azolla grown from a pond- cultivation system.

In a Duck-fish integration, different sorts of carp can be kept in combination with ducks. The stocking density can be 45 to 60 fish per 100 square meter of water surface. The stocking density of tilapias can be 100 to 200 fish per 100 meter square, whereas, a density of 400 Catfish per 100 square meters could be sufficient. Under this Duck-fish integration, yields of 30 to 55 kg fish per 100 square meters, per year can be obtained. Similarly, for carp and catfish production, a maximum of 70- 75 ducks per 100sq. meter can be reared.

As regards to major output from Integrated Duck - fish farming, not only it increases fish production but also cuts down the cost of fish culture operations considerably. Where the average cost of production in conventional polyculture with supplemental feeding and inorganic fertilization was Rs. 2.93/kg in Eastern India (Anon, 1976), researchers have recorded the cost of production nearing Rs. 1.61/kg from a duck-fish integrated farming system.

**General remarks and conclusions**

As can be visible from the above, the duck-fish-rice integration system as a multi-species farming system works out to be a highly desirable Duck-farming system approach, which enables the best gain to the crops from either systems, in comparison to single-species rearing system. As regards to the ideal variety of Ducks suitable for these integration systems, either customized strains of Khaki Campbells, Pekins (now maintained at CARI, Regional centre, Bhubaneswar), or their crossbreds using local duck varieties( e.g. Kuzi ducks of Odisha) could optimally suit to be introduced in a Duck-fish or duck-fish-rice integration system, very appropriately.

In general, need for steady-supply of ducklings, minimal feed-cost, preventive measures for Bird-flu constitute the most important points for integrated duck production. Though indigenous duck varieties (being hardy and adapted to local environment) are usually promoted in rural areas, introduction of cross-bred or customized back-yard purpose ducks (with substantial egg production) could always be considered appropriate for such systems for ensuring best outputs (more table-eggs, entailing enhanced egg production for the country) and monetary margins.

Last but not the least, as a tool for women empowerment, the duckery, in preference to chickens and other poultry holds a specific advantage in our coastal and backward states, where traditionally women's involvement in livestock rearing have been an accepted norm. While, for generating a respectable livelihood with self-esteem, promotion of duckery can lead to great contribution, through remunerative potentials to tune of Rs.12000 to 15000 per year, feasible from rearing a small unit of 20 to 30 high-yielding ducks in a semi-intensive rearing module, it can be scaled up adequately, where ever required. Managing large flocks exceeding 100s of ducks, with or without water bodies can also be feasible for women entrepreneurs, which can be least labor-intensive as compared to chicken-rearing, but suffice to have potentials to engage women workers remuneratively, in self-employment platforms.

# Occupational Health Hazard in Agriculture with Special Reference to Animal Farming

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Majority of the India farmers derive their livelihood from agriculture. Agriculture and allied activities support livelihoods of nearly 70 percent of India's rural population. In recent years, land based livelihoods of small and marginal farmers are increasingly becoming unsustainable, since their land has not been able to support the family's food requirements and fodder for their cattle. As a result, rural households are forced to look at alternative means for supplementing livelihoods. Besides the Indian economy is predominantly rural and agricultural, and the declining trend in size of land holding poses a serious challenge to the sustainability and profitability of farming management of available resources by small farmers . Under the gradual shrinking of land holding, farmers are interested to integrate land based enterprises like livestock rearing, fishery, poultry, duckery, apiary horticultural crops, fodder etc. within the bio-physical and socio-economic environment of the farmers. As they are involved in multifarious activities, there is possibility of occurrences of occupational health hazards among them.

Occupational health hazards of farm workers may be due to exposure to weather/climate, snakes, insect bites, sharp tools, use of farm equipment, physical labour, carrying loads, pesticides, dusts/ fumes/ gases/particulates, biological agents & vectors of diseases. In rural parts of the country, men and women, both are engaged in farm activities. Of both, women do the household work in addition to child bearing and nursing to old parents. Thus their job in rural surrounding is more challenging than counter parts. This also reflects that they may be more prone to health hazards as they are involved in household's activities, animal caring, child rearing etc. Thus there is every possible chance to face the hazards, which is something that can cause harm if not controlled. So the outcome is the harm that results from uncontrolled hazards. In favourable circumstances, work contributes to good health and economic achievement. However, the work environment exposes many workers to health hazards that contribute to injuries, respiratory diseases, cancer, musculoskeletal disorders, cardiovascular diseases, mental and neurological illnesses, eye damage and hearing loss as well as to communicable diseases.

As per population statistics of our country, the female population in agriculture work force is increasing (20% in the year 1971 to 41.9% in the year 2007, based on estimate) and it is estimated that during 2025,it will reach to 60%. This statistics clearly indicates about more involvement of women in agriculture. Rural women perform most of the activities in their own convenient posture like sitting, standing, bending or squatting without realizing the harmful affect on the body. Due to this ignorance, women might be suffering from various health hazards.

**Meaning of Occupational Health Hazards**

Occupational refers to relating or resulting from a particular occupation that involves the individual from a particular occupation. 'Health' refers to the condition of being sound in body and mind. 'Hazard 'refers to a source of danger.

By combining these three words, 'Occupational Health Hazards' means the possible dangers that might be caused to body or mind by being engaged in any occupation.

Occupational health hazards of women are widely ranged from land based to home based occupations. In reality, every occupation has a set of activities and it is the performance of these activities that cause different types of health hazards.

**Most frequent hazards in agriculture**

- Machinery such as tractors, trucks and harvesters and cutting and piercing tools
- Hazardous chemicals: pesticides, fertilizers, antibiotics
- 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 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**

Work related diseases occur due to two factors: Workers' susceptibility-Age, Life style, Genetic factors, Race, Gender, Medical history.

**Work place factors**- Multiplicity of exposure, Duration of exposure, Physical properties, Magnitude of exposure, Timing of exposure. The major workplace hazards are physical hazards, chemical hazards, biological hazards, ergonomically hazards, and psychosocial hazards**.**

**Physical hazards:** Physical factors in the workplace such as noise, vibration, extreme temperature, illumination, radiation can affect health adversely.

**Types of Noise-Induced Hearing Loss**

- Temporary loss of hearing acuity after exposure to loud noise. Recovery is within 16-48 hours.

- Permanent Threshold Shift. Irreversible loss of hearing

**Other Harmful Effects of Noise**

- Hypertension
- Hyperacidity
- Palpitations
- Disturbs relaxation & sleep

**Vibration**

Physical factor which affects man/ woman by transmission of mechanical energy from oscillating sources

**Types**

- Segmental vibration( Health Effects: hand arm vibration syndrome, pain, tingling, blanching fingers)
- Whole body vibration (Health Effects: fatigue, irritability, headache, disorders of the spine)

**Extreme Temperature**

Sources of heat stress: Natural Conditions, Hot work process related to furnaces, kilns, boilers & smelting. Prickly heat, Heat cramps, heat exhaustion, heat stoke is the disorders.

Sources of Cold environment are ice plants and freezers in the food industry. Mostly farm women are the victims. The health effects are burning pain, numbness in fingers, toes, nose, and ears. Cramps, ulceration and gangrene are the disorders.

**Inadequate Illumination**

Sufficient light is necessary at the workplace to have better and safe performance from the workers. For Agricultural work in open space during day time, there is always sufficient light in normal working hours. During night, light is often poor & it may lead to accidents. It is important that proper light intensity is maintained at workplace so as to have safe and efficient performance. Otherwise the workers may develop visual fatigue, double vision, headache, painful irritation, lacrimation, conjunctivitis

**Radiation**

Radiation may be due to ionizing (x-rays, gamma rays) and non-ionizing (ultraviolet, infrared, laser) rays. The health effects are cancer, death, skin redness, premature skin aging and eye problem.

**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. The goal is 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.

**Most frequent hazards in animal farming**

On average, two people die every year in accidents involving animals on Ontario farms. Inadequate animal handling facilities and poor animal handling methods increase the likelihood that accidents will occur. Animals are also the source of some infectious diseases that can be spread to humans. Handlers must always be on guard when working with or around animals.

**General Responsibilities**

1. The employer shall provide information, instruction and supervision to a worker handling large farm animals and shall ensure that the worker is competent to do so safely.
2. A worker coming into contact with an animal should wear appropriate personal protective equipment for the assigned work.
3. A worker coming into contact with an animal should be made aware of any transmittable diseases that the animal may carry and should be instructed on how to prevent transmission, to themselves and to other animals.
4. An employer should ensure that workers know how to safely separate themselves from an animal while working in an enclosure occupied by animals.

**Animal Handling Hazards**

Farm employers and workers handling large animals can be killed or injured in a number of ways, including being:

- stepped on,
- knocked down,
- kicked,
- bitten,
- pinned against a hard surface, or
- exposed to a transmittable disease.

**Factors to Consider When Handling Large Animals**

The measures set out below are general factors that employers and workers should take into account to reduce the likelihood that an animal will behave in an unpredictable or aggressive way and thereby endanger either people or other animals nearby.

1. The employer should ensure that proper equipment and facilities are available for housing and handling the type of animals in the operation with attention to:
    - good housekeeping practices;
    - equipment, fencing and gates that are able to restrain animals safely for general maintenance or health care;
    - walking or working surfaces that are even and finished or constructed to prevent slipping under wet conditions;
    - even and diffused lighting; and,
    - alleys and chutes that are wide enough for animals to pass but not to turn around.
2. When approaching an animal, handlers should announce their presence by voice or by being clearly visible and gently touching the animal on the front or side.
3. Handlers should be aware of and avoid an animal's kicking region.
4. Noise and yelling should be kept to a minimum when working with livestock to enable the animal to feel secure.
5. When handling livestock with young, allow them to remain as close to their offspring as possible.

**Background--Animal Characteristics and Behaviour**

The points below are provided for information purposes only and may help those handling large animals to understand why certain precautions are necessary.

**Animal Vision**

Workers should be aware of the limitations of vision of the particular animal that they are working with. Animals may have:

- colour blindness;
- poor depth perception;
- sensitivity to contrasts, which may cause them to balk or hesitate at sudden changes in lighting (shadows), colour or texture;
- difficulty in picking out small details;
- sensitivity to distractions or sudden movement because of wide angled vision;
- a natural tendency to move from dimly lit areas to lighter areas;
- blind spots where they cannot see a worker.

**Animal Hearing**

Loud, abrupt noises can cause distress in livestock. Reduction of noise levels will have a calming effect on animals.

**Maternal Instincts and Territorial Behaviours**

Livestock with young exhibit a maternal instinct. They are usually more defensive and difficult to handle.

Most animals have a strong territorial instinct and develop a very distinctive attachment to certain areas such as pastures, buildings, water troughs and worn paths. Forcible removal from familiar areas can cause animals to react unexpectedly. Similar problems occur when animals are moved away from feed, separated from the herd or approached by an unfamiliar person.

**Kicking and Biting**

Each type of animal kicks differently. Some of the reasons animals kick include:

- pain, injury, or inflammation,
- something in their blind spot,
- sudden noise.

Animals may signal their intention to kick. For example, ears that are "laid back," or flattened backward, warn you that a horse is getting ready to kick or bite.

**Approaching Animals**

Most animals, like humans, have a comfort zone. The illustration below is specific to cattle but the principles apply generally to other animals as well.

A **comfort or flight zone** can be used to effectively move cattle and other animals. This works best when the handler works at the edge of the flight zone. These zones will vary from

animal to animal and can be anywhere from five to twenty-five feet. Deep invasion into the flight zone may cause panic and confusion. Learning the principles of using the flight zone will allow a handler to move the herd safely.

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

**1-Use women- friendly tools and equipment help to achieve.**

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

**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.

**CONCLUSION**

Occupational Health Hazards have been a widespread problem in agriculture and allied sectors in more than a decade. The identification of occupational health hazards and development of systems to evaluate intervene and decrease musculoskeletal risk factors and resulting disorders is quite crucial for safety of farm women. Role of women in agriculture is increasingly understood and recognized in agriculture. There is need to initiate women oriented researches in agriculture. As woman has different ergonomically characteristics than man, design of women friendly tools and equipment is required. Work station should be adjustable to make it comfortable for women during performing agricultural activities. Occupational safety and health work in agriculture has to respond to the needs of diverse farm types, e.g. small farms with part-time farming and large farms with permanent and/or seasonal workers. Larger farms usually have larger and more modern machinery and therefore less machinery injuries. New animal confinement buildings are generally better in

terms of air quality and working conditions. However, the increasing farm size may bring longer work exposure times and increase the risk of chronic diseases. Stress is also often reported as a major problem among farmers. The introduction of safety measures depends on the technical, economic and social development of the agricultural industry. Integrating safety into quality systems and the planning of new production processes and buildings is a great challenge for all concerned –farmers, safety organisations, professional associations, extension services and administrations. However, this is a challenge that must be met in order to protect the most valuable asset that the agricultural industry has, namely its people.

# Integrated Health Management in Livestock Farming

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Livestock wealth is very precious for a developing country like India. In India, animal husbandry is no longer a subsidiary to agriculture or a backyard vocation. Animal husbandry has metamorphosed into an industry and the latest reports suggest that the contribution of animal husbandry sector to the GDP of the nation is substantially higher despite the meager input. Animal husbandry offers a better scope for marginal farmers whose income from agriculture is dwindling fast due to vagaries of monsoon, fragmentation of landholdings, pest problems, poor pricing etc.

The concept of "Integrated animal health management" relies in building and validating integrated holistic environmental and systems approach including "pathogens" and "hosts" as animals in "production" systems. The ultimate goal is to develop the necessary elements e.g. management procedures, biosecurity, feeding systems, prompt disease diagnosis, effective treatment and vaccination, disease resistant genotypes etc. It is imperative to integrate it with developments in other fields. The developments in Information Technology over the past few decades are tremendous and offer great potential in improving animal health through various measures like effective disease forecasting, rapid and accurate disease diagnosis, modern therapeutic measures etc.

Livestock likely to suffer from infectious or non-infectious diseases due to unhealthy environment or improper management. Livestock owners or farmers owe a greater responsibility for better health management of their animals and birds. Many times ignorance or negligence of the livestock owners in proper management, delayed presentation of the sick animals to the veterinary clinicians, not able to afford the expenditure for diagnosis and treatment and non-availability of diagnostic and health care facilities including lack of expertise are the stumble blocks for better health management in livestock farming. In integrated health management system, disease diagnosis is having highest significance. Diagnostic approaches should be prompt, easier and cost effective in Indian condition.

Clinicians mostly depend upon clinical pathology for prompt, easier and cost effective diagnosis in farm animals and birds. Veterinary clinical pathology has become an integral part in modern animal practice. It deals with routine screening of samples collected by the clinician. Generally examination of blood, blood smear, wet film of blood, urine, faecal sample, skin scrapping and cytological preparations are carried out in such laboratory. Tests could be easily and quickly performed in such laboratory. Complete clinical pathology laboratory deals with basic clinical pathology, biochemical, parasitological and microbiological examination of the clinical samples collected from the diseased animals. Clinical pathology mostly depend upon the proper collection of the samples, procedure of the tests and interpretation of the results which yield useful information and provide definite

evidence regarding the alterations during the disease process which can be applied for diagnosis of the animal diseases.

Proper hematological procedure and accurate results are essential for diagnosis of many disorders. Hematological examination should be performed as early as possible after collection of blood. If not possible blood may be stored in refrigerator maximum up to 24 hrs. Blood smear should be prepared preferably from fresh blood and kept dry at room temperature. A complete blood count (CBC) provides a minimum set of values that can be reliable and determined cost effectively in the hospital setting. The CBC should consist of at least the basic informations like Hemoglobin concentration (Hb), Erythrocyte sedimentation rate (ESR), Packed cell volume (PCV), Total red blood cell (RBC) count, Total white blood cell (WBC) count, Blood film examination, differential WBC count, erythrocyte morphology etc. Examination of urine is an important diagnostic procedure for studying renal pathology since urine is the end product of a complicated and delicately balanced physiologic, process. Many physiological and pathological mechanisms may influence the constituents of the urine. Physical, chemical and microscopic examination of urine can be performed for interpretation of pathological disorders. Skin scrapping is a commonly performed test that can help diagnose certain skin inflammations, fungal infections, and skin cancer and is quite effective in determining the presence of mites. Fine needle aspiration cytology (FNAC) is a diagnostic procedure where a needle is inserted into the affected part or tissue and a small amount of tissue is sucked out for examination under a microscope. This has been widely used in the diagnosis of lesions from various origins, especially neoplastic. The technique is simple, fast, safe, minimally invasive and inexpensive, which allows through the evaluation of cell morphology to establish prognosis, delineate surgical margins, monitor lesion growth, validate indication euthanasia during surgery and monitor chemotherapy protocols. Serum biochemistry refers to the chemical analysis of blood serum. A profile of tests can be combined to evaluate renal function, electrolyte metabolism, serum proteins, digestion, injury, lipids, pancreatic function, and the liver. Metabolic disturbances like Milk fever/Parturient paresis, Hypomagnesaemia, Ketosis, Post parturient haemoglobinuria in high yielding cows mostly monitored through serum biochemistry. Spectrophotometer/ Automated analyzers for veterinary use have been implemented to provide a precision to sample analysis using commercial reagent kits. Bacteriological examination and antibiotic sensitivity test is carried out by putting antibiotic discs in the cultural media to see the zone of inhibition for treatment with selective antibiotics in bacterial infected clinical cases.

Due to certain limitations in veterinary clinical practice definitive diagnosis and appropriate treatment cannot be made with a consequence of death. Dead animals and birds can be utilized for diagnosis through Post- mortem or necropsy. Post- mortem or necropsy is the systematic exposure and scientific examination of the tissues or organs of a carcass to determine the cause of death, the extent of lesions or the nature of illness. Post- mortem is an important aid for diagnosis of diseases in animals. It gives a better understanding of the clinical symptoms showed by animals before death as well as to assess the efficacy of the line of treatment followed. To assess and monitor the deaths in an outbreak and health status of other animals in the farm, flock or area, post-mortem is very essential. Isolation and identification of organisms that might have caused the death is possible by collecting selective material during post-mortem. Sometimes post-mortem gives a confirmatory diagnosis. It is easy to conduct post-mortem without any costly equipments. Post-mortem

reports are referred as death certificates for records as well as insurance and legal claims. Above all post-mortem is an important aspect of disease investigation to advance the knowledge and contribute to the science of disease. After detailed post-mortem examinations, post-mortem findings of different organs or tissues are correlated with possible systemic and special diseases. Special diseases which are suspected on the basis of post-mortem are to be confirmed by laboratory diagnosis.

Definitive diagnosis of the diseases and correlating with etiology through various pathological techniques will guide to meet the required management procedures, biosecurity, feeding systems, treatment and vaccination for integrated health management in livestock farming.

# Mitigating Feed and Fodder Scarcity for Livestock Feeding Through Conservation

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Agriculture and animal husbandry are the primary occupations of the rural inhabitants. The animals depend predominantly on open grazing or stall feeding on the byproducts of agricultural produce like wheat straw, paddy straw, hay and green or dry grass collected from forest. The livestock population greatly exceeds the carrying capacity of the land and thus a situation of acute shortage of feed and fodder arises. This results imbalanced or underfeeding of animals which adversely affects the health and productivity of the animals. During the rainy season, green fodder may be in excess of need which can be effectively conserved for lean period. It has been estimated that 66% of total dry matter of available fodder comes from forests as tree leaves and forest floor litter and only 34% is contributed from cultivable land (Singh, 2003). Besides this, huge amount of poor quality roughages and agro industrial byproducts are left or burnt in the field which can be effectively preserved for the scarcity period. The quantitative and qualitative deterioration in common grazing lands by indiscriminate grazing pressure and the lack of adoption of fodder production technologies and its preservation further deteriorates the bioavailability of forage resources for animals. Therefore, conservation of forage resources with the principle of judicious utilization of existing conventional and unconventional resources to augment productive performance of animals is the need of the hour.

**Conservation of conventional forage resources**

Green fodders of conventional source can be conserved as silage and hay making

**Silage making**

Silage is the preserved green fodder in succulent form under air tight conditions where acids produced by controlled anaerobic fermentation of carbohydrates. The objectives of ensiling are achievement of anaerobic conditions and to discourage the activities of undesirable micro organisms i.e. clostridia and enterobacteria allowing proliferation of desired spp. of lactobacilli which stabilize the acidic pH (<4.2) and restricts the growth of spore forming anaerobes and clostridia producing objectionable fermentation products (amines, ammonia, $CO_2$, butyric acid, acetic acid etc.). Good silage is yellowish-green in colour with a pleasant vinegar smell. The technique is more or less similar to that commonly employed in the preparation of pickles in home.

Suitable stage of crops and silage making

All the crops are suitable for silage making. However, excellent silage may be made from maize, sorghum, bajra and barely. Among the perennial grasses, hybrid napier grass, guinea grass, para grass, sudan grass and rhode grass are commonly used for silage making.

Legumes like berseem, lucerne and cowpea are not suitable for silage making. However, when mixed with non-legume crops in the right proportion, the mixture yields a well balanced silage.

The fodder crop should be harvested at a stage when nutrient content is at peak stage. The crop must have sufficient sugars to permit the quick production of preservative acids of which lactic acid is the most important one. Flowering to milk stage is recommended for making silage from maize, Jowar and oats crops. In case of bajra and teosinte boot stage is best harvested at blooming stage but hybrid napier and guinea grass should be harvested at 1.25 meter height stage. Good quality silage can be made when the dry matter of crop is 30-35 per cent which can be manually confirmed by farmer taking a handful of chaffed fodder in between the hands and pressing. If hands do not moist, the fodder has the desired dry matter.

Silage is made by compressing the chaffed green fodder in tight pits called silos. Pit silo is best for ensiling under village areas of hills out of many types of silos i.e. pit silo, tower silo, trench silo, bunker silo and bag silo etc. Pit silo may be of circular or rectangular pit of desirable dimension on a site located at the higher elevation and near the animal shed. The size of the pit depends on the fodder available for ensiling as well as the silage requirement of the cattle. It may be roughly calculated on the basis that one cubic meter of the silo can have 650 to 700kg settled silage. A silo pit of 3.0X2.5X2.0 meter (LxWxD) dimension is a convenient size for making silage for feeding five dairy animals at the rate of 20 kg silage per head per day for three months. A circular pit is better than rectangular one, because the chaffed fodder has comparatively less surface contact and while filling air can be expelled easily. Before filling, the sides should be plastered with mud and line with long stalks of dried fodder to prevent fodder coming into direct contact with earth.

The green fodder are chaffed into small pieces (2.5 to 4.0 cm) with a chaff cutter and filled inside the silo compactly. In case the silage is to be prepared from leguminous fodders like berseem, lucerne or cowpea or immature grass rich in protein, the addition of carbohydrate like molassess (@4-5% of weight of fresh fodder) is essential. Before ensiling, crops should be wilted to 65 to 70 % of moisture to reduce seepage and leaching losses. To check the growth of undesirable organisms and to increase the growth of lactic acid producing bacteria, certain preservatives like common salt (18-20 kg), sodium meta-bisulphite (5 kg) dilute acetic acid (10 litres) or phosphoric acid at the rate of 6 kg per tonne of chaffed forage may be added. The material should be well trodden, during filling to exclude air pockets, spread in uniform thin layers over the entire area and thoroughly compacted by trampling with foot, heavy animals or tractors. The compressed material in the pit should stand at least 2.5 to 3.0 feet above the ground level in a dome shape to facilitate draining out of rainy water. It is essential to complete the filling of the silo in the shortest possible time; otherwise the quality of silage is adversely affected. The silo should be covered from the top up to ground level by polythene sheet and on which a layer of 10 cm moist earth should be spread. Alternatively spread a 10-15 cm layer of dry fodders and cover it with and a layer of earth, and plastered with cow dung and earth mixture to make it air tight and water proof. Silage should be ready for feeding in about 45 days. Good silage has higher vitamin A content and better palatability than hay and other dry roughages. Cattle prefer silage to coarse, mature and less palatable green fodder. During ensiling the concentration of toxic constituents such as hydrocyanic acid, nitrate and oxalic acid is reduced drastically thus,

the fodder having very high concentrations can be safely fed to animals after ensiling. The animals may take 4-5 days adoption period to accept the silage.

**Hay making**

Hay making is the traditional method of drying and storing of high quality forage by reducing the moisture content to the level at which plant tissues are dead or dormant. The aim in hay making is to reduce the moisture content of green crop to a level low enough to inhibit the action of plant and microbial enzymes so that it can be safely stored without any deterioration. The moisture level in well cured hay should be below 15%. In most of the crops, early flowering stage having maximum nutrient contents is considered to be the best stage to harvest crop for hay making. Thin stemmed crops like berseem, lucerne, cowpea, soybean, oat and natural grasses are suitable for hay making. The crops should be preferably harvested in the morning when sunrises and allowed for field curing until it is wilted sufficiently. Then it is rolled into small loose bundles followed by collection at one place into big heap in tripod system or baled for storing. Good quality hay should be leafy, green colour with typical aroma of forage from which it was prepared and should be soft, pliable, free from dust, moulds, weeds and foreign materials. It reduces the labour involved in handling and transport green forage due to less moisture content. The labour and botheration of cutting green forage daily is eliminated. Even the intensity of cropping can be increased and more cuttings can be taken from the multicut crops. In hay making from high-quality forage, the biggest drawback is the loss of valuable leaves in handling. With the loss of leaves, a large fraction of proteins in the crop is lost particularly in case of legumes such as berseem, Lucerne, cowpeas, rice bean and guar.

**Conservation of non-conventional forage resources**

Forage resources which do not form the part of normal diet of animal are generally termed as non-conventional forage like crop residues and agro industrial byproducts and tree leaves.

**Crop residues and agro industrial byproducts**

The poor quality roughages, crop residues and agro industrial byproducts are used as a staple diet for ruminants in our country. The crop residues having relevance in ruminant feeding are jowar, bajra, maize stovers, wheat and paddy straw. These are highly fibrous in nature with low crude protein content. Most of the crop residues have more than 60% of DM in the form of cellulose and hemicellulose which are good source of energy (Jakhmola and Misra, 2000) for ruminants. But, their association with lignin form lingo cellulose complex which is more resistant for action by hydrolytic enzymes and rumen microbial enzymes and reduce the bioavailability of energy source (cellulose and hemicellulose) to animals. The products of digestion from such roughages are also considered to be poorly balanced for all productive purposes. Several methods have been developed in form of physical (chaffing, chopping, soaking, grinding, pelleting etc.) alkali treatment (sodium hydroxide, calciu hydroxide, urea etc.) and supplementation of trace minerals which improve the rumen fermentation pattern, digestibility and nutritive value of crop residues to enhance animal productive performance. Urea (4% level) is generally the most practical and often cheapest chemical available for treating crop residues which changes its physical nature and improve digestibility (ICAR, 1985). Further, maintenance of animals on all roughages diet utilizing urea treated straw in combination with tree leaves in 25 : 75 ratio is a viable alternative

(Misra *et al.,* 1998). However, urea ammoniation technology is not accepted to the desired extent due to wastage of 75 – 85 % added nitrogen, labour intensive, problems of environmental pollution and lack of awareness among the people.

Most of the agro industrial by products are invariably moderate source of energy and protein with high levels of acid insoluble ash, erratic levels of minerals. The presence of toxic principles may not show apparent toxicity but may cause cumulative toxicity over a period of time and may adversely affect the health and production of animals. Therefore, suitable treatments are needed for removal of anti nutritional factors for efficient utilization of feed. Besides physical and chemical treatment, biotechnological tools through use of white rot and brown rot fungi also improve the nutritive value of crop residues and agro industrial byproducts (Sharma and Walli, 1992). They solubilize the lignocellulosic complex by secreting enzymes and synthesize amino acids resulting improvement in quality.

**Compact feed block**

The feeding value of crop residues and agro industrial byproducts can be improved if they are blended into complete feeds. Complete feeds with desired ratio of roughages, concentrate, molasses and other agro forest based non-conventional feeds including top feeds improve the feed palatability, voluntary DM intake, avoids refusal of unpalatable portion, reduces wastage, increase bulk density thereby reducing transportation cost. This feeding system not only ensures improved utilization of nutrient from non-conventional feed stuffs but also helps in developing low cost balanced feeds for ruminants especially the dairy animals in hills suffering from chronic shortage of conventional feed and fodder. Compact feed blocks are found to be very nutritious, easily digestible, handy to transport in remote areas of the hills and require comparatively lesser space for storage and are considered as readymade balanced ration for ruminants for the benefit of landless labourers, small and marginal farmers. The common formulation of standard compact feed block is wheat straw / cellulosic waste/ tree leaves – 55-60 %, concentrate mixture - 30-35 %, molasses - 10%, mineral mixture - 1% and salt - 0.5% (Singh and Singh, 2007)

**Top feed resources**

Livestock component is closely linked with the forest ecosystem and common property resources to meet the fodder demand. About 30-50 percent of total animal feed is derived from forests and grasslands (Singh and Singh, 2007). The hilly areas are blessed with a great biodiversity of fodder frees, shrubs, bushes, creepers, grasses and herbaceous plants with variable palatability and nutritive value. Bhimal (*Grewia optiva*) is the most common fodder tree contributing 4% of fodder alone and Oak leaves contribute 6% of green fodder available to whole livestock population (Tiwari and Rao, 2004) besides other important fodder trees i.e. *Celtis australis, Toona ciliate, ficus Spp, Bauhinia* spp. etc. *Quercus* spp. of tree leaves abundantly distributed in temperate hills are extensively used as fodder round the year. Supplementation of leaf meal prepared from top feed rich in protein such as *Leucaena, gliricidia* etc. could act as a replacer of feed concentrates for livestock with reduced feed cost and nutritive value of cereal forages can be improved by supplementing with top feeds such as subabul (Mojumdar and Mahanta, 2006). The tree leaves contain about 12-15 % of crude protein and as high as 23% protein in subabool and bhimal has been are reported in tree leaves, but the fibre is complex and highly lignified at the mature stage and as fibre level

increases, protein content decreases (Fernandes, 2004) The higher calcium content is a unique feature of tree leaves (2-3 times more than fodder or grasses) with low phosphorous content resulting very wide Ca: P ratio which limits their bioavailability in animals (Fernandes, 2004). It was reported that tannin, the major anti nutritional factor in most of the tree leaves exerts its toxic effect if the condensed tannin level exceeds 5% and low to moderate level of condensed tannin (1-4%) has beneficial effect in augmenting productive performance of ruminants. Fortunately, most of the tree leaves in hilly areas have less than 4% level of tannin. Therefore, the tree leaves of higher nutritive value can be judiciously used as part of diet with concentrate mixture and green grasses (2:1:1) even after detoxification of anti nutritional factors (if required) through various physical and chemical treatments (Min *et al.,* 2003). Further, top feds should be conserved through effective lopping management for supply of these precious fodder to the animals round the year.

**Remedial measures**

The livestock is the backbone of the agricultural economy forming an integral part of mixed farming. Balanced supply of fodder through judicious utilization of available resources and conservation of surplus forages is very vital to get maximum benefit from the livestock. Some of the remedial measures are as follows:

- Transformation of grazing land to agricultural land should be checked.
- Rehabilitation of the degraded and waste land. Care must be taken not to touch the grazing area by planting them with non-browsable timber species.
- Grassland and pasture area should be planted with superior palatable plants and grasses for regeneration of the area and adequate and nutritious fodder to the livestock.
- Proper management of grazing area and conservation of forage should be done with the help of local community.
- Scientific methods should be adopted to accelerate the processes of regeneration of trees, shrubs, herbs and grasses.
- Measures should be taken to establish the nurseries, fodder banks and stall feeding which improve production of fodder, pelletization of nutritive grasses.
- The overgrazing leads to degradation of grasses and erosion of the top soil. It is therefore necessary to create awareness among people for adopting the suitable breeds which can be maintained on the basis of carrying capacity.
- Illegal activities such as lopping and cutting of trees, collection of barks and branches etc. should be banned.
- Production and dissemination of high quality fodder germplasms.

**Conclusion**

Keeping in view the agroclimatic condition of different parts of our country, conservation of good quality surplus fodder should be conserved through suitable means for future use during the scarcity period. Further, judicious use of top feeds and poor quality roughages along with proper management of the grazing and deteriorated land with help of

community not only provide the fodder and forage and grazing to livestock but also save our valuable forests for world wide.

**References**

Fernandes, A.P. 2004. Management and feeding value of top feed resources for sheep and goats. In proc. Of winter school on sustainable livestock production, MPKV Rahuri.P. 108-120.

ICAR. 1985. Final report (1967-85) AICRP on "Utilization of agricultural byproducts and industrial waste materials for evolving economic ration for livestock.p.28-32.

Jakhmola, R.C. and Misra, A.K. 2000. Feeding strategies using unconventional feeds. Proc. III Biennial Conf. of Anim. Nutr. Assoc., Hisar. P. 83-98.

Min, B.R., Barry, T.N., Attwood, G.T., McNabb, W.C., 2003. The effects of condensed tannins on the nutrition and health of ruminants fed fresh temperate forages: a review. *Animal Feed Science Technology,* 106:3-19.

Mishra, A.K.,Chaturvedi, O.H. and Karim, S.A. 1998. Utilization of urea treated mustard straw with tree leaves in sheep feeding. Indian J. Anim. Prod. & Mang. 14.

Mojumdar, A.B. and Mahanta, S.K. 2006. Potential and profitable means of preserving nutrients from forages and top feeds. Proc. XII Anim.Nutr.Conf.Anand P. 78-84.

Sahoo, B., Tiwari, D.P., Bhushan,C., Agarwal, A. Vishwanath. 2006.Nutritional evaluation of tree leaves for ruminants in hills of Uttaranchal. Proc. XII Anim.Nutr.Conf.p 17.

Sharma, D.D. and Walli, T.K. 1992. Bioconversion of crop residues in India. Final Report phases I & II, NDRI, Karnal.

Singh, K. and Singh, H.S. 2007. Forage resources development in Uttarakhand. Experiences and observations. Uttarakhand Livestock development board.(Personal communication)

Singh, V.2003. Agroforestry in the development of sustainable mountain agriculture. In reent advances in Agroforestry. Pantnagar., G.B.Pant University of Agriculture and Technology.

Tiwari,D.P. and Raman Rao, P.V. 2004.Problems and prospects of feed resource development for dairy animals in Himalayan zone. Proc. short course on participatory research in Animal Nutrition. P. 95-97.

# Current Marketing Strategies & Export Potential of Livestock & Poultry Products

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**Introduction:**

I must thank all of you for your efforts and concerns But what use if I cannot be facilitated to sell my produce at

- Remunerative Price / Quality linked returns
- Choose my buyer
- Place and time convenient to me
- Escape the fleecing of multiple intermediaries

**Indian Agriculture**

- Agriculture Sector is changing the socio-economic environments of the population due to liberalization and globalization
- About 75% people are living in rural areas and are still dependent on Agriculture. About 43% of India's geographical area is used for agricultural activity
- Agriculture continues to play a major role in Indian Economy

**Stakeholders of Livestock Marketing**

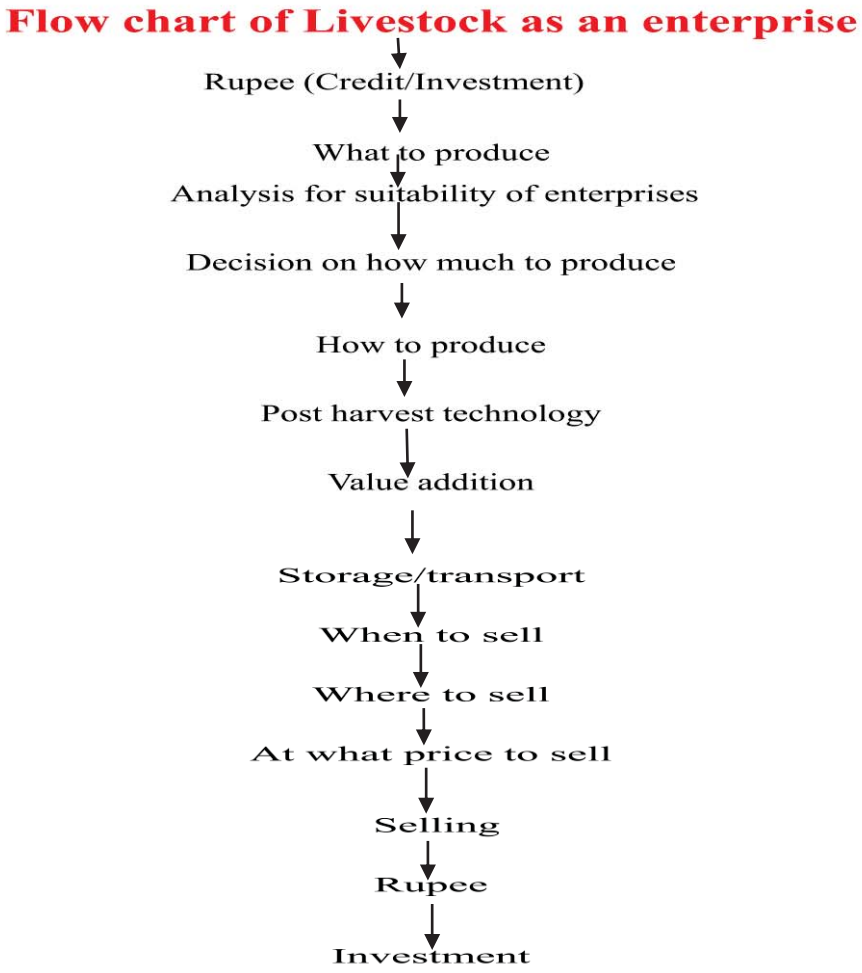
Related to

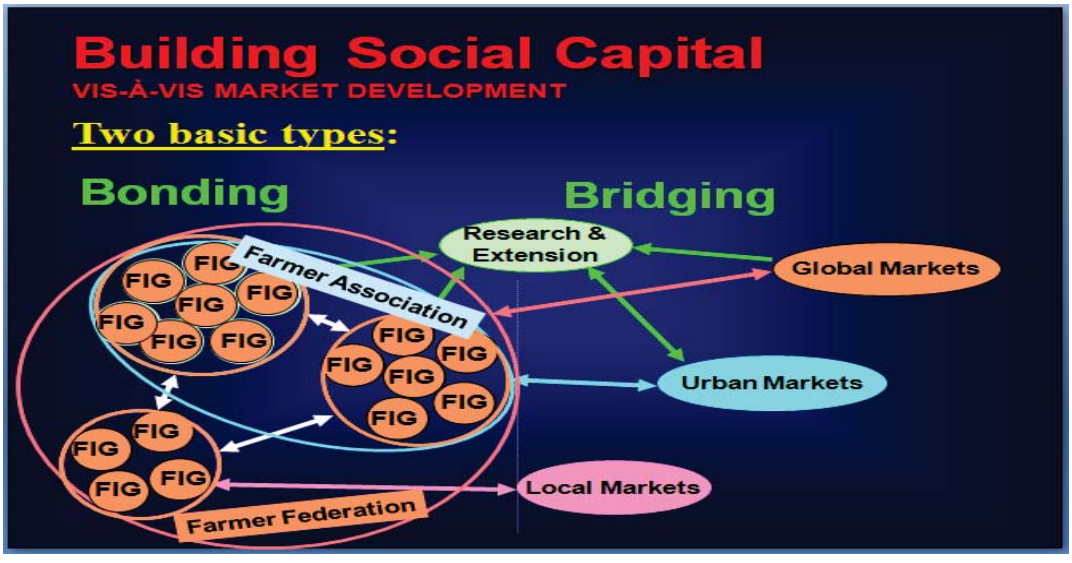
- ❑ Input
- ❑ Production
  1. Contract Farming
  2. PPP
- ❑ Logistic and Supply Chain
- ❑ Processing and Value Addition
  1. Food Processing Industry
     a. Grading and standardization
- ❑ Marketing
  1. Market Information and Market Intelligence
  2. Agriculture Price Policy

3. Agricultural Marketing Reform

- ❑ Risk and Financial Resource Management
- ❑ ICT application in Agriculture

**Concept of Money to Money**



**Livestock sector**

- The livestock sector has emerged as one of the important drivers of agricultural growth and diversification in India.
- The livestock sector in India has grown at an annual rate of 4-5 per cent during the past two decades.
- The rising global demand for livestock products, various global trade negotiations and reforming domestic markets in India, have substantially expanded international markets for livestock products. Such developments offer enormous opportunities to India to increase exports of its livestock products.
- However, apprehensions are being raised about the ability of Indian livestock farmers, a majority of whom are small and marginal, in sharing the benefits of emerging opportunities, under the liberalized trade era.
- The import tariff was 60 per cent for dairy products and hides & skins and 100 per cent for live animals, meat and eggs during the pre-reform period. It has been gradually reduced and brought down to 30 per cent for all the livestock products.
- In addition, non-tariff barriers like stringent sanitary and photo-sanitary (SPS) standards, technical barriers to trade (TBT), anti-dumping duties, countervailing duties, etc. are emerging as the major constraints in tappingthe benefits of export potential of the livestock products.
- Besides, concerns have also been expressed about the necessity to improve and expand the supply capacity to augment exports of livestock products from India.
- A deeper understanding of the determinants of export performance of livestock sector in India would contribute towards building the development strategy of this sector.
- This publication throws lights on these issues, and provides strategies to harness the potential of livestock sector in India.
- The contribution of bovine meat in the total foreign exchange earnings from the livestock sector was about 70.5 per cent, It is followed by dairy products, eggs and other edible animal products (swine meat, sheep meat and poultry meat), which have contributed about 0.13 per cent, 2.2 per cent and 0.14 per cent to the total earnings from the livestock exports, respectively.
- India lacks access to developed country markets due to their stringent food safety and quality standards.
- The Indian livestock sector is on a rising spree with its current contribution of about 33 per cent to the agricultural gross domestic product (Ag GDP) and providing employment to over 20 million people, particularly to women folk.
- Agriculture sector contributes 20% to GDP(Out of Total Agricultural contribution) and budget provision is 80%,but allied sector contributes 80% to GDP (and budget provision is 20%

- The export of bovine meat has registered the highest annual growth of about 27 per cent, followed by eggs (21.4%), swine meat (23.0 %), dairy products (15.3 %) and poultry meat (13.9 %).
- Poultry industry in India is a mega billion industry having third position in egg production and fifth position in broilers in the world. The total egg production accounts to 68 billion and broilers 2.8 billion. The average cumulative growth rate in layer and broiler is 8% and 12 % respectively.
- Currently only 20 % of the chicken and 6% of the eggs are processed.
- Among the dressed chickens, 70 % are sold as dressed or chilled or frozen whole carcass, limiting remaining 30% to cut up parts and further processed products.

**Production Cost**

- In general the average variable cost of production is lowest in the south followed by west, east and north.
- The feed consumption rate (FCR) based market is generally higher in the north because of higher market weight, higher mortality rate due to extremes of hot and cold temperature.
- Projected global egg and meat production during 2020 are 77 million tons and 123 million tons to cater to the demands of 8 million of the human population.

**Channels of marketing**

Currently more than 75% of the poultry products are reaching the consumers through various channels of distribution leading the consumers to pay more and producers to get fewer margins. Besides, major share of the profit at present goes to the middlemen.

At present poultry products are marketed in the following four marketing networks.

- Producer-Consumer
- Producer- Wholesaler- Retailer- Consumer
- Producer- Collector- Assembly merchant- Consumer
- Producer- Retailer

- Channel -2 may account to marketing of major portion of eggs to the consumers.
- Channel -4 is responsible for getting 12-15% of the total profit to the retailers.
- However in channel -2 a middleman gets 22% of the profit.
- National Egg Coordination Committee owned by private sector organization and National Agricultural Cooperative
- Marketing Federation governed by Government of India to some extent streamline the marketing of major poultry products.

- Major Meat consumption pattern in India are towards Fish(51%), mutton and goat meat (8%), bovine(29%), poultry (6%) and Pig (6%)

**Prospects of Poultry Marketing**

Growth and marketing of the poultry industry are limited due to the following factors:

- Demand for poultry meat is highly price sensitive among low and middle income groups
- Major limitation is logistics and distribution network within India mostly due to limited demands for frozen products, high cost of transport infrastructure, unreliable cold chain facilities and the quality of the products produced.
- Vertical integration encourages higher production, better marketing efficiency with reduced consumer prices
- In India marketing efficiency is important than the production efficiency
- Competitive feed price results in competitive meat and egg production
- Seasonal variation due to religious practices

**Private Players in Poultry Industry**

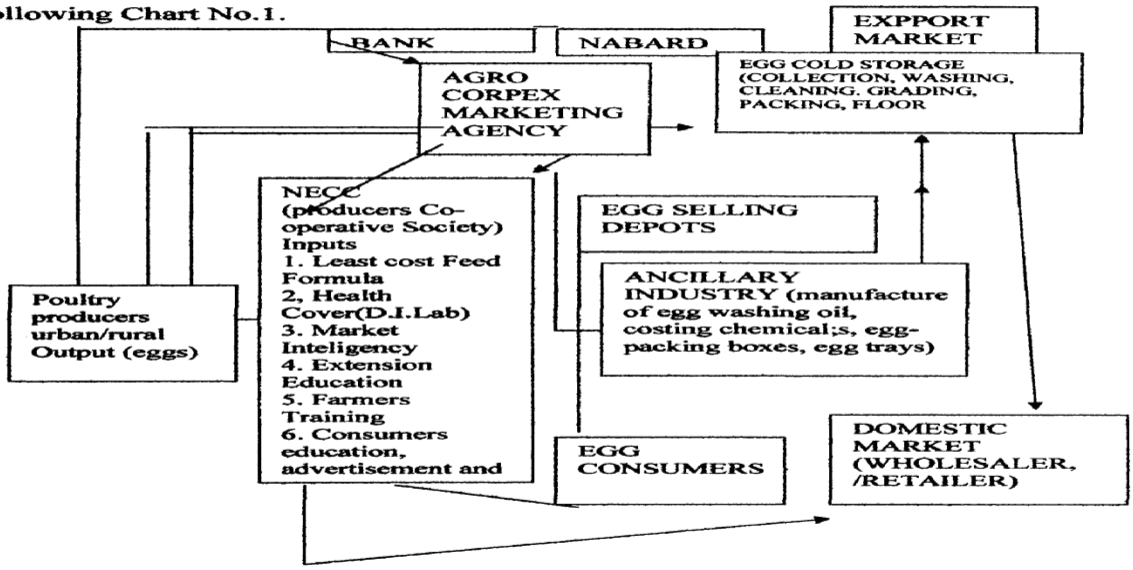
The major private industries involved in the poultry processing, further processing operations and marketing poultry products are Venkateshwara Hatcheries Pvt. ltd., Suguna Poultry farm ltd., CP (Charoen Pokphand India), KFC (Kentucky Fried Chicken), SRM agro foods, McDonald's and Arthur's food company pvt. ltd., Shanthi Poultry Farm LTD, VKS Farms PVT LTD, Real Good Chicken (GODREJ-TYSON), SKM Eggs

**Need for Emerging Technologies to Encourage Marketing**

Accordingly there is a necessity to concentrate on the research and development wing to come out with newer technologies on the following lines.

- Design of mini poultry processing units
- Shelf-life extension of poultry products by application of hurdle technology and biotechnology means
- Developing newer techniques for tenderization of meats
- Efficient processing techniques for extraction of lysozyme, avidin, lecithin and other bio-molecules from eggs
- Ultra-pasteurization cum aseptic packaging technology for liquid egg
- Uniform processing technology for traditional poultry products
- Improved packaging techniques like vacuum, MAB, CAP, retort and aseptic
- Development of quick and sensitive methods for detection of pathogens and hazardous feed residues
- Application of bio- processing techniques for efficient disposal of poultry products
- User-friendly transport system as per the food engineering norms

**NECC is also planning to enter the export market as a means of balancing supply and demand. To achieve this end Agro-Corpex India Ltd. has been set up. The structure and function of Agro-Corpoex is presented in the following Chart No.1.**




**Opportunities*:***

Rapid urbanization, industrialization, rising disposable income, changing food habits towards processed products and higher middle income group are major positive factors to boost up processed food markets.

Following are the major elements need to be given due attention to encourage the export of poultry products:-

- Application of modern processing techniques
- Provision of logistic support
- Production of quality products fit for export
- Policy changes in the government level
- Developing the appropriate packaging technology
- Effective R & D work to increase the shelf life of the products
- Harmonization of quality control norms
- Single window approach for export
- Creation of database
- Well trained techno graphs and skilled human resources
- NABL accredited laboratories for certification of food products

- Cost effective mini poultry processing units

**Threats (Marketing System) :-**

- At present poultry marketing is dictated by the private traders and commission agents present in various cities and towns.
- Most of the trading activity of the poultry meat and egg is in the disadvantageous position to the farmers giving lesser margins of profit than the traders' profit margin.
- Right now, organized marketing network need to encourage positive trend for uniform profits to all the players in the poultry industry.

**MARKETING CHANNELS**

Broadly, there are four methods of marketing-

Indirect Marketing,

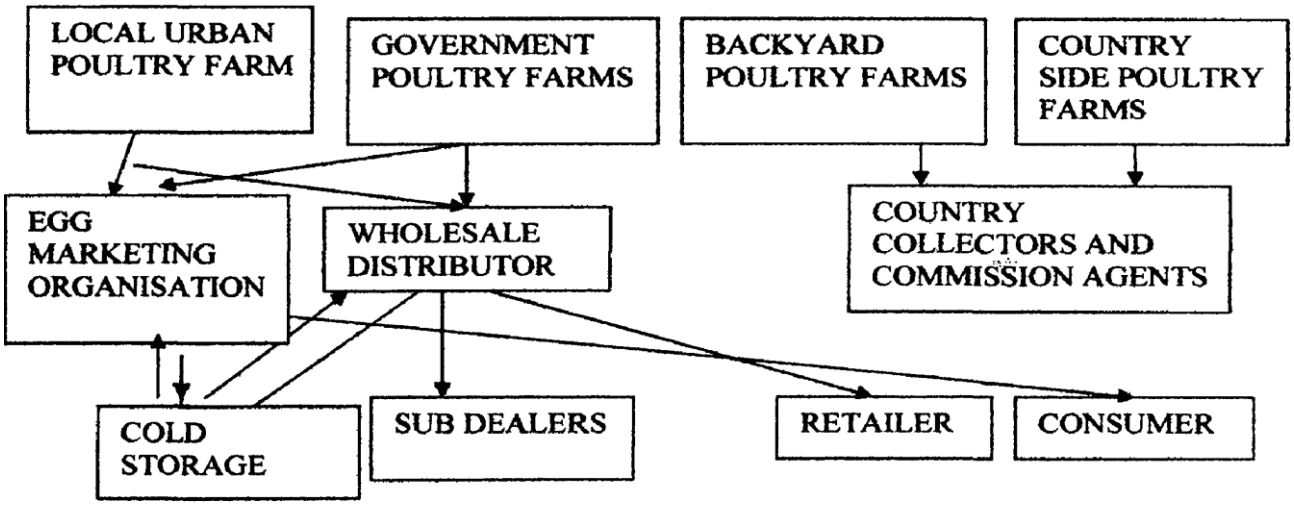
Direct Marketing,

Integrated Marketing

Co-operative Marketing.

There are different channels through which eggs are marketed such as producer to consumer, producer via retailer to consumer, and producer via co-operative agency to consumer. The most common marketing channel usually adopted in our country by some egg dealers is given in following.

**POULTRY PRODUCTION-COMMON MARKETING CHANNEL**




**Contract Farming in Poultry**

Today's poultry industry is characterized by vertical integration (also known as contract farming) whereby a single company owns the facilities and controls the breeding, hatching and/ or processing of broilers but contracts with private poultry farmers for the raising of the chicks. It is estimated that at present 36.7% of broiler production in India is

under contract farming out of which about 78 % of the contracts are concentrated in Southern India (*Rajiajwani, 2012).*

The key players in this sector in India are Venkateshwara Hatcheries, Suguna, Godrej, Shanti, Taffa, Arumbagh, Skylark, etc.

**Process of Contract Farming**

The process of contract farming can be described as under:

- Integrator supplies the 'raw-material' which in this case are the day old chicks (DOC).
- He also supplies the feed, medications, veterinary supplies and implements that may be required (E.g.: Water dispensers, feeders etc).
- The contract farmer provides his services (labour) and space for the shed and other related services or equipment that may be required.
- The integrator also bears the marketing responsibility (risk) and the expense involved in transportation (to and from the farm).
- Since the major chunk of the expense (working capital) is borne by the integrator-he is the absolute owner of the moveable stocks (broiler) on the farm.
- The farmer's role is like that of a 'care-taker' who gets a pre determined wage which is listed in the contract.
- This wage paid to the farmer is linked to various parameters such as the 'Feed Conversion Ratio'(FCR) or in other words the quantum of feed consumed by the bird to produce the weight, percentage of birds dead etc.
- A farmer is rewarded for surpassing the set standards and penalized if any of the agreed criteria is not met.
- This penalty is deducted by calculating the loss incurred per bird and deducting that amount from the money to be paid (wage bill).

| Returns | CBF | Non- CBF |
|---|---|---|
| Birds sale rate (per kg of bird) | 65.18 | 69.20 |
| Manure sale (per kg of bird) | 0.60 | 1.30 |
| Feed bags sale (per kg of bird) | 0.12 | 0.18 |
| Total returns (per kg of bird) | 65.89 | 70.68 |
| **Net return / profit (per kg of bird)** | 5.07 | 7.54 |
| Average body weight (kg) | 2.41 | 2.32 |
| **Net return (Rupees/bird produced)** | **12.22** | **17.49** |

**Advantages**

- Reduced management responsibilities.
- Less risk for production and less risk for loss of income.
- Relatively fixed income; some insulation from price changes.
- Less operating capital necessary.
- Opportunity to participate in poultry production.
- Opportunity to obtain additional income from the farm.

**Disadvantages**

- Possibility of limited opportunity for growth. New building and expansion are dictated by integrators' plans.
- High fixed investment. Broiler houses with modern equipment currently cost in excess of $120,000 each.
- Pressure to keep up with technological changes in management, housing, and equipment.
- Possible lack of bargaining power.

**Dairy Marketing Strategies**

India is the world's largest milk producer, accounting for more than 13% of world's total milk production. As it is the world's largest consumer of dairy products, but consuming almost 100% of its own milk production. Dairy products are a major source of cheap and nutritious food to millions of people in India and the only acceptable source of animal protein for large vegetarian segment of Indian population, particularly among the landless, small and marginal farmers and women.

Presently there are around 70,000 village dairy cooperatives across the country. The co-operative societies are federated into 170 district milk producers unions, which is turn has 22-state cooperative dairy federation. Milk production gives employment to more than 72mn dairy farmers.

Only 10% of all the milk is delivered to some 400 dairy plants. A specific Indian phenomenon is the unorganized sector of milkmen, vendors who collect the milk from local producers and sell the milk in both, urban and rural areas, which handles around 65-70% of the national milk production. In the organized dairy industry, the cooperative milk processors have a 60% market share.

The cooperative dairies process 90% of the collected milk as liquid milk whereas the private dairies process and sell only 20% of the milk collected as liquid milk and 80% for other dairy products with a focus on value-added products.

**Dairy marketing Strategies in the context of Globalization**

1) Focused Approach: While the product portfolio has been growing, Indian dairy Industry should plan for reach out to newer markets - but the strategy here is more product-specific.

2) Wider Spread: However, as far as other dairy products are concerned, Indian dairy Industry should plan to expand across the board.

3) Create Original Marketing: Re-invent a product with a powerful marketing campaign. No matter if you are selling milk, yogurt, butter, sour cream, or cheese, a truly original commercial or print ad can cause consumers to think of your product in a new light. Whether you are conceiving of the marketing yourself or hiring a top advertising agency, aim for outside-of-the-box thinking. A catchy slogan, a memorable spokesperson or an emotionally powerful commercial can go a long way. Use viral marketing and social media to get your product to the masses without spending an enormous amount on advertising.

4) Focus on Nutritional Value: Use scientific-based guides and studies such as this to convince consumers to consume your dairy product. Associate your product with the study itself.

5) Appeal to the Organic Market: Consumer demand for organic milk continues to grow at an annual rate approaching 20 percent, according to the Agricultural Marketing Research Center. Many people are attracted to products that are free of chemicals and are manufactured naturally. Utilize the organic trend in your product line. Follow the government guidelines to get the organic seal to include in your product advertising

and packaging.

6) Introduce New or Unknown Products: Offering consumers something they have never heard of is a sure-fire way to peak interest in a product. There were 448 total new dairy product launches in 2010, according to Dairy Foods. Consider creative yogurt flavors such as Yoplait's Apricot Mango and Dannon's Banana Cream Pie. Try new flavors of milk, such as banana or black raspberry, or varieties of cheese that are not well-known in the American market. Consider dairy products with added dietary supplements, such as probiotic, acidophilus or bifidus cultures.

**List of commodities (live stock, diary & poultry products) for which grade standards have been prescribed under the agricultural produce (grading and marking) act, 1937**

**(AS ON 31-05-2006)**

**LIVESTOCK DAIRY AND POULTRY PRODUCTS**

| | |
|---|---|
| 1. Wool | 6. Animal casings |
| 2. Bristles | 7. Raw Meat (Chilled/Frozen) |
| 3. Goat Hair | 8. Table eggs |
| 4. Hides | 9. Creamery butter |
| 5. Skins | 10. Ghee |

**Standards under Different Acts**

- Agricultural produce (grading and marking) Act,1937 as amended in 1986
- Prevention of Food Adulteration Act,1954

- Food products order,1956
- Meat and food products order,1973
- Export Quality control and inspection Act,1963
- Milk Food product order

**Suggestions**

- Harmonization of quality and safety standards with international standards.
- Developing India GAP standards
- Promotion of marketing extension- marketing cell to be in all the line departments- Horticulture, animal husbandry
- Quality and grade consciousness amongst consumers to be enhanced through awareness programmes.
- Farmers should get prices commensurate with grades
- Promotion of integrated supply chain in place of the present fragmented one through contract farming and direct marketing
- Reforms in the overall agricultural marketing system – introduction of good marketing practices, hazard analysis and critical control points.
- Promotion of processing
- Every state to have its own Standards Making Bureau under Marketing Boards..
- Facilitate Private Investment in owning, establishing and operating markets.
- Public-Private-Partnership to promote professionalism in existing markets.
- Stepping-up of Pledge Financing and Marketing Credit.
- Introduction of Negotiable Warehousing Receipt System in Rural Storage Projects.
- IT to Promote Trade and Market led Extension Services.

**Groupwise list of the commodities for which agmark grade standards have been formulated under the agricultural produce (grading and marking) act, 1937 (AS ON 31-05-2006)**

| **Name of the Group:** | **No. of commodities notified** |
|---|---|
| 1. Food grain and allied products | 29 |
| 2. Fruits and Vegetables | 29 |
| 3. Spices and condiments | 26 |
| 4. Edible Nuts | 8 |

| Name of the Group: | No. of commodities notified |
|---|---|
| 5. Oil Seeds | 15 |
| 6. Vegetable Oils and Fats | 18 |
| 7. Oil cakes | 8 |
| 8. Essential oils | 8 |
| 9. Fibre crops | 5 |
| 10. Live stock, Dairy and poultry products | 10 |
| 11. Other products | 25 |
| **TOTAL** | **181** |

**MARKET INFORMATION**

- Includes Prices – Wholesale & Retail
- Marketed Surplus of Agricultural Produce

**MARKET INFORMATION PROVIDES:**

- Local Consumption pattern
- Outside demand
- Stock with traders
- Consumers' Demand
- Dealers' Demand
- Purchases by others
- Market sentiments
- Crop forecasts
- Weather forecasts etc.

**MARKETINFORMATION BENEFITS**

Market Information is helpful for all

- *Farmer* - Helps in decision making of Farmers
  - What to produce
  - How Much to produce
  - What quality to produce
  - Where to sale
  - At what price to sale
- *Traders* - Helps to plan purchase, storage and sale

- *Consumers* – To make purchase decisions

*Government* - Helps in framing Agricultural Policy relating to regulation of Markets, Buffer stock, Export-Import and Administered Prices.

**CRITERIA FOR GOOD MARKET INFORMATION**

- Comprehensive
- Accurate
- Timely
- Relevant
- Trustworthy
- Easily accessible

SOURCES OF MARKET INTELLIGENCE IN INDIA

**WEBSITES** www.agmarknet.nic.in

www.agriculturalinformation.com

www.agriwatch.com

www.kisan.net

www.agnic.org

www.fao.org

www.fieo.com/cwc

www.commodityindia.com

www.apeda.com

www.ncdc.nic.in

www.agricoop.nic.in

www.indiaagronet.com

www.nafed-india.com

www.icar.org.in

www.codexalimentarius.net

**RISK IN AGRI-BUSINESS**

- **Agricultural risks:**

(a) production risk:

weather factors and diseases

(b) price risk:

Substantial production lags difference between realized prices and expected prices

**Price risk**

- price risk: difficult to anticipate at the time of starting the farming, the price that will prevail at the time of sale
- Variability in demand and supply demand for most of livestock and poultry product usually changes in predictable manner – governed by income and population
- Variability in supply: Due to production risks: inelastic demand of livestock and poultry product magnify the impact of supply shocks on prices.
- Fluctuation in planned supply: Variability in area: area variability generates price variability that in turn induces further variability in area
- Price risks – seasonality

  supply at one shot but consumption is continuous annual and seasonal price variability

**Agriculture price policy**

- Minimum support price/procurement price to provide incentives to the producers for adopting technology for maximizing production

  Agricultural price commission – 1965
- Commission for agricultural costs and prices (cacp) – 1985
- Minimum support price

  Cost of production (cost c)

  Input/output price parity

  Inter crop price parity

  Effect on cost of living

  Parity between price paid and price received by farmers (terms of trade)
- Market intervention scheme for those crops not covered under msp – onion, potato, turmeric, chillies these crops are important at regional level need for price support does not arise every year

# Entrepreneurship Development for Farm Women

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Indian economy is basically agrarian economy. On 2.4 percent of world land India is managing 16 percent of world population. Agriculture is the main source of livelihood for over 80% of the rural poor in India. Out of 149.8 million women workers in India, 81.3% live in rural areas. 77.3% of the women workers living in rural areas are engaged as cultivators and agricultural labourers. About 50% of them being poor, most of their earnings are spent on meeting their basic needs, particularly food. As per the 2011 Census, Agriculture is India's largest private-sector enterprise, engaging about 119 million farmers and another 144 million landless labourers. One question comes to everybody's mind is farming really a business? Is there something about agriculture that makes it fundamentally different as a business? Entrepreneurship in agriculture is not only an opportunity but also a necessity for improving the production and profitability. Agripreneurship is solution to many economic problems like urbanization, poverty, unemployment and economic development. It helps in rural development. But development of entrepreneurship in the areas of agriculture requires special skills like human development, knowledge of agriculture, knowledge of global agriculture market. Developing entrepreneurs in agriculture can solve many problems viz. reduce the burden of agriculture, generate employment opportunities for rural youth, control migration from rural to urban areas, increase national income and support industrial development in rural areas.

Although, agriculture is the major source of livelihood, the productivity as well as profitability in agriculture is significantly low in India. The lower productivity can be attributed to lack of awareness, poor dissemination of technology, inadequate investment in agricultural inputs and poor communication and information services; while the lack of profitability is mainly due to inadequate and inefficient infrastructure required for forward and backward integration, poor post harvest and processing facilities and poor linkage with market. Traditionally, the farmers have been dependent on the Agricultural Extension Agencies of the State Government for information, input supply and marketing services. Over the years, these agencies are not being able to cope up with the growing responsibilities and specific needs of the farmers. There is a need to develop mechanism so that various agricultural inputs can reach the farmers and they can market their farm produce easily. One of the major problem with Indian farmers is that agriculture is considered as a family tradition, a majority of the farmers continue to practise what their forefathers or their neighbours practised. This needs a major change. Agriculture must be considered as an enterprise. This needs proper planning about demand forecast, choice of technology, inventory of resources, need for external inputs, skill level of the available human resources and their training needs, infrastructure and services needed for carrying out various operations and marketing. To promote successful entrepreneurship in agriculture, the basic need of the hour is to change the mindset of both the farmers and Agricultural Extension Agencies.

**Agri-entrepreneurship**

A lot is being said these days about farmers becoming 'entrepreneurs'. But what is entrepreneurship? How can entrepreneurial skills be developed? How do entrepreneurial farmers respond to the changing farming environment? What strategies do they use? Entrepreneurship is the willingness to take risks and develop, organize and manage a business venture in a competitive global marketplace that is constantly evolving. Entrepreneurs are pioneers, innovators, leaders and inventors. They are at the forefront of technological and social movements – in their fields, in their forward thinking, in their desire to push the envelope. They are dreamers and most importantly– doers. There are two parts to entrepreneurship. The first is the managerial skills needed to start and run a profitable farm business. The second is 'entrepreneurial spirit'. Both are important. Managerial skills can be taught, but an entrepreneurial spirit cannot be taught. Many farmers are already excellent managers and many also have some of the spirit of an entrepreneur.

Entrepreneurship is a key factor for the survival of small scale farming in an ever-changing and increasingly complex global economy. But what is entrepreneurship in agriculture? How does it relate to small-scale farmers who operate on the edges of the economy Farmer-entrepreneurs see their farms as a business. They see their farms as a means of earning profits. They are passionate about their farm business and are willing to take calculated risks to make their farms profitable and their businesses grow. Farmer-entrepreneurs operate in a complex and dynamic environment. They are part of a larger collection of people including other farmers, suppliers, traders, transporters, processors and many others. Each of these has a role to play in producing products and moving them through to the market – through the value chain. Each one needs to be an entrepreneur. They also need to respect each other

and work together to make the whole system work better and be more profitable.

**Constraints in Entrepreneurship Development**

Agriculture is mainly a means of survival for most of the farmers in India. Majority of the farmers are illiterate and in the absence of adequate knowledge, resources, technology and linkage with the market, it is very difficult to turn agriculture into an enterprise. It is a general apprehension amongst the famers that the government is responsible for providing extension and technical advisory services to the farmers. However, over the years, the credibility has eroded and the services of these agencies are not available to small farmers, particularly those living in remote areas. Agriculture is becoming more complex and risk-prone, achieving higher and sustainable growth would depend on how successfully one adopt scientific knowledge, modern technology and innovations on the farm. Human Resource development is critical for sustaining, diversifying and realizing the potentials of agriculture and women are integral component of it.

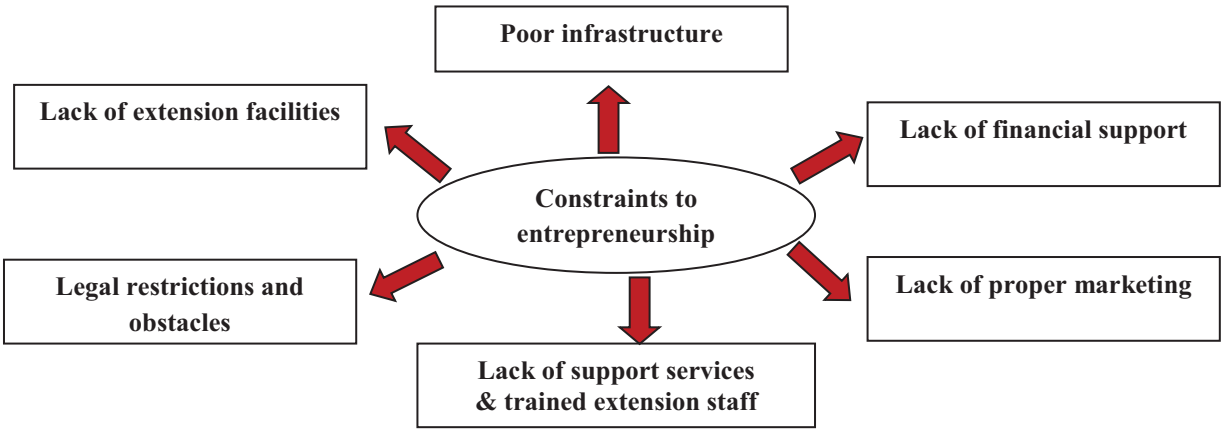



**Fig.1 Constraints for entrepreneurship development**

## Types of Enterprises

While promoting entrepreneurship, one may consider different types of enterprises in agriculture

- **Production Enterprises/ Family enterprises:** The farming family involves in farming should optimize the production at individual family level by making best use of the technology, resources and demand in the market. Entrepreneurship development in agriculture includes crop production, Dairy husbandry, Goattery, Backyard Poultry, Aquaculture, Horticulture, vermi compost etc.

- **Service Providing Enterprises:** To optimize the productivity from agriculture by family enterprise, different types of services like input procurement and distribution, hiring of implements and equipment like tractors, seed drills, sprayers, harvesters, threshers, dryers and technical services such as installation of irrigation facilities, weed control, plant protection, harvesting, threshing, transportation, storage, etc. are required at the village levels. In the livestock and poultry sectors also different types of services like feed, vaccination, disease diagnostic and treatment services are also required.

- **Input Producers Enterprises:** Entrepreneurship can be developed for providing critical inputs at the village level are biofertilizers, biopesticides, vermicompost, soil amendments, plants of different species of fruits, vegetables, agricultural tools, irrigation accessories, production of animal feed concentrate, mineral mixture and complete feed. There are good opportunities to support sericulture, fishery and poultry as well, through promotion of critical service facilities in rural areas.

- **Processing and Marketing Enterprises:** The efficiency of post-production management requires higher scale of technology as well as investment. Such enterprises can be handled by forming cooperatives at the village levels like sugar cooperatives, dairy cooperatives, poultry cooperatives, fruit growers' cooperatives etc. However, the success of such ventures is solely dependent on the integrity and competence of the leaders involved.

**The 'way of life' of a farmer-entrepreneur**

- Freedom in making decisions about the business and the relationship with family
- Control over what has to be done, when and in what order
- Working alone often in solitude
- Coping with a wide range of managerial and 'day to day' tasks
- Lives with uncertainty; if you can't generate profit you may not survive in the future
- Risking personal assets and security
- High level of responsibility and risk of failure
- Lives with an inability to control the actions of stakeholders upon whom the success of the business depends
- Develops trust and alliances with other stakeholders where mutual benefits exist
- Works long and irregular hours to meet demands
- Closely interwoven family and business life
- Social status is linked to the success of the business
- 'Learns by doing' under pressure from stakeholders, by solving problems, experimenting, seizing opportunities, and learning from competitors

**What does one require to venture into women entrepreneurship??**

- Willingness to explore opportunities for growth
- Self confidence
- Motivation to explore one's own talent
- Making the family understand that you need to use your talent and potential
- Mobilizing finance
- Identifying the correlation between your capability and the market need
- Technical support from experts
- Keenness to learn, experiment and achieve
- Innovation
- A burning desire for financial independence

**Requirements for starting of an Enterprise**

- Infrastructure,
- manpower,
- Procurement of materials,
- Fixed Assets and Machinery for processing,
- Storage facilities,
- Marketing of products and
- Collection of receivables.
- Complying with Govt regulations
- Pollution control,
- Labour welfare,
- Adhering to license conditions

**Strategies for Promotion of Successful Enterprises**

The idea of entrepreneurship is complex. When a farmer introduces a new enterprise into his farming system, there are different stages of development that the enterprise goes through. The skills of the farmer must also change and develop to meet the management demands of the enterprise

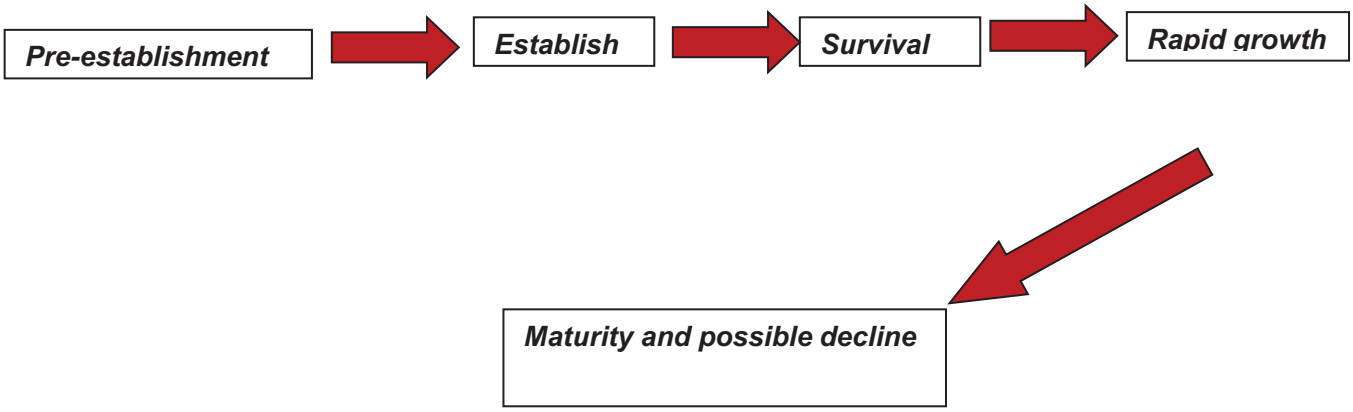



**Fig. 2. Different Stages of entrepreneurship**

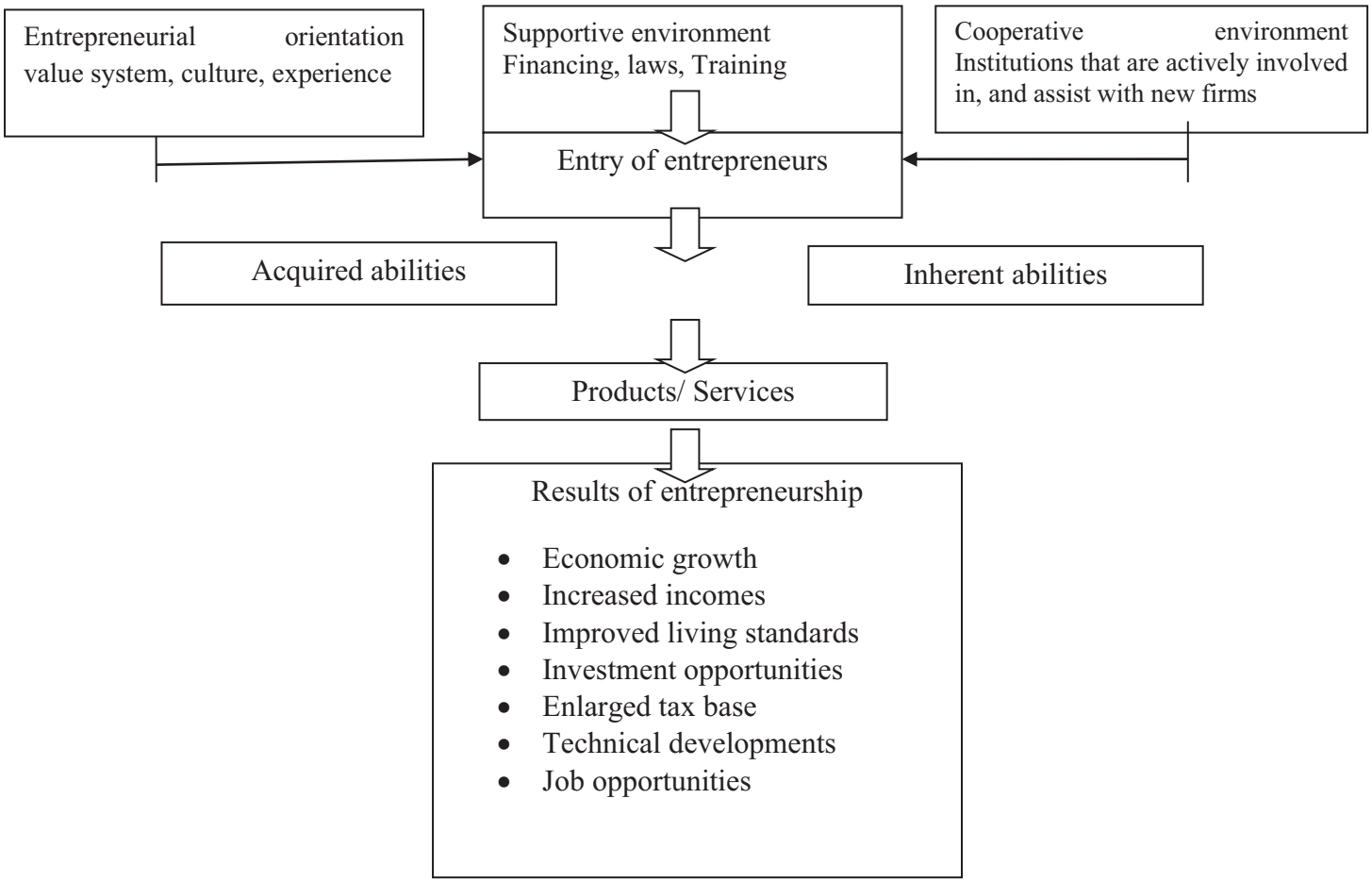
India lives in its villages where agriculture provides a livelihood to more than two-third of its population. More than 80% of the rural women are directly engaged in agricultural activities. Research findings has observed that there is gradual feminization of agriculture because of rural to urban migration of the male population. Any strategy for economic development shall remain lop-sided without the involvement of women who constitute roughly half of world's population. But women are now the torch bearers in many developmental activities of the nation due to growing industrialization, urbanization, spatial mobility and social legislations. With the spread of education and awareness, women have shifted their base from kitchen to higher levels of professional activities. Human Resource development is critical for

sustaining, diversifying and realizing the potentials of agriculture and women are integral component of it. The future scenario of agriculture would depend largely on the attitude and capacity of the rural women to more effectively participate in and contribute to agriculture. Access to agricultural education can promote adoption of science and knowledge-based practices for sustainable growth, entrepreneur skills and self reliance. In the medium and long term, access of rural women to agricultural education would bridge the persisting gender gap in access to agricultural knowledge, which in turn would create conditions for accelerated dissemination and application of knowledge and technology in agriculture and home management. The process would create new avenues of income and employment for rural women and youth, particularly those who are not even considered as workers in strict economic sense, and help in tackling many problems that agriculture and rural India are facing, thereby contributing to sustainable development of agriculture and rural areas.

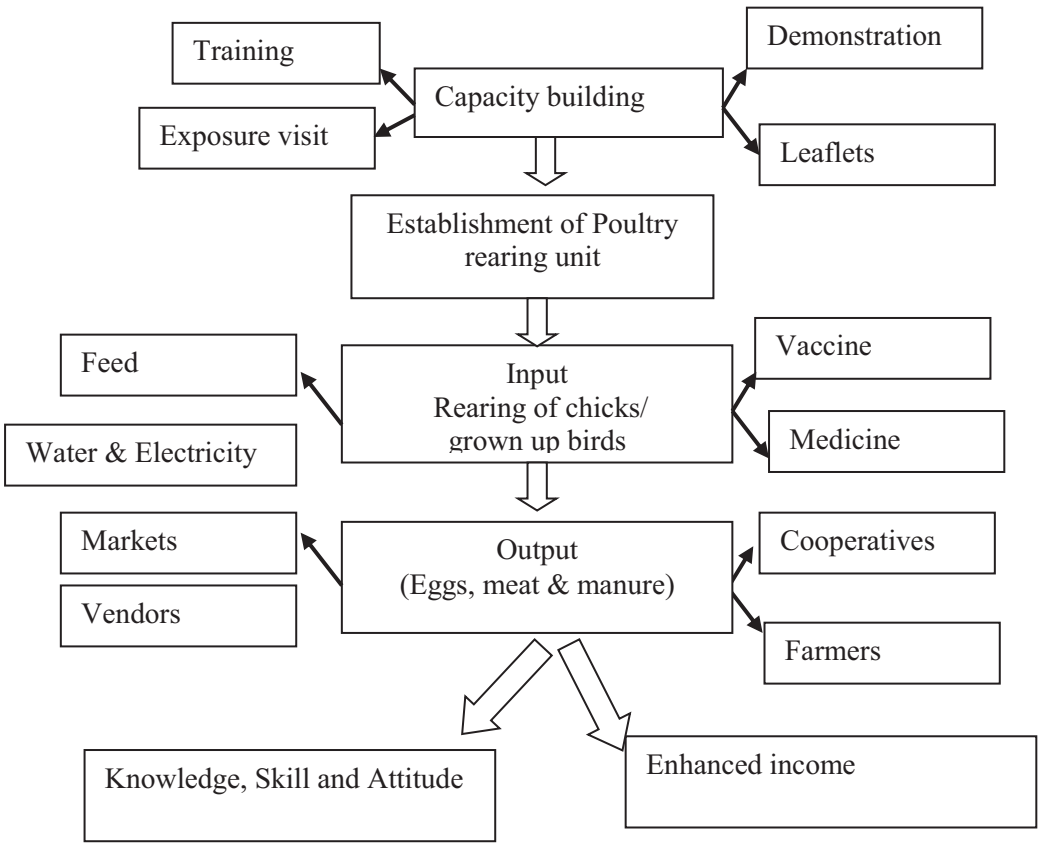
Some of the important conditions necessary for successful entrepreneurship are below:

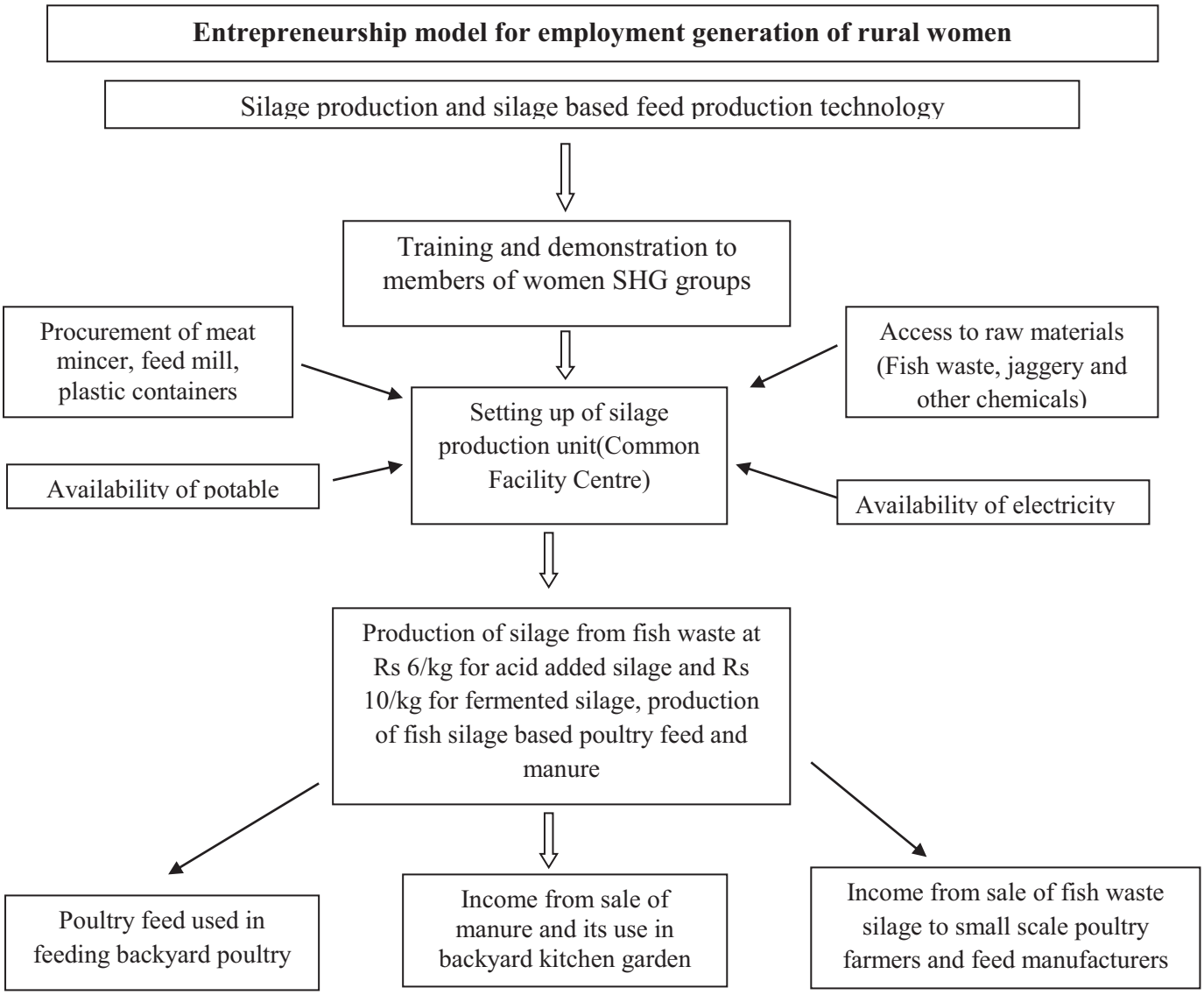
- A common programme between among government and farmers about the need and benefits of promoting self-employed youth or private entrepreneurs to facilitate the farmers to enhance agricultural production and profitability.
- The technical skills and ability of the entrepreneurs should be evaluated to ensure high standards. There should be a monitoring agency to check the quality of the services and the charges collected from the farmers to avoid exploitation.
- Introduction of concessions and incentives by the Government for encouraging entrepreneurs development.
- A wider publicity about the services available to the farmers through the Agricultural Extension Agencies and Farmers Organizations to popularize the services of the entrepreneurs.
- Developing networking of entrepreneurs to share their experiences. Network to close link with Research Institutions and Universities to update with the latest research findings and seek solutions for their field problems.

**Entrepreneurship development model**

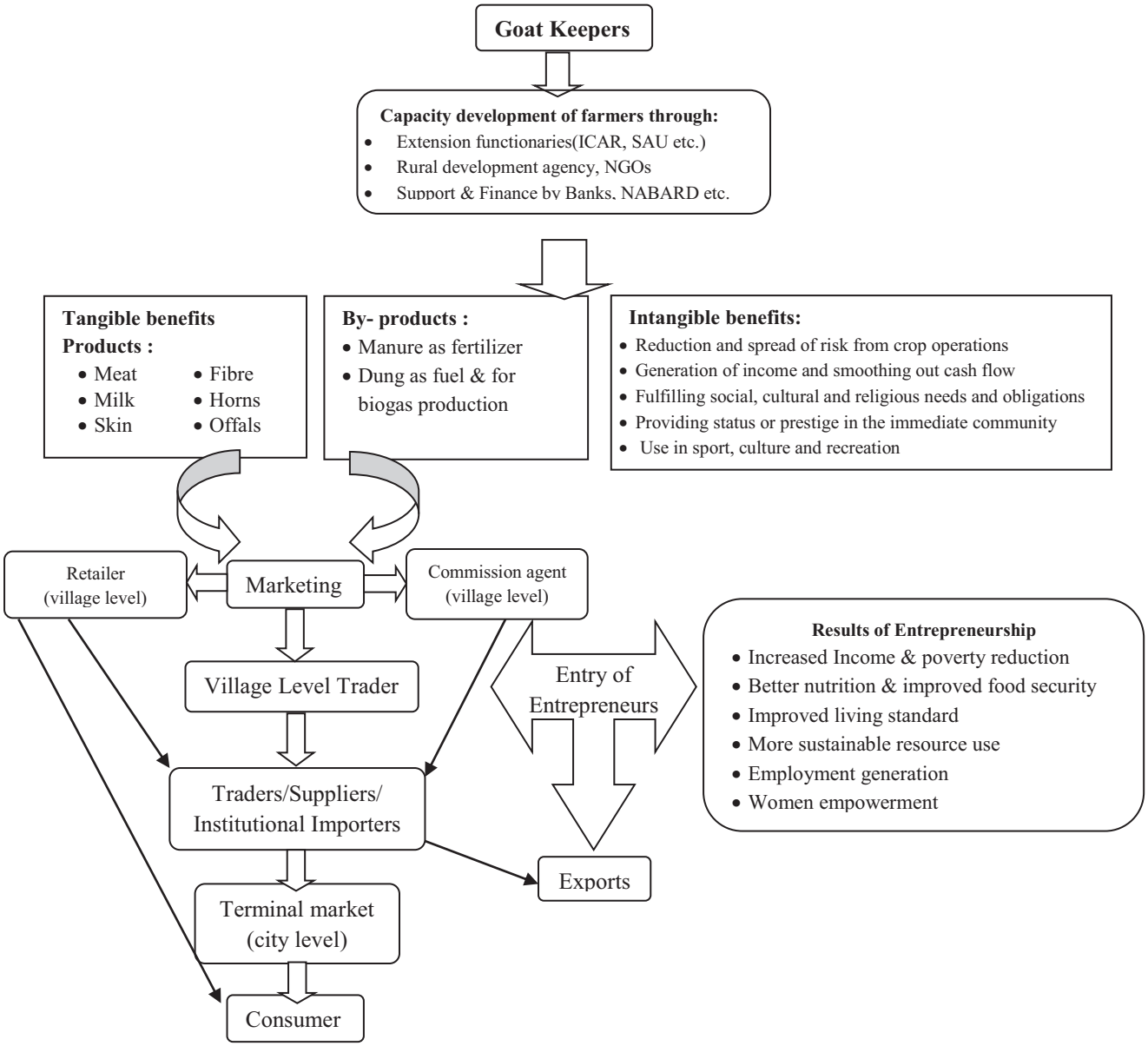



**Entrepreneurship model for backyard poultry production**




Entrepreneurship model for employment generation of rural women
Silage production and silage based feed production technology
Training and demonstration to members of women SHG groups
Procurement of meat mincer, feed mill, plastic containers
Access to raw materials (Fish waste, jaggery and other chemicals)
Setting up of silage production unit(Common Facility Centre)
Availability of potable
Availability of electricity
Production of silage from fish waste at Rs 6/kg for acid added silage and Rs 10/kg for fermented silage, production of fish silage based poultry feed and manure
Poultry feed used in feeding backyard poultry
Income from sale of manure and its use in backyard kitchen garden
Income from sale of fish waste silage to small scale poultry farmers and feed manufacturers

## Entrepreneurship development through Goat Farming



# Augmenting Livestock Production through Extension Strategies

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Since time immemorial the mankind has been utilizing different animal species for a variety of purposes viz. production of milk, meat, wool, egg and leather. Since then various animal species are used for draught power, companionship, entertainment, research experimentation, sports, security etc. Today, the livestock sector plays a very crucial role in rural economy and livelihood. During 11th five year plan( 2007-12), the livestock sector employs eight percent of the countries labour force, including small ,marginal farmers, women and landless agricultural workers. Milk production alone involves more than 30 million small producers, each raising one or two cows or buffaloes. The organic fertilizer produced by the sector is an important input to crop production, and dung from livestock is widely used as fuel in rural areas. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India. Livestock sector contributes to national 4.11% GDP and 25.6% of total Agriculture GDP .Livestock also serves as an insurance substitute, especially for poor rural households; it can easily be sold during time of distress. As per 19th Livestock census, 2012 (GOI, 2014) India's livestock sector is one of the largest in the world with a holding of 11.6% of world livestock population which consists buffaloes (57.83%), cattle (15.06%), sheep (7.14%), goats (17.93%), camel (2.18%), equine (1.3%), pigs (1.2%), chickens (4.72%) and ducks (1.94%). India has huge livestock population of 512 million nos. which mainly includes cattle, buffaloes, goats, sheep and pigs. Contribution of cattle, buffalo, sheep, goat, pig and others in total livestock population is 37.28, 21.23, 12.71, 26.4, 2.01 and 0.5%, respectively. Population of exotic and crossbred cattle registered a significant increase of 20.18% while the indigenous cattle decreased by 8.94%. Total poultry population in India is 729.21 million, which includes 692.65, 23.54 and 13.02 million chickens, duck and turkeys & other poultry, respectively. It is observed that growth tend in total poultry population is quite more as compared to total livestock population.

**Contribution of livestock**

**With respect to food and non-food items**

1. **Food:** The livestock provides food items such as Milk, Meat and Eggs for human consumption. India stands first in the world in milk production, producing about 137.7 million tones of milk in a year. Similarly it is producing about 74.75 billions of eggs, 8.89 million tonnes of meat in a year. The value of milk group and meat group at current prices was Rs 4,06,035 crores in 2013-14.

2. **Fibre and skins:** The livestock also contributes to the production of wool, hair, hides, and pelts. Leather is the most important product which has a very high export potential. India is producing about 47.9 million Kg of wool per annum.

3. **Draft:** Bullocks are the back bone of Indian agriculture. The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks.

4. **Dung and other animal waste materials:** Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees. In addition it is also used as fuel (bio gas, dung cakes), and for construction as poor man's cement (dung).

5. **Storage:** Livestock are considered as "moving banks" because of their potentiality to dispose off during emergencies. They serve as capital and in cases of landless agricultural labourers many time it is the only capital resource they possess. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.

6. **Weed control:** Livestock are also used as biological control of brush, plants and weeds.

7. **Cultural:** Livestock offer security to the owners and also add to their self esteem especially when they are owning prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc.

8. **Sports / recreation:** People also use the animals like cocks, rams, bulls etc for competition and sports. Despite ban on these animal competitions the cock fights, ram fights and bull fights (jalli kattu) are quite common during festive seasons.

9. **Companion animals:** Dogs are known for their faithfulness and are being used as companions since time immemorial. When the nuclear families are increasing in number

10. and the old parents are forced to lead solitary life ,the dogs and cats are providing the needed company to the latter thus making them lead a comfortable life.

**With respect to farmers' economy**

The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. The livestock serve the farmers in different ways.

1. **Income**: Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes if in milk will provide regular income to the livestock farmers through sale of milk. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners.

2. **Employment:** A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The land less and less land people depend upon livestock for utilizing their labour during lean agricultural season.

3. **Food:** The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners.

4. **Social security:** The animals offer social security to the owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture. Animals are used for various socio religious functions. Cows for house warming ceremonies; rams, bucks and chicken for sacrifice during festive seasons; Bulls and Cows are worshipped during various religious functions. Many owners develop attachment to their animals.

5. **Draft :** The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs.

6. **Dung:** In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement).

**Cause for augmenting livestock production**

Around 2.6 billion people in the developing world are estimated to have to make a living on less than 2 square meal a day and of these, about 1.4 billion are 'extremely' poor; surviving on less than 1 square meal a day. Nearly three quarters of the extremely poor – that is around 1 billion people live in rural areas and, despite growing urbanization, more than half of the poor will reside in rural areas until about 2035. Most rural households depend on agriculture as part of their livelihood and livestock commonly form an integral part of their production system. On the other hand, to a large extent driven by increasing per capita incomes, the livestock sector has become one of the fastest developing agricultural sub-sectors, exerting substantial pressure on natural resources as well as on traditional production (and marketing) practices. In the face of these opposing forces, guiding livestock sector development on a pathway that balances the interests of low and high income households and regions as well as the interest of current and future generations poses a tremendous challenge to policymakers and development practioners. Furthermore, technologies are rapidly changing while at the same time countries are engaging in institutional 'experiments' through planned and un-planned restructuring of their livestock and related industries, making it difficult for anyone to keep abreast with current realities.

In India, out of total households residing in the rural area, about 73 per cent own livestock. More importantly, small and marginal farmers account for three-quarters of these households. Income from livestock production accounts for 15-40 per cent of the total farm household's income in different states. Thus, an increase in demand for livestock products, can be a major factor in raising the income and living standards of the rural households. The demand projections for livestock products corresponding to 5 per cent GDP growth rate, generally regarded as closer to the realistic situation. The estimated consumption in the year 1993 was of 45.02 million tonnes milk, 0.78 million tonnes mutton and goat meat, 0.49 million tonnes beef and buffalo meat and 0.25 million tonnes chicken and 0.54 million tonnes eggs. In the year 2020, the demand would reach 147.26 million tonnes form milk, 12.72 million tonnes for mutton and goat meat, 1.15 million tonnes for beef and buffalo meat, 0.81 million tones for chicken and 2.58 million tonnes eggs. To meet the above demand of the ever growing population and address the challenge of food security and malnutrition there is need to augment the livestock production. Development will bring food security only if it is people-centred, if it is environmentally sound, if it is participatory, and if it builds local and national capacity for self-reliance. These are the basic characteristics of sustainable human development. Livestock are important contributors to total food production. Moreover, their contribution increases at a higher rate than that of cereals. Recent increases in livestock products appear to be even more spectacular than those achieved for cereals from the green revolution. Most notably, egg production has increased by 331 percent over the last two decades, compared with 127 percent for meat production, 78 percent for cereals and 113 percent for fish. The alarming situation arising due to erratic climate change posing a challenge on even the subsistence income of the farmers, hence draws the attention on alternative agriculture. In mixed-farming systems; livestock reduce the risks associated with crop production and also represent liquid assets that can be realized at any time, adding further stability to the production system. Further, indiscrimination use of fertiliser and pesticide in the crop production destroys the soil fertility and develop health hazards thus, developing imbalance in the ecosystem. The alternative approach to maintain the soil and human health is to promote the integrated and sustainable livestock production. Nutrient recycling is an essential component of any sustainable farming system. The

integration of livestock and crops allows for efficient nutrient recycling. Animals use the crop residues, such as cereal straws, as well as maize and sorghum stovers and groundnut haulms as feed. The manure produced can be recycled directly as fertilizer. One tonne of cow dung contains about 8 kg N. 4 kg $P_2O_5$ and 16 kg $K_2O$.

The importance of animals as an efficient and economic means of food production has been challenged on the backdrop of environmental issues such as;

- Competition with alternative land uses for raising fodder and cereals for cattle feed.
- Competition for carbohydrate and protein sources.(cultivation for paddy or raising animals)
- Inability to meet national targets for animal proteins.
- Only a few large investments in livestock development projects have been marginally successful in increasing productivity and these have had a limited impact on agriculture.
- Inadequate demonstration of how livestock can play a key role in the development of sustainable agriculture in different agro-ecosystems, and the failure to transfer appropriate technologies
- Resource degradation and environmental damage caused by deforestation, overgrazing and pollution.
- Contribution to global warming (methane from ruminants represents 2.5 percent of total greenhouse gases).
- Pollution from concentrations of intensive animal production enterprises.

Many of these problems are a result of the inability to identify appropriate technologies and define strategies for livestock development that are applicable to individual agro-ecosystems. Often, technology is transferred from developed countries unmodified, rather than generating appropriate technologies within the developing countries themselves. Imported technologies have almost always failed to overcome the constraints imposed on local farming systems or to meet the socio-economic requirements of the local farmers.

Careful analysis and assessment are required so that livestock development strategies can be reoriented towards better use of local resources, contribute more effectively to food security, improve the living standards of poor farmers and ensure sustainable animal agriculture development. The determining factors of this overall strategy include:

- political support for fair commodity prices and proposed strategies;
- better definition of the target recipients' needs;
- increased efficiency of use and management of natural resources;
- linking of production and post-production components to efficient infrastructure, services and marketing schemes;
- more appropriate policies for the use of common land and rangelands;
- improved capacity and commitment of national and international agricultural centres and non-governmental organizations (NGOs) to implement strategies that contribute to the development of livestock production within specific agro-ecosystems/ecoregions.

In livestock production, the overriding considerations are the availability and efficient use of local natural resources. A successful livestock development strategy requires the formulation of resource management plans that complement the wider economic, ecological and sociological objectives. Particular attention needs to be given to land-use systems and to the natural resources required for improved livestock production. The strategy will also need to consider the social, cultural, political and institutional elements that affect the management of natural resources. On the policy side, issues relating to land use, common property, legislation, price policies, subsidies, levies, national priorities for livestock development and research capacity have to be addressed. Finally, the implementation of action programmes requires both technical and institutional support and, equally important, government commitment.

**Constraints in livestock extension service visa-a -vis strategy for augmenting production**

According to survey by National Sample Survey Organisation(NSSO) of 51,770 households in the country, only 5.1% of households can access information on modern animal husbandry practices and out of these 5.1% only 5.7% farmers access information from the livestock extension workers where as 40.4% of households can access information on modern agricultural practices. So there is an urgent need for entire revamp of our livestock extension delivery systems. Our extension agents are under trained, under equipped, under paid, under motivated, multiplicity of duties and lack of technical support. The External constraints include social, economical, administrative, and political. The Internal constraints include lack of appropriate technical messages, lack of trained staff, lack of programme planning, lack of resources, lack of communication. Earlier extension efforts include general extension service, commodity based service, training and visit, participatory extension services, project driven services, farming system approach and university extension services. Still these are continuing as the major extension services in our country with slight improvement such as involvement of mass media, limited use of cyber extension. So in order to improve the livestock production the extension services has to be strengthened and some future strategies to improve the extension services are discussed as follows:

1. **National planning:** Policies should be realistic as well as being economically and environmentally sound and should take into account existing situations regarding institutional, infrastructural and marketing aspects. Policies should take into account the aspiration and capability of the producer. Policy should provide a framework with clearly defined and attainable objectives at the regional and local level.

2. **Setting priorities:** Efforts should be targeted to those situations where intervention likely to have greatest impact or benefit.

   e.g. Small animal farming is mostly based on free ranging where majority of time and energy of the animals spent in grazing to distant places so body wt. gain is very less. So if we can plant browsing trees like sobabool in village roads or pond sides then their much of the energy will be saved. This may be a small intervention and investment but it will have a greater impact on overall weight gain and productivity.

3. **Problem identification and potential solutions:** PRA and RRA should be utilized for the identification of resources, problems of the villagers by themselves and selecting suitable solutions by the subject matter specialists with the active involvement of villagers.

4. **Detailed work plans:** A detailed plan should be made regarding manpower requirements, their responsibilities, analyzing critical path and activities and thus reducing effective time in implementation.

5. **Extension methodologies:** Women play a prominent role in all AH activities but are very difficult to communicate because most of the extension workers are male. So recruiting more female extension agents may solve the problem.

6. **Family centric approach instead of individual approach (contact family):** Extension workers should focus on the entire family including both husband and wife where the family acts as demonstrators, risk takers and sources of information and pass on to their peers and groups, so extension by example.

7. **Training cum development:** Small multidisciplinary task force within a selected area should undertake the training programme. Training must be started with properly identifying target group (having capacity to avail and repay loan), their training need assessment and immediately creating a facility for the successfully trained farmers to avail credit facility. Training should be undertaken with small training teams in selected districts which travel around and hold training sessions for both farmers and extension staff in villages using village facilities and thus will be able to identify the benefits with the available local resources.

8. **Sustainable approaches for the future:** Govt. funded livestock extension services may not be viable and sustainable in long run in developing countries. So advisory roles may be transferred to the respected livestock producers within the community. So the developments of the producers association have a pivotal role in the provision of livestock extension services in the future. When the producer associations will develop they will be able to develop their own advisory services along with input supply and marketing services with a nominal cost.

9. **Maximization and best bet approach:** The technique which has high probability of success should be brought to farmers' field, inputs are subsidized, demonstration trials conducted and local administration fully involved in creating a dramatic impact over a short period of time. All mass media should be used in this campaign. Once a group of farmers is convinced with technology's superiority then widespread adoption will follow.

10. **Market led development:** Development should always focus on the village of producing farmers. Unless the village requirement is met, no milk/meat/egg should be sent to district centres, unless the district requirement is met, no milk/meat/egg should be sent to state agencies. In this way we can fulfill the nutritional requirement of the entire village and also farmers will have to spend less on transport and storage of their product.

11. **Market led Extension:** Market Led Extension establishes its position by helping the farmers realize high returns for the produce, minimize the production cost and improve the product value and marketability.

12. **Climate smart animal husbandry:** feeding balanced feed to livestock to reduce green house gases production, feeding and management of livestock to withstand the effect of climate change.

13. Allowing extension agents to take up shares in farmers' production programme thereby accepting both the risks and benefits.

14. **Commercialization of livestock services:** The extension services of the public sector should be more of catalytic, advisory and monitoring role. In any extent the provision of Govt. services must not inhibit the development of parallel services. Farmers will always be prepared to pay the full cost for the services if reliability and quality are assured.

    **e.**g. Milky moo, Poultry industry

15. **Increasing the reach of risk management:** Now only 6% of the total animals are covered for insurance. So we need to enhance the reach of insurance.

16. **Strengthening ATMA:** ATMA is the best model for livestock extension services where all the activities are decided according to farmers' group. But in most of the ATMAs agriculture plays a major role and majority of the expenditure is on agricultural sector. Even the veterinary surgeons of the concerned block are not involved with the ATMA due to their departmental burden. So we need to fix these issues by employing veterinarians as Block Technical Team Convenor, Block Technical Manager so as many animal husbandry development programme should be undertaken.

17. **Up scaling the uses of ICT:**

    Wide spread media coverage

    Computer based learning system

    GPS based on Mobile Veterinary Unit

    Smart phone application containing the detailed information on diseases, financing and processing of loan applications.

    Tele veterinary medicine

    Information kiosks in every villages where the farmers can learn, sell and buy livestock products

    e-market for online trading of livestock

    e-exchange for online trading livestock products like NCDEX( National Commodity Exchange)

18. **Provision of demarcated land for livestock development:** Increasing population, urban and commercial demands put pressure on rural land resources. Erosion and poor maintenance of farm land results in decrease of farm productivity. So in each village special livestock corridor should be created.

19. **Farmer field school:** FFS are the best places for learning of farmers. Now ATMA is sponsoring FFS for the livestock purpose, but its numbers are very limited. So FFS should be encouraged for the holistic development of farmers.

20. **Model animal husbandry village/block:** In each district the blocks and villages may be selected carefully according to available resources to act as an animal husbandry model(dairy/sheep and goat/pig/poultry) for the other villages and blocks.

21. **Animal husbandry resource mapping:** The entire livestock , infrastructure and anima husbandry services of country should be mapped so that the farmers on a single click can access all the information.

22. **Gender mainstreaming:** Since women are mostly involved in majority of the animal husbandry activities, providing equal rights to women over the resources will pave a clear path way for their participation in livestock production system.

# Extension Strategies for Socio Economic Empowerment of Women Through Livestock Farming

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## Background

Animal husbandry, dairying and fisheries activities, along with agriculture, continue to be an integral part of human life since the process of civilization started. These activities have contributed not only to the food basket and draught animal power but also by maintaining ecological balance. Owing to conducive climate and topography, animal husbandry, dairying and fisheries sectors have played prominent socioeconomic role in India. Traditional, cultural and religious beliefs have also been contributing in the continuance of these activities. They further play a significant role in generating gainful employment in the rural sector, particularly among the landless, small and marginal farmers and women, besides providing cheap and nutritious food to the millions of people.

Livestock sector is an important sub-sector of the agriculture of Indian economy. It forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, contributing to the health and nutrition of the household, supplementing incomes, offering employment opportunities, and finally being a dependable "bank on hooves" in times of need. It acts as a supplementary and complementary enterprise. According to NSSO 66th Round Survey (July 2009 – June 2010), total number of workers in farming of animals is 20.5 millions as per usual status (principal status plus subsidiaries status irrespective their principal activity status). Farmers of marginal, small and semi-medium operational holdings (area less than 4 ha) own about 87.7% of the livestock. Hence development of livestock sector would be more inclusive. India has vast resource of livestock and poultry, which play a vital role in improving the socio-economic conditions of rural masses. There are about 300.00 million bovines, 65.07 million sheep, 135.2 million goats and about 10.3 million pigs as per 19$^{th}$ Livestock Census in the country.

## Livestock Production

Livestock production and agriculture are intrinsically linked, each being dependent on the other, and both crucial for overall food security. According to estimates of the Central Statistics Office (CSO), the Gross Value Added from livestock sector at current prices was about Rs. 4,06,035 crore during 2013-14 which is about 21.58% of the Gross Value Added from total agriculture, forestry and fishing sector at current prices. The livestock Sector is contributing about 3.88% of total Gross Value added of the Country at current prices (2011-12). The Livestock Sector was expanded by 5.5% during 2013-14 against the total agriculture, forestry and fishing sectors growth of 3.7% during the same period at 2011-12 prices.

**Milk Production**

India continues to be the largest producer of milk in world. Several measures have been initiated by the Government to increase the productivity of livestock, which has resulted in increasing the milk production significantly from the level of 102.6 million tonnes at the end of the Tenth Plan (2006-07) to 127.9 million tonnes at the end of the Eleventh Plan (2011-12). Milk production during 2012-13 and 2013-14 is 132.4 million tonnes and 137.7 million tonnes respectively with an annual growth rate of 3.54% and 3.97% respectively. The per capita availability of milk is around 307 grams per day in 2013-14.

**Dairy Development**

The Dairy sector in India has grown substantially over the years. As a result of prudent policy intervention, India ranks first among the world's milk producing nations, achieving an annual output of 137.68 million tonnes of milk during the year 2013-14 as compared to 132.43 million tonnes in 2012-13 recording a growth of 3.96%. The milk production in the country for the year 2014-15 was about 142 million tonnes. This represents a sustained growth in the availability of milk and milk products for growing population.

Dairying has become an important secondary source of income for millions of rural families and has assumed the most important role in providing employment and income generating opportunities particularly for women and marginal farmers. The per capita availability of milk has reached a level of 307 grams per day during the year 2013-14, which is more than the world average of 294 grams per day. Most of the milk in the Country is produced by small, marginal farmers and landless labourers. About 15.46 million farmers have been brought under the ambit of 1,62,600 village level dairy corporative societies up to March, 2014. The cooperative milk unions have procured an average of 34.2 million kgs of milk per day during the year 2013-14 as compared to 33.5 million kgs in the previous year recording a growth of 2.1%. The sale of liquid milk by cooperative sector has reached 29.4 million litres per day during the year 2013-14 registering a growth of 5.8% over the previous year.

**Role of women in livestock**

Management of livestock is one of the important allied agricultural activity in which rural women contribute significantly. Dairy related task such as fodder cutting, care of animals, grazing, milking of animals, cleaning of sheds are performed mainly by women. Despite of dual responsibility of home and farm sector, women have to perform all the activities of dairy sector also. Dairy farming involved back-breaking tasks, as all the activities are carried out in arduous posture. Heavy load in these activities can cause musculo skeletal disorders (MSD) and disability. Tools to perform dairy activities are rarely designed as per the needs of women.

In the animal husbandry sector, men and women work hand in hand. Feeding the animals, milking of animals etc. mostly performed by women. However, role of both men and women are complementary in the field of animal husbandry and it is not possible to segregate the functions into specific grouping. Women have been at the fore-front of dairy cooperative movement, which was initially carried under the Operation Flood Programme and later also under the Integrated Dairy Development Programme implemented by the Government. In the poultry sector, the rural backyard poultry is an income supplementing scheme mostly

implemented by women, priority in training should be given to women. Similarly, in the scheme for conservation of breeds, the conservation of sheep, goat and small ruminants are oriented in such a way that women are being identified to take up such schemes.

**Technologies developed for drudgery reduction in care and management of livestock**

***Load fetching trolley for -transportation of dung:*** Dung transportation is the most drudgery prone activity in animal husbandry sector. A woman carries a load of 15-18 kg of dung weight per cycle. While doing this activity, along with carrying load she adopts different postures viz., squatting, sitting and bending to collect, carry and transport the dung. All these factors add stress on worker. Therefore, there is a need of transportation aid that can be used by women in rural environment. Thus a trolley with three wheels moving with push effort, saves time, energy and reduces drudgery. Cost (in Rs.) : Rs. 3000/- per unit.

***Gopal khore- useful for cleaning animal shed:*** The observation of the dairy activities revealed that dung collection is performed by women in bending or squatting posture which is an unnatural and imbalanced position of the body. Hence in order to improve the posture and reduce drudgery of the activity, the Gopal Khore with long handle was designed and developed under AICRP (HS). Dung removal underneath the animal is possible due to long handle of dung collector. It can be fabricated with the help of the local artisan out of locally available material. It is simple in fabrication light in weight and easy to handle, carry and store, made out of locally available material and local artisan. Dung collection is also possible on uneven surfaces with the help of Gopal khore. Cost (in Rs.) **:** Rs. 300/-.

***Revolving milking stool and stand- reduces stress and strain while milking:*** When milking activity was performed by using revolving stand and stool, it reduces stress and strain of milkman due to fear in mind that milk will get spill due to kick of animal. It helps to avoid wastage of milk. It is easy to move, simple in fabrication and made out of locally available material by local artisan. Useful on uneven surfaces also and suitable for any type of vessels, low cost and useful for resting the hands while taking break in milking activity. It is easy to handle, carry and store. Cost (in Rs.) **:** Rs. 900/- for one set.

**Conventional Extension Methods**

Concepts of Extension vary in respect of relative emphasis upon education, service, operations, programme and leadership style of the extension organization in bringing about change. All definitions of extension education involve change; changes in the behaviour of people presumably resulting in improved production, better living and a strengthening of the national economy. Extension Education is an applied science consisting of contents derived from research, accumulated field experiences and relevant principles drawn from the behavioural sciences synthesized with useful technology into a body of philosophy, principles, content and methods focused on the problems of out-of-school education for adults and youths. Extension Education is also defined as a science which deals with the creation, transmission and application of knowledge designed to bring out planned changes in the behaviour complex of people with a view to help them live better by learning the ways of improving their vocations, enterprises and institutions. One of the primary roles of extension in livestock development is to increase the productivity by transferring the proven technical know-how to the actual users under the various socio-economic and geographical conditions.

There is vast scope for extension in improving the living standards of farming community through the implementation of welfare schemes. To solve critical technological and financial problems, the cooperatives have to be orgnised and effectively managed in the villages. The two-way communication between the research and extension, and between the extension and clientele systems have to be maintained for the transfer of technologies and also for the generation of appropriate technologies.

**Extension Education Approaches**

Different extension educational approaches were used in the past under the extension educational programmes. These approaches can be grouped under four main headings: 1) the educational approach 2) the training approach 3) the cooperative self-help approach and 4) the integrated development approach. These are not watertight, mutually exclusive compartments, nor are they purely educational classifications. They differ mainly, not in their educational principles and methods, but in their quite different underlying conceptions and theories of rural development.

1. Educational Approach: The educational approach uses the extension methods for educating the people. It believes that the extension can transform static economy into a dynamic economy. While improving the quality of life, it emphasizes the communication of information about innovative technical practices. It is mostly followed in America and Asia and is referred to as the classical model of extension.

2. Training Approach: The training approach is considered to be related to the educational approach. It emphasizes more systematic and deeper learning of specific basic skills and related knowledge. The trained extension workers are supposed to transmit the useful knowledge gained by them to the rural people. The training and visit system is a good example of the training approach. The training and visit system evolved by Benor is being used in most of the developing countries with assistance from the World Bank to reduce the technological gaps.

3. Cooperative Self-help Approach: The cooperative self-help approach starts with the assumption that the complex process of rural transformation must begin with changes in the rural people themselves. The chief motive power for development must come from the people so that outside help of various kinds can be provided in response to the expressed needs of the people. There is heavy emphasis in this approach on the building of local institutions for cooperative self-help and governance.

4. Integrated Development Approach: The integrated development approach emphasizes the need of coordinating different agencies under a single management system of essential components required to get rural development moving. The management system may be authoritarian. The main emphasis is on rational development and coordination of all principal factors required for rural and animal husbandry development. The Intensive Agriculture District Programme (IADP) in India used this approach in tackling the problem of rural development.

**Extension methods**

The great task of extension for animal husbandry development is to exert a desirable influence over the clientele through the skilful use of extension methods. In order to bridge the wide gap between the technological innovations developed at the research stations and the technologies used by the clientele system, the extension methods and methodologies are accepted in many of the countries. In this context, the function of extension organizations is to carefully design extension services to use extension methods so as to attain specific predetermined objectives.

The methods used for extension teaching are classified as shown in Table 1.

**Table 1 – Classification of extension methods**

| | |
|---|---|
| I. According to use: | |
| a) | Individual contacts<br>Farm and home visits; Office calls; Result demonstrations |
| b) | Group contacts<br>Method demonstrations; General meetings; Group discussions; Group action process; Field trips |
| c) | Mass contacts<br>Publications; Radio/TV Programmes; Exhibitions; Campaigns |
| II. According to form: | |
| a) | Written<br>Bulletins; Leaflets; News articles; Personal letters |
| b) | Spoken<br>General meetings; Farm and home visits; Office calls; Radio |
| c) | Visual<br>Result demonstrations; Exhibits; Posters; Motion pictures; Slides and other visual aids |
| d) | Spoken and visual<br>Method demonstration meetings; Result demonstration meetings; Meetings involving visual aids; Films |

**Technology Transfer Process**

The conceptional and practical understanding of technology transfer has undergone several changes in the recent years. Technology transfer starts after the perfection of technology in the research organizations and ends in its utilization by the target clientele. The systems involved in technology transfer are as follows:

**Research system:** Research system includes various Institutes carrying out research investigations on specific problems. As the result of these investigations, new or improved technologies are developed in the research system.

**Extension system:** The new innovations developed in the research system are taken to the extension system. This system consists of personnel trained in extension and technology transfer programmes. The extension system examines the viability of the technology developed by the research system. If the technology is worth recommending, the extension system organizes various extension programmes to transfer the new message to the field.

**Client system:** The client system includes farmers, farm women, processors and others who adopt the new ideas for production and quality improvement of livestock and livestock products.

**Support system: T**his system has to play a vital role in the development of animal husbandry. It helps the client system adopt the new technology by providing finance and other facilities to increase production and improve quality of the products. Support system also assists in marketing the items produced by the client system. State Departments, Corporations, financial institutions, other development agencies and NGOs come under this system.

In the initial stage, the technology is taken from the research Institutes to the Extension Department which further conveys the message to the actual users. Some times the message is directly taken to the users bypassing the extension personnel. Some users mentally accept the technology while others mentally reject it due to several unfavourable factors. Those who mentally accept the technology are prepared to adopt it if they are provided with necessary facilities like technical and financial inputs. If such inputs are not provided, even the people who mentally accept the message reject the same after sometime. When the people adopt the technology, production and quality of the products are improved. They get higher price for their products if there are facilities for processing and marketing of their products. If they do not have facilities for processing and marketing they do not get better price for their products. Naturally they will discontinue the adoption of the new technology. The reasons for non-adoption and discontinuation of the new technology have to be identified and the constraints have to be rectified with the cooperation and coordination of various agencies involved.

**Major constraints in technology transfer**

1. Economic constraints
2. Lack of easy, timely and adequate inputs
3. Lack of marketing facilities
4. Lack of sufficient feed back
5. Low price of finished products in the market
6. Inadequate training facilities/ Inadequate field demonstrations
7. Lack of indigenous equipments/machinery
8. Lack of coordination among different agencies
9. Social problems

**Extension Strategies for Socio Economic Empowerment of Women through Livestock Farming**

- Decentralized Decision Making
- Bottom up Planning
- Farming System Approach
- Assistance to the economically weaker section of the community
- Cohesion and Co-operative self help in the community
- Development of the co-operative institutions
- Development of local resources including the utilization of manpower
- Promotion of rural industries
- Provides full integration to supply chain systems
- Participatory Research and Extension Approaches
- Value chain development
- Privatised extension services
- Farmer to farmer extension
- Farmers Field Schools
- Village adoption progammes
- Extension Pluralism
- ICT applications in livestock extension
- Strengthening market linkages

**Strategies for Small-Scale Livestock Development and Extension Techniques**

- ***Planning for Livestock Development Projects***: Overview of small-scale livestock development; production resources analysis; critical analysis in livestock production system; basic economic analysis and financing for small-scale livestock development projects; livestock development for poverty alleviation.
- **Livestock Nutrition and Health:** Overview of animal nutrition and health management; nutrition needs and feed management for poultry, cattle and small ruminants; utilization of crops and crop by products, and crop nutrition; sanitation and epidemic control.
- **Livestock Production Extension:** Farmers' knowledge, attitudes and practices (KAP) survey; KAP data analysis and utilization for extension development; message and media design; planning and implementing farmers' training programs.

- **Farmers' Institution Strengthening**: Participatory problem analysis and development planning; strategies and approaches for farmers empowerment; participatory monitoring and evaluation technique.
- **Case Studies and Study Visits:** Case studies on small-scale livestock production management for commercial broiler, cross-breed backyard poultry, dairy and integrated crop-fish- livestock farms, promotion materials and extension activities for small-scale livestock development undertaken by government agencies, universities and private agri-business companies. Field visits to livestock research and extension stations, small-scale and commercial poultry, dairy, beef fattening and small ruminants farms.
- **Training Needs Assessment (TNA)- Keep It Short and Simple (KISS):** Farmers prioritize and analyse their problems, and identify skills needed to address these.
- **Constraints Analysis for a production process:** This supplements the TNA-KISS, helping farmers to identify the underlying cause of production problems, taking account of the roles of both men and women.
- **Farmer to Farmer Exchange:** Farmers from the production group analyse the results of the learning project and decide on follow-up activities. This involved other interested farmers as well as those in the original production group.

For animal husbandry production, possible programmes and policy interventions include the following broad classifications:

- On-farm interventions, adapted to specific agro-ecological conditions and production systems. These interventions commonly aim at increasing the availability or utilization of local feeds, control of economically important diseases (internal and external parasites) and/or improved housing and management.
- Institutional changes, including the structure and function of support services covering input supply, research, extension and training, processing and marketing and credit. Institutional programmes often complement technical interventions and aim at providing a support framework for livestock production that should be both cost-effective and congruent with overall government policies. The concept of "private" and "public" good will increasingly determine who will pay for such services.
- Genetic improvement programmes aimed at improving the livestock resource base. Options include within-breed selection of adapted indigenous breeds, substitution with exotic breeds or cross-breeding. The choice largely depends on the production system, its objectives and the resources at its disposal. Experience has shown serious misjudgement with policies aimed at importing exotic breeds with a corresponding neglect of indigenous breeds in many developing countries. Whatever breeding programme is adopted, equal attention needs to be given to the dissemination of improved genetic material. Dissemination concerns the institutional aspects as well as the choice of biotechnology, such as artificial insemination and embryo transfer.
- Animal health programmes aimed at limiting the impact of disease on animal production. Policy issues concern who will provide and pay for such services. Foremost is the need to control and protect (quarantine) the national livestock

resource from major epizootic diseases, such as rinderpest, which is clearly a "public" good. Disease monitoring, veterinary investigation and legislation (public health and meat inspection) also fall within the public domain. On the other hand, control of diseases that cause production losses, for example, helminthiasis, is primarily a "private" good and determined on grounds of cost effectiveness. In this case, institutional policies that encourage the provision of private clinical services are required.

- Processing and marketing policies related to investment in the necessary infrastructure that enables livestock products to safely supply existing demands as well as those of the future. Such specific issues as the design of structures, equipment, training and quality, along with the question of the degree of state intervention (marketing boards, etc.) in the market, must also be addressed.

**Impact Assessment**

The predictive phase of the strategy design and planning process examines the various policy options and their implications in light of the government's broader development objectives. Strategy impact assessments usually address issues such as:

- economic efficiency;
- distribution and equity considerations (of both costs and benefits);
- stability (food supply, income, export earnings, etc.) and risk considerations;
- sustainability (environmental, financial and institutional);
- conformity with government objectives.

**Conclusion**

Livestock production has grown faster than agricultural production in most developing countries, and this trend is likely to continue with growth rates over the next 20 years estimated at 4.5 percent per annum. Historically, growth has come primarily from the expansion of livestock numbers rather than an increase in productivity. If this trend continues, it will put tremendous pressure on the available feed resources - even assuming substantial progress in feed conversion efficiency - and this probably will be the major challenge facing livestock planners.

The development of livestock in many developing countries is constrained by minimal public-sector investment and inefficient and poorly coordinated support services, however. This situation can, in part, be attributed to a lack of any consistent strategy for livestock development, which is exacerbated by inadequate analytical tools and a lack of information on which to base decision-making.

Clearly, increased livestock production will depend ultimately on the adoption of appropriate technology, improved support services, market access and infrastructural development to stimulate increased productivity. However, there must be a framework of coherent policies and development strategies that facilitate such development and ensure that the full potential of livestock in developing countries is exploited.

**REFERENCES**

AICRP-Technologies for women in agriculture, DRWA, Bhubaneswar.

DAHD Annual Report (2014-15) Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Government of India.

Doran, M.W., Low, A.R.C. & Kemp, R.L. 1979. Cattle as a store of wealth in Swaziland: implications for livestock development in eastern and southern Africa. Am. J. Agric. Econ., 61: 41-47.

FAO. 1994. Methods of microlevel analysis for agricultural programmes and policies: a guideline for policy analysts. Rome, FAO.

Ruthenberg, H. 1980. Farming systems in the tropics. 3rd ed. Oxford, UK, Clarendon Press. 424 pp.

Savvides, S. 1994. Risk analysis in investment appraisal: project appraisal, 9(1): 3-18. Surrey, UK, Beech Tree Publishing.

# Statistical Designs and Tools for Animal System Research

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Design of experiments is important in animal science research. Proper understanding of design of experiment helps the experimenter to use minimum number of animals, analyze the data correctly and extract all useful information from the resulting data. Any experiment should be started with a clear idea of how the resulting data are to be analyzed. Therefore, investigators must follow statistical rules from the beginning stage i.e. at the design stage.

Here we define some important terms and concepts normally used in experimental designs and some widely used basic designs along with example in sequel.

Experimental unit is piece of experimental material to which treatment is assigned and applied. Example: experimental plot, patient, tree, cattle etc.

Observational unit is the unit on which observations/measurements are made. Experimental Units and observational units may be same. Example: entire field - for yield, sample of plants - for plant height, entire herd - for milk yield, sample of cattle - for height and weight etc.

Partition of variation: Total variability/ response = assignable causes + error

Assignable causes: Variation due to treatments and variation due to any other known factor

Error: Variation due to all unassignable causes

Analysis of variance (ANOVA): Technique of partitioning total variance into assignable causes and error. ANOVA is used to test whether treatment differences are significant or not using F-test. Different designs differ in how total variation can be partitioned. ANOVA can be performed when the response variable is quantitative and the explanatory variables are qualitative in nature.

Example: Let average milk production of cows is 12 litre/animal/day. The cows are given concentrate, BST and there was improved management practices which resulted in average milk production of 16 litre/animal/day. There was increase of 4 litre/animal/day milk. ANOVA can then be used to answer the question how much proportion of milk was improved due to Concentrate, BST and improved management?

Here we provide some information about important designs widely used in agriculture and animal science research.

**Completely Randomized Design (CRD)**

- Assign treatments randomly to the experimental units
- Model: Response = Treatment + Error

- Simplest of all
- Null Hypothesis: All treatments (means) are equal
- Alternative Hypothesis: At least one of the treatment is different from other

Assumptions in CRD

- All experimental units are Homogeneous (no differences between experimental units)
- Number of replications for each treatment need not be equal
- Treatments and errors are independent
- Errors are independently distributed
- Errors have constant variance
- Errors are distributed as Normal distribution

ANOVA Table for CRD

| Source | d.f. | S.S. | M.S. | F-Ratio | P-Value |
|---|---|---|---|---|---|
| Treatment | t-1 | SST | MST | MST/MSE | |
| Error | n-t | SSE | MSE | | |
| **Total** | **n-1** | **TSS** | | | |

t – number of treatments

n – total number of experimental units (each treatment must be replicated at least twice)

Interpretation

- Find out significance of F-value (Rule: if P-value is <0.05 => significant at 5%)
- If significant, reject null hypothesis, "All treatment means are same"
- Rejection shows at least one treatment is different from other, then multiple comparison tests are performed to identify the best treatment (highest value or lowest value)
- If Null hypothesis is not rejected, analysis is stopped

Multiple Comparison Tests

- Multiple comparison or Post Hoc tests are useful for finding out "best" treatments
- Various Multiple comparison tests: LSD, Duncan, Tukey, etc.
- Best – Tukey's HSD (Honestly Significant Difference)
- Valid only when treatment effects are significant (null hypothesis is rejected)

Example CRD: There are 3 feed treatments randomly assigned to a number of similar cattle (similar in the sense having similar age, health, milk yield, feeding habit, same location, same environment etc) and all other conditions are kept controlled (no other special treatment is given to any cattle). One can find which out of three feed treatments is the best one in increasing milk yield of cattle.

*Interpretation and multiple comparison tests are common for most of the designs, therefore, for all below designs these text is not repeated.*

**Randomized Complete Block Design (RCBD)**

- Total Experimental units are divided into sets of homogenous units, called blocks
- Each treatment is assigned to one experimental units within each block randomly
- Number of blocks = number of replications of each treatment
- Removes one additional source of variation
- Model: Response = Block + Treatment + Error
- Null Hypothesis: All treatments (means) are same
- Alternative Hypothesis: At least one treatment is different from others
- Block effects can also be tested (usually of not interest)

Assumptions

- All experimental units within a block are homogeneous
- Every treatment appears once in every block
- Errors are independent of block & treatment effects
- Errors have constant variance
- Errors are normally distributed

ANOVA Table for RCBD

| Source | d.f. | S.S. | M.S. | F-Ratio | P-Value |
|---|---|---|---|---|---|
| Treatment | t-1 | SST | MST | MST/MSE | |
| Block | r-1 | SSR | MSR | MSR/MSE | |
| Error | (r-1)(t-1) | SSE | MSE | | |
| **Total** | **rt-1** | **TSS** | | | |

Example RCBD: There are 3 feed treatments randomly assigned to 4 milk yielding groups of similar cattle (similar in the sense having similar age, health, feeding habit, same location, same environment etc within a group) and all other conditions are kept controlled (no other

special treatment is given to any cattle or any group). One can find which out of three feed treatments is the best one in increasing milk yield of cattle.

**Latin Square Design (LSD)**

- Total Experimental units are divided into $t^2$ units such that there are t rows and t columns and t treatments are assigned in such a way that each treatment appears exactly once in each row and each column
- No. of rows = No. of columns = No. of treatments = No. of replications
- Model: Response = Row + Column + Treatment + Error
- Removes two additional sources of variation
- Null Hypothesis: All treatments (means) are same
- Alternative Hypothesis: At least one treatment is different from others
- Row and Column effects can also be tested (usually of not interest)

Assumptions

- Errors are independent of row, column & treatment effects
- Errors have constant variance
- Errors are normally distributed

ANOVA Table for LSD

| Source | d.f. | S.S. | M.S. | F-Ratio | P-Value |
|---|---|---|---|---|---|
| Treatment | t-1 | SST | MST | MST/MSE | |
| Row | t-1 | SSR | MSR | MSR/MSE | |
| Column | t-1 | SSC | MSC | MSC/MSE | |
| Error | (t-1)(t-2) | SSE | MSE | | |
| **Total** | **$t^2$-1** | **TSS** | | | |

Example LSD: Suppose there are four feeds you wanted to test on milk yield of cows. The feeds would be tested over time during the lactation period. This experiment would require 4 animals (rows: 4 animals). There would be 4 feeding periods at even intervals during the lactation period beginning early in lactation (columns: 4 periods). The treatments would be the four feeds. Each animal receives each treatment one time only, all other factors care controlled. One can find which out of four feed treatments is the best one in increasing milk yield of cattle.

**Split Plot Design**

- One factor requires larger plots (main plots) & another requires smaller plots (sub plots)
- First, a design with main plots is taken, then, main plots are split into as many parts as the number of sub plots, randomization takes place in each step
- Main Plot treatment may be in factorial structure
- Sub Plot treatment may be in factorial structure

Assumptions

- Errors are independent of replication, main plot & sub plot effects
- Errors have constant variance
- Errors are normally distributed

ANOVA for Split Plot Design

| Source | d.f. | S.S. | M.S. | F-Ratio | P-Value |
|---|---|---|---|---|---|
| Rep | r-1 | SSR | MSR | $MSR/MSE_a$ | |
| Main Plot Treatment (A) | a-1 | SSA | MSA | $MSA/MSE_a$ | |
| Rep * Main Plot (Error A) | (r-1)(a-1) | $SSE_a$ | $MSE_a$ | | |
| Sub Plot Treatment (B) | b-1 | SSB | MSB | $MSB/MSE_b$ | |
| A * B | (a-1)(b-1) | SSAB | MSAB | $MSAB/MSE_b$ | |
| Error (B) | a(b-1)(r-1) | $SSE_b$ | $MSE_b$ | | |
| **Total** | **abr-1** | **TSS** | | | |

**Factorial experiments**

- Factorial experiments are not experimental designs, factorial experiments are used to create treatment combinations (treatments) that are further studied using some designs like CRD, RCBD, LSD, Split plot etc.
- When number of factors are more than one, then factorial experiments are used
- Treatments are combination of levels of different factors
- Treatment effect may be divided into main effects and interaction effects
- If interaction is absent, saves time, resources and increases precision
- If interaction is present, gives more information

- When both main and interaction effects are significant, then, the interaction effects are to be interpreted not the main effects

Many more designs are available in literature. Experimenter needs to use proper design that fits for the experiment. One can get more detail about above said designs in any standard statistical book on experimental design. Designs available in books or generated through software (offline/ online) or manually generated following right steps and randomization is needed before implementing the design in the experiment. A number of statistical software like SAS, R, SPSS etc. can be used for data analysis. There are in built options in the software to perform ANOVA and the post hoc tests/ multiple comparison tests. Care is required in data entry and data import in any software. One need to verify logically that the data has been imported correctly in the software for analysis. Further, online help files of different software and different research centres/ universities along with different books may be used for proper experimentation because only these can help one in finding the best treatment or set of best treatments.

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# Low Cost Feed Formulation for Rural Poultry Production

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There is need to improve the scientific knowledge for utilizing low cost locally available agro-industrial by-products in poultry feed in order to reduce the feed cost. As feed constitutes 60-70 % of the total cost of production, any attempt to reduce the feed cost may lead to a significant reduction in the total cost of production. Poultry being the monogastric animal lack fibre degrading enzyme for breakdown of complex carbohydrates like cellulose, hemicellulose and lignin. Since, the complex carbohydrate is a major component of fibrous by-products like cashew apple waste, brewery waste, rice bran, wheat bran and sunflower cake etc, there is need to find ways and means for improvement in the utilization of these fibrous materials so as to incorporate these materials in the poultry feed without any adverse effect on their health and production. There is an opportunity to utilize locally available by-products for economic production of rural poultry like Vanaraja, Gramapriya etc. Hence, it was felt to evaluate these by-products for economic feeding of poultry to produce more meat and egg with less cost. Considering the demand for egg and meat in the coming years, low cost poultry rearing is a boon for marginal farmers and landless poor in the coastal ecosystem. There is ever increasing demand for conventional feed ingredients for feeding of poultry. Incorporation of these feed ingredients in poultry feed has increased the cost of production enormously. Attempts to utilize locally available cheap by-products may benefit the end users in reducing the feed cost which in turn can reduce the total cost of production of meat and egg and making them easily available at cheaper cost in rural India. The traditional sources of vitamins and proteins used in poultry rations such as fish meal, meat and bone meal, soybean meal, groundnut cake etc. are becoming expensive in developed countries. The availability of such feed ingredients is not adequate because of the spiraling cost of raw materials and ever increasing competition with the human beings for the same food items. Hence, the search for alternative feed sources has become inevitable to reduce the feed cost.

The chemical composition of agro-industrial by-products i.e. brewers' dried grain, cashew apple waste, cashew nut shell, rice kani (broken rice) and other unconventional feed ingredients like cereals ( bajra and ragi), poultry hatchery waste, and legume green fodder (cow pea leaf meal) along with their use in feed formulation have been summarized here under for low cost feed formulation for the benefit of farmers and other people associated with poultry farming.

## Brewers' dried grains

Brewer's dried grain is a valuable by-product of brewery which has a potential to be used as supplementary feed for livestock and poultry. It is a safe feed when it is used as fresh or properly dried form. These materials are considered to be good sources of un-degradable protein, energy and water-soluble vitamins. They have been used in feeding of both ruminant and monogastric animals (monogastrics using predominantly the dried forms). Brewer's grain

is the material that remain after grains have been fermented during the beer making process. These materials can be fed as wet brewer's grains or dried brewer's grains. Brewers' dried grain (BDG) is a by-product of barley malt, corn or rice that is treated to remove most of the readily soluble carbohydrates, protein, fibre, linoleic acid, vitamins and minerals. Some breweries dry the brewer's grain and sell it as dried brewer's grain, while others sell it as wet brewer's grain. Both types have similar feeding characteristics if the wet brewer's grain is fed shortly after it is produced. Fermented local and industrial by-products of brewing have been used as non-conventional feedstuffs in broiler rations mainly as protein and energy supplements . Brewery wastes are available in plenty from the local breweries which can be a potential feed ingredient to economize the poultry production. Brewery by-products like brewery waste grains and yeast's are worthy of consideration as potential non-conventional feeds to promote use of locally available feed ingredients. Since the brewers' dried grain is rich in fibre, addition of fibre degrading enzyme may be useful in improving its feed value.

**Fresh Brewers' grains**

**Formulated feed with inclusion of Brewers' dried grains**

**Chemical Composition**

Brewery waste collected from the local breweries has to be sun dried before inclusion in the poultry feed. Brewery waste when collected from the brewery contains about 75 % moisture which is a major constraint for storing and because of high moisture content it is not possible to feed poultry as it is and need complete drying without much loss of nutrients. After complete drying, the brewery waste is designated as brewers' dried grain (BDG). The nutritional content of the material may vary from plant to plant and depending upon the type of grain used (barley, wheat, corn, etc.) in the initial brewing process as well as proportions being fermented and fermentative process being used. The range values for different chemical constituents of BDG are given below in tabular form.

**Chemical composition of Brewers' dried grain**

| Chemical Constituents | % Composition |
|---|---|
| Dry matter | 90.10-93.00 |
| Crude protein | 11.00-30.89 |
| Ether extract | 7.00-11.05 |
| Crude fibre | 9.55-20.00 |

| Chemical Constituents | % Composition |
|---|---|
| Total ash | 3.09-11.04 |
| Acid insoluble ash | 1.37-1.96 |
| Calcium | 0.28-0.60 |
| Total Phosphorous | 0.43-1.00 |

Practical diets formulated with inclusion of BDG for different types of poultry birds are presented below in tabular form.

**Practical diets for different types of poultry birds with inclusion of brewers' dried grain**

| Ingredients | Starter Diet (0-3 wk) | Finisher Diet (4-6 wk) | Vanaraja chicks | RIR chicks |
|---|---|---|---|---|
| Yellow ground maize | 55.00 | 60.00 | 43.00 | 50.00 |
| Groundnut cake/Soybean meal | 20.00 | 17.60 | 21.00 | 12.00 |
| Fish meal | 10.00 | 10.00 | _ | 10.00 |
| Wheat bran | 7.78 | 6.03 | _ | 6.30 |
| De-oiled rice bran | - | - | 13.00 | - |
| Brewers' dried grain (BDG) | 5.00 | 4.40 | 20.00 | 20.00 |
| Dicalcium Phosphate | 1.13 | 1.16 | 1.17 | 1.15 |
| Common salt | 0.40 | 0.40 | 0.50 | 0.40 |
| L-Lysine HCl | 0.36 | 0.22 | 0.03 | 0.02 |
| DL-Methionine | 0.14 | - | 0.06 | - |
| Vitamin Mixture | 0.04 | 0.04 | 0.04 | 0.04 |
| Mineral Mixture | 0.15 | 0.15 | 0.15 | 0.15 |

**Cashew apple waste**

The cashew is native to northeast Brazil in the 16th Century; Portuguese traders introduced it to Mozambique and coastal India, but only as a soil retainer to stop erosion on the coasts. In India vast tonnages of cashew apples have largely gone to waste while it pioneered in the utilization and promotion of the nut. Cashew apple (*Anacardium occidentale L*) is a promising feed source, which could be used for dairy cows and monogastric animals to some extent. In 1995, the whole country had 200,000 ha of cashew trees. From this area, about 500,000 tons of cashew apple will be produced per year. There is commercial interest in processing the fresh apple as a source of sugar-rich juice for human consumption. The waste product from processing, after drying, has been fed to pigs and poultry with promising results. Cashew apple waste (CAW) is available in plenty in the coastal states with an annual production of about 3, 82,000 metric tons. The average weight of fresh apple is about 74.33 grams having dry matter content of 10.22 per cent. CAW is obtained after extraction of fenny which can be used as a cheaper source feed ingredient for poultry by partially replacing costly energy source maize. The waste is usually sun dried and ground before incorporation

in the feed. Similarly cashew nut shell is the outer covering of cashew nuts which is not usually used for human consumption but can be used as a cheaper source feed ingredient for poultry.

**Dried cashew apple waste**

**Chemical Composition**

The chemical composition of cashew apple waste (CAW) varies according to the location and species from which the apple wastes are prepared. The range values (%) for the different chemical constituents of CAW and per cent composition of cashew nut shell (CNS) are given below in tabular form.

**Chemical composition of cashew apple waste**

| Chemical constituent's | % Composition | |
|---|---|---|
| | CAW | CNS |
| Dry matter | 18.40-22.50 | - |
| Crude protein | 6.45-11.40 | 5.00 |
| Ether extract | 3.35-11.04 | 11.7 |
| Crude fibre | 8.50-11.85 | 27.3 |
| Total ash | 3.51-6.15 | 1.39 |
| Acid insoluble ash | 1.26-1.42 | 0.20 |

**Practical diets for Vanaraja growing chickens using cashew apple waste**

| Ingredients (%) | Vanaraja growing chickens |
|---|---|
| Maize | 40.00 |
| Groundnut cake | 22.00 |
| Fish meal | 10.00 |
| Wheat bran | 17.74 |
| CAW | 8.00 |
| DCP | 1.00 |
| L-Lysine HCl | 0.16 |

| Ingredients (%) | Vanaraja growing chickens |
|---|---|
| DL-Methionine | 0.20 |
| Common salt | 0.40 |
| Vitamin and Mineral mixture | 0.50 |

**Rice kani**

Rice (*Oryza sativa*) is a staple food of most of the Indian states including Goa. Rice is a staple crop in tropical cereal crop is Asia, accounts nearly 90 % of the World's total production of 480 million tones. During the milling of rough rice or paddy, several by-products become available and include polished rice (50-60 %), broken rice (1-17 %), polishings (2-3 %), bran (6-8 %) and hulls (20 %). Rice kani (broken rice) a by-product obtained through milling of rough rice or paddy is a potential unconventional energy source for poultry feeding. Therefore, there is tremendous scope for using rice kani as a substitute for high energy feed ingredient maize in poultry feed in order to reduce the feed cost as well as the competition with human beings for conventional energy source i.e. maize. Another additional advantage is that rice kani is not associated with aflatoxin which pose threat to the survivability of poultry and other livestock.

**Chemical Composition**

The chemical composition of rice kani varies as per the sources from where it is collected, processing conditions and storage period. The range values for the chemical constituents of rice kani are given below in tabular form.

**Chemical composition of Rice kani**

| Attributes | % Composition |
|---|---|
| Dry matter | 87.90-95.50 |
| Crude protein | 7.19-11.41 |
| Ether extract | 1.4-1.5 |
| Crude fibre | 0.7-2.52 |
| Total ash | 0.3-3.30 |

**Practical diets for Vanaraja growing chicks with inclusion of rice kani**

| Ingredients | % Inclusion |
|---|---|
| Ground yellow maize | 35.00 |
| Ground nut cake | 23.00 |
| Fish meal | 10.00 |
| Wheat bran | 15.00 |
| Rice kani | 15.00 |
| DCP | 1.00 |
| Limestone | - |

| Ingredients | % Inclusion |
|---|---|
| L-Lysine HCl | 0.14 |
| DL-Methionine | 0.01 |
| Common salt | 0.40 |
| Mineral mixture | 0.25 |
| Vitamin mixture | 0.04 |

**Cow pea leaves**

Cow pea (*Vigna unguiculata [L.] Walp.*) is an important grain and fodder legume crop grown in many parts of the world. Cow pea is used at all stages of its growth including as vegetables . Harvested tender green cow pea leaves constitute an important leafy vegetable often prepared as salad like spinach, lettuce, amaranthus and cabbage for direct consumption.

**Cow pea leaves ready for feeding**

**Chemical Composition of cow pea leaves**

| Attributes | % Composition |
|---|---|
| DM | 12.00 |
| CP | 20.4 |
| EE | 1.24 |
| CF | 15.02 |
| Total ash | 11.72 |
| Acid insoluble ash | 0.92 |

**Feeding value**

Cow pea leaves (fresh) were fed to Vanaraja laying hens at an inclusion level of 75 g and 125g per day, respectively by replacing part of whole standard layer ration. First group was given standard layer ration @ 75g/hen/day and fresh cow pea leaves 75g/hen/day and second group was given standard layer ration @ 62.5 g/hen/day and fresh cow pea leaves @ 125/hen/day. The result of this feeding trial was compared with the control group. Results indicated that significant ($P<0.05$) reduction in egg production (dozen) was observed in group fed 125g cow pea leaves and pod/hen/day. However, laying hens fed 75g of fresh cow pea

leaves and pods/hen/day produced eggs similar to that of control group. Egg production record (kg mass) followed the similar trend as that of egg production in dozen. The egg weight was not affected by the feeding of cow pea leaves and pods. Feed intake was significantly ($P<0.05$) reduced based on the dry matter intake. Feed efficiency (feed intake in kg/dozen egg) was significantly improved ($P<0.05$) in 1st group fed cow pea leaves and pods @ 75g/hen/day. Feed conversion ratio (Feed intake in kg/egg production in kg) followed the similar trend. Feed cost to produce dozen egg was significantly lower ($P<0.05$) for both the experimental groups fed cow pea leaves and pods. This study indicated that cow pea leaves and pods can be fed to vanaraja laying hens for more income generation due to significant reduction in feed cost.

**Unconventional cereals as alternative energy source**

**Bajra (*Pennisetum typhoides*) and Ragi (*Eleusine coracana*)**

Coarse cereals like bajra ((*Pennisetum typhoides*) and ragi (*Eleusine coracana*) are abundantly available in most parts of India. The demand for maize has increased tremendously for use as human and other industrial use making it less available for animal feed. Millets grossly resemble maize in proximate composition except variation in protein and minerals. Replacement of maize with coarse cereals, reduces feed cost and pressure in use of maize. Bajra is satisfactory feed ingredient for laying hens that can be included in unground form at moderate levels as per the results of research work conducted by earlier workers. The proximate composition of the Bajra and Ragi is given below in tabular form.

**Proximate composition of Bajra (*Pennisetum typhoides*) and Ragi (*Eleusine coracana*)**

| Attributes | Bajra (*Pennisetum typhoides*) | Ragi (*Eleusine coracana*) |
|---|---|---|
| DM | 90.09-91.3 | 90.54-91.0 |
| CP | 8.36-10.89 | 8.34-8.36 |
| EE | 3.86-5.24 | 1.16-3.38 |
| CF | 1.97-2.80 | 3.28-3.66 |
| Total ash | 1.68-6.39 | 3.16-6.73 |
| Acid insoluble ash | 0.19-2.08 | 0.26-2.73 |
| Calcium | 1.9 | 1.7 |

**Feeding Value**

**Effect of replacement of Maize with Bajra (*Pennisetum typhoides*) or Ragi (*Eleusine coracana*) on the performance of laying hens**

Sixty three, 30 weeks old Gramapriya white laying hens were assigned to 21 groups with 3 laying hens in each group having approximately equal body weight. Seven experimental diets were formulated by replacing 50 and 100 percent of maize by unground and ground bajra and ragi. Data were recorded on egg production, egg weight, feed intake, feed efficiency, egg white and yolk contents, shape index ,shell contents and shell thickness. Egg production (Kgs) and feed efficiency (Kg feed/Kg eggs) of hens fed bajra (ground and unground) and

ragi (unground) by replacing maize completely were similar to those fed control diet with maize as a sole energy source. The egg weights of hens fed ragi replacing 100 % maize and bajra (unground) by replacing 50 and 100 % maize were similar to the egg weight recorded on control groups. The shell percentage was significantly (P≤0.01) higher in hens fed diet with 50 and 100 % maize replaced by ragi. A significantly (P≤0.01) higher shell thickness was recorded in laying hens fed diet with 100 % maize replaced by ragi. The shape index, % egg white and % yolk were similar in all the groups. Results suggested that unground bajra and ragi could replace maize completely in the diet of laying hens without affecting the egg production, egg weight, feed efficiency and other quality parameters in addition to production of stronger shell.

**Effect of replacing maize by Ragi (Finger millet) on the performance of Gramapriya White chicks (1-8 weeks)**

A feeding trial was conducted in 120 nos of 1 day old Gramapriya chicks to see the effect of replacing maize by Ragi at various levels on their performance. Four experimental diets were formulated by replacing 0, 25, 50 and 100 % of maize in the control diet with ragi. Each diet was fed to triplicate groups and each replicate had 10 nos. of chicks. The experiment was conducted in a completely randomized design and for a period of 8 weeks. Data were recorded on weekly body weight gain, feed consumption and feed efficiency was calculated. Result indicated that significant depression in body weight gain and deterioration in feed efficiency was observed in chicks fed diet with total replacement of maize by ragi. However, the feed intake remained uninfluenced. The body weight gains and feed efficiencies of groups fed control diet and diets with 25 and 50 % maize replaced by ragi were similar statistically. Cost of feed per kg meat production was lowest in chicks fed diet with 50 % maize replaced by ragi. It may be concluded that ragi could replace up to 50 % maize in the diet of laying Gramapriya white chicks without any adverse effect on their body weight gain and feed efficiency.

**Poultry hatchery waste**

The Poultry hatchery waste (PHW) is the product left over in the poultry hatchery after the hatching process is completed. Poultry hatchery waste is primarily composed of dead chicks, infertile whole eggs and shells from hatched eggs. This material is usually incinerated, rendered, or taken to sanitary landfills and used for composting. Each of these disposal methods has particular regulatory or operational requirements or economic characteristics that may enhance or limit its use within a particular farm. Since, the moisture content of the fresh hatchery waste is high, it makes the disposal and incineration costly to the producer and it may be unsafe environmentally. Chemical composition of processed poultry hatchery waste is given below in tabular form.

**Chemical composition of processed poultry hatchery waste**

| Chemical Constituents | % Composition |
|---|---|
| Crude protein | 22.80-44.25 |
| Ether extract | 14.40-30.00 |
| Crude fibre | 0.90-8.06 |

| Chemical Constituents | % Composition |
|---|---|
| Total ash | 14.00-40.00 |
| Calcium | 7.26-22.60 |
| Total Phosphorous | 0.39-0.84 |

**Feeding value of processed Poultry hatchery waste in Vanaraja chicks**

To study the effect of feeding processed poultry hatchery waste (PHW) on the growth performance in Vanaraja chicks. 120 (2 wk) Vanaraja chicks were randomly distributed in to 4 equal groups with 3 replicates and fed on diets prepared by inclusion 0, 2, 4 and 8 percent processed hatchery waste by replacing 0, 25, 50 and 100 percent fish meal of the control diet. The PHW was cooked at 120 lb for 30 min., dried in hot air oven and analysed for proximate composition. Results on performance study indicated significant ($P<0.01$) increase in body weight gain due to incorporation of processed hatchery waste at all the levels in the diet of chicks at 7 week of age by replacing fish meal at 0, 25, 50 and 100 % levels (Table 52). Significant ($P<0.01$) improvements in feed conversion ratio (FCR), protein efficiency ratio (PER) and performance index (PI) in chicks were observed due to feeding of PHW at all the levels. Maximum net profit was recorded due to feeding of 8 % PHW as shown below in tabular form.

**Conclusion**

The agro-industrial by-products like brewery waste, cashew apple waste, cashew nut shell, rice kani (broken rice), alternative cereals like ragi, bajra and green fodder like cow pea leaves, are available in plenty locally. Presently these by-products are not exploited to full extent for inclusion in the poultry feed. These by-products and fodder leaves have good nutrient composition and reported to contribute to the productive value for egg and meat with reduction in cost of production. Hence, keeping their chemical composition and potential feeding value in consideration, these by-products can be incorporated to some level in the poultry feed formulations to economise the feed cost and to increase the profit margin for the poultry farmers.

# Project Formulation: Dairy & Goatery

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**A Scheme for a Dairy Farm** (20 CB Cows):

**Assumptions**

1. **Purchase of animals:** Animals in 1st/2nd lactation during first month after calving along with female calves will be purchased in two batches, 50% (10) in first batch and 50% (10) in second batch at an interval of 6 months. (185 days)
2. **Milk production:** (a) Crossbred cows – 10 kg/day on an average in lactation period of 280days

   (b) Sale price of milk @ Rs.30/kg cow milk
3. **Cost of animals:**

   Cost of each Crossbred cow including transportation charges is Rs. 35,000/cow
4. **Housing:**
   a) Civil work for cow shed @ 40sft/cow
   b) Civil work for calf shed @ 20sft/calf
   c) Civil work for cow store room @ 20sft/cow
   d) Cost of construction of livestock shed & store room @ Rs.300 per sft and Rs.400 per sft respectively
5. **Year:** Taken as 12 months or 365 days
6. **Lactation Period:** 280 days
7. **Dry period:** 120 days in cows
8. **Female calves:** Female calves born in herd calve at 2½ years in cows ( Not calculated here)
9. Depreciation: (a) The depreciation on shed will be 5% per year. However, this will not be taken into consideration during loan repayment period.
10. Production ration: This will be provided by feeding one kg concentrates for every 2½ kg ofmilk
11. Dairy feed cost: (a) Green fodder @ Rs.100 per qt. (b) Dry fodder (Bhusa) @ Rs300 per qt. and (c) Concentrates @ Rs.1500 per qt.
12. Feed During dry period: Concentrates @ 2 kg per adult per day.

13. Calves sex ratio: 50% male and 50% female
14. Male calf feeding expenses: Equal to the income received by their sale.
15. Mortality in calves: In adult 3% and 15 to 20% in calves.
16. Cattle insurance: Annual premium of 5% of the cost of animal.
17. Veterinary vaccination and artificial insemination charges: Rs.1000 per animal in a year.
18. Labour: One labourer for 10 animals @ Rs.5000 per month
    a. Calved animals and income: If the milk production is less or if the animals are reproductively inefficient, they have to be removed and replaced by newly purchased / raised (on the farm) animals, during first three years at the rate of one per year.
    b. Income from calved animal approximately @ 1/3 of the purchase cost.
19. Manure: Four tones of manure per animal per year @ Rs.300 per tone.
20. Loan: 60% of the capital cost.
21. Interest: @ 13.5% per annum on the basis of yearly repayment of loan installment.
22. Prices of feed and milk: Shown as same for 5 years.
23. Cultivable land: Cultivable land fully irrigated and fertile of 6 acres will be sufficient for 20 animals to supply green fodder round the year or 2.5 hectare for 8 to 10 dairy cows.( Sale proceed of manure is shown in this calculation )
24. Replacement of milch animals: After 7 lactations, difficult to breed and culled ones @ 10%, sale price of culled @ 40% of their purchase cost.
25. Ratio of milch animals to dry cows: 3:1 keeping in view their optimum values of reproductive and productive traits.
26. Sale price of 50kg empty livestock feed gunny bag @ Rs. 8/bag

**LACTATION CHART FOR 20 CB COWS**

| **Batch** | **1st Year** | | | **2nd Year** | | | **3rd Year** | | | **4th Year** | | | **5th Year** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Batch | 30 L | 250 L | 115 D | 5 D | 280 L | 80 D | 40 D | 280 L | 45 D | 75 D | 280 L | 10 D | 110 D | 255 L | |
| 2nd Batch | | 30 L | 180 L | 70 L | 120 D | 175 L | 105 L | 120 D | 140 L | 140 L | 120 D | 105 L | 175 L | 120 D | 70 L |

**Note:**

- All the numbers are in days. L= Lactation length, D= Dry Period.
- 1st batch cows purchased 30 days after calving.
- 2nd batch cows purchased after 6 months after 1st batch and also 30 days after calving.

**1st batch:**

1st Year = 250 days lactation × 10 = 2500 days

115 days dry × 10 = 1150 days

2nd Year = 280 days lactation × 10 = 2800 days

85 = (5+80) days dry × 10 = 850 days

3rd Year = 280 days lactation × 10 = 2800 days

85 = (40+45) days dry × 10 = 850 days

4th Year = 280 days lactation × 10 = 2800 days

85 = (75+10) days dry × 10 = 850 days

5th Year = 255 days lactation × 10 = 2550 days

110 days dry × 10 = 1100 days

**2nd batch**:

1st Year = 180 days lactation × 10 = 1800 days

0 days dry × 10 = 0 days

2nd Year = 245 = (70+175) days lactation × 10 = 2450 days

120 days dry × 10 = 1200 days

3rd Year = 245 = (105+140) days lactation × 10 = 2450 days

120 days dry × 10 = 1200 days

4th Year = 245 = (140+105) days lactation × 10 = 2450 days

120 days dry × 10 =1200 days

5th Year = 245 = (175+70) days lactation × 10 = 2450 days

120 days dry × 10 = 1200 days

**CAPITAL INVESTMENT**

| A. **CIVIL WORKS** | **Amount (Rs)** |
|---|---|
| 1. Cowshed for 20 cows @ 40 sq ft/cow<br>800 sq ft @ Rs 400/- | 2, 40, 000 |
| 2. Calf pen for 20 calves @ 20 sq ft/calf<br>400 sq ft @ Rs 400/- | 1, 20, 000 |
| 3. Two calving pens: 80 sq ft @ Rs 400/- | 24,000 |
| 4. Feed Store Room cum Office room @ 20 sq ft/cow<br>400 sq ft @Rs 400/ sq ft | 1, 60, 000 |
| 5. Water supply- One Tube well with 1 HP motor & pipeline | 1, 00, 000 |
| 6. Electrification | 10,000 |

| | |
|---|---|
| 7. Equipments such as bucket, milk canes, lactometer, milk measures spade etc. @ Rs 5000/- per cow | 20,000 |
| 8. One manually operated chaff cutter | 20,000 |
| 9. Animals : Cost of 20 CB cows with average milk yield of 10 lit/day @ Rs 35,000/cow with transportation charge (10 cows will be purchased initially and the 2nd batch of cows after 6 months) | 7, 00, 000 |
| **TOTAL** | **Rs 13, 94000** |

B. WORKING CAPITAL

| | |
|---|---|
| 1. Cost of feed for 10 cows @ 4 kg/cow/day for 1 month @ Rs **18**/kg= Total 1200 kg (4x10x30) x18 | 216000 |
| 2. Cost of dry fodder or straw @ 5 kg/cow/day for 1 month @ Rs 3/kg= Total 1500 kg (5x10x30) x3 | 4500 |
| 3. Cost of green fodder @ 20 kg/cow/day for 10 cows @ Re 1/kg= Total 6000 kg (20x10x30) x 1 | 6000 |
| 4. Veterinary Aid & Medicine | 1000 |
| **TOTAL** | **Rs 33,100** |

**TOTAL PROJECT COST:**

Capital cost + Working capital = Rs 13,94,000 + Rs 33,100 = **Rs 14, 27, 100**

**FUNDING PATTERN:**

1. Margin money to be provided by the entrepreneur @ 10 % of the total project cost Rs 1, 42,710
2. Capital investment subsidy @ 40% of the fixed capital(13,94,000) Rs 5,57,600
3. Term Loan by the bank Rs 14,27,100 - Rs 1,42,710 = Rs 12,84, 390/-
4. Bank loan repayable = bank loan – subsidy = Rs 12,84, 390 - Rs 5,57,600 = Rs 7, 26, 790

Interest is to be paid @ 13.5 % of the repayable bank loan availed from the bank. Duration of the loan repayment is within 5 years.

**ECONOMICS**

| **1st year Expenditure (feeding)** (Rs) | **Amount** |
|---|---|
| 1. Cost of Concentrates | |
| a. Feed during lactation days @ 4 kg/cow/day | |
| 1st batch cows 2500 days & 2nd batch 1800 days | |
| Total = 4300 days (@ Rs 18/ kg.) Hence, 17200 kg of feed.x18 | 3, 09, 600 |
| b. Feed during dry period @ 1.5 kg/cow/day | |
| 1st batch cows - 1150 days & 2nd batch nil. | |
| Total = 1150 days. Hence total feed is 1725 kg. x 18 | 31,050 |
| c. Feed for 20 calves @ 0.25 kg/day. | |
| 10calves×365 days×0.25kg=912.5 kg | 24,525 |
| 10calves×180 days×0.25kg=450 kg | |
| Total = 1362.5 kg@ Rs 18/kg | |
| d. Pregnancy ration 10x100days (after180days to 280days)x18 | 18, 000 |
| 2. Cost of Dry Fodder | |
| 1st batch: 2500 + 1150 = 3650 days | |
| 2nd batch: 1800days | |
| Total = 5450 days @ 5 kg/cow/day @ Rs 3/ kg | 81, 750 |
| 3. Cost of Green Fodder | |
| a. Cows: Total days = 5450 @ 20 kg/cow/day @ Re 1/kg | |
| Total = 109,000 kg | 1, 09, 000 |
| b. Calves: @ 5 kg/calf/day | |
| (5x10x365=18250) + (5x10x180=9000) = 27250 kg x Re 1/kg | 27, 250 |
| **TOTAL** | **Rs 6,01,175** |

**2nd year Expenditure (feeding)**

1. Cost of Concentrates
   a. Feed during lactation days 5250 (=2800+2450) days@ 4 kg/cow/day
      @ Rs 18/kg (5250x4x18) 3, 78, 000
   b. Feed during dry period of 2050(1200+850) days
      @ 1.5 kg/cow/day @ Rs 18/kg (2050x1.5x Rs18/kg) 55,350
   c. Feed for 20 calves for 365 days @ 0.5 kg/calf/day
      @ Rs 18/kg (20x365x0.5x18) 65,700
   d. Pregnancy ration: 20 cows × 1 kg × 100 days = 2000 kg
      @ Rs 18/kg 36,000
2. Cost of Dry Fodder
   20 cows × 365 days = 7300 days @ 5 kg/cow/day @ Re 3/kg 1, 09, 500
3. Cost of Green Fodder
   a. 20 cows × 365 days = 7300days x@ 20 kg/cow @ Re 1/kg 146,000
   b. 20 Calves for 365 days @ 5 kg/calf/day
      Total = 3650 days @ Re 1/kg (5x20x365x1) 36, 500

**Total** **8,27,050**

**INCOME & EXPENDITURE STATEMENT**

**Expenditure:**

| Particulars | 1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
|---|---|---|---|---|---|
| Lactation Days | 4300 | 5250 | 5250 | 5250 | 5000 |
| Dry Days | 1150 | 2050 | 2050 | 2050 | 2300 |
| Feed Cost during lactation | 3,09,600 | 3,78,000 | 3,78,000 | 3,78,000 | 3,60,000 |
| Feed cost during dry period | 55,350 | 55,350 | 55,350 | 55,350 | 62,100 |
| Feed cost for calves | 24,525 | 65,700 | 65,700 | 65,700 | 65,700 |
| Cost of pregnancy ration | 18,000 | 36,000 | 36,000 | 36,000 | 36,000 |
| Cost of dry fodder | 81,750 | 1,09,500 | 1,09,500 | 1,09,500 | 1,09,500 |
| Cost of green fodder for cows | 1,09,000 | 1,46,000 | 1,46,000 | 1,46,000 | 1,46,000 |
| Cost of green fodder for calves | 27,250 | 36,500 | 36,500 | 36,500 | 36,500 |

| Particulars | 1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
|---|---|---|---|---|---|
| Cost of 2 labour (Rs5000/month/labour) | 1,20,000 | 1,20,000 | 1,20,000 | 1,20,000 | 1,20,000 |
| Insurance @ 5 % of Rs 7,00000 | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 |
| Vety. Aid & medicine | 20,000 | 22,000 | 22,000 | 22,000 | 22,000 |
| Electricity Bill | 10,000 | 11,000 | 11,000 | 11,000 | 11,000 |
| Repairs | ---- | 4,000 | 5,000 | 5,000 | 5,000 |
| **TOTAL** | **8,10,475** | **10,19,050** | **10,20,050** | **10,20,050** | **10,08,800** |

**Receipts:**

| Particulars | 1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
|---|---|---|---|---|---|
| Milk yield @ 10 litres/cow/day | 43,000 | 52,500 | 52,500 | 52,500 | 50,000 |
| Sale of Milk @ Rs 30/lit | 12,90,000 | 15,75,000 | 15,75,000 | 15,75,000 | 15,00,000 |
| Manure @ Rs.800/tonne | 48,000 | 64,000 | 64,000 | 64,000 | 64,000 |
| Gunny Bags @ Rs 8/bag(50kg) | 3,408 | 4,760 | 4,760 | 4,760 | 4,656 |
| Sale of Calves | 15,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| **TOTAL** | **13,56,408** | **16,73,760** | **16,73,760** | **16,73,760** | **15,98,656** |

**PROFIT& LOSS STATEMENT**

| NO | Particulars | 1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
|---|---|---|---|---|---|---|
| A | Receipt | 13,56,408 | 16,73760 | 16,73760 | 16,73760 | 15,98,656 |
| B | Recurring Expenditure | 8,10,475 | 10,19,050 | 10,20,050 | 10,20,050 | 10,08,800 |
| C | Gross Surplus(A-B ) | 5,45,933 | 6,54,710 | 6,53,710 | 6,53,710 | 5,89,856 |
| D | Loan amount | 7,26,790 | 6,17,771 | 4,72,413 | 3,27,055 | 181697 |
| E | Interest( 13.5% ) | 98,117 | 83,399 | 63,776 | 44,152 | 24,529 |
| F | Net surplus( C-E ) | 4,47,816 | 5,71,311 | 5,89,934 | 6,09,558 | 5,65,327 |
| G | Loan paid | 1,09,019 | 1,45,358 | 1,45,358 | 1,45,358 | 1,81,697 |
| H | Surplus with the farmer / year ( F – G ) | 3,38,797 | 4,25,953 | 4,44,576 | 4,64,200 | 3,83,630 |
| I | Profit/month | 28,233 | 35,496 | 37,048 | 38,683 | 31,969 |
| j | Profit/cow/month | 1412 | 1775 | 1852 | 1934 | 1598 |

**Analysis of Dairy Project** (Capital Cost Rs. 15,67,000)

| | | 1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year | Total |
|---|---|---|---|---|---|---|---|
| I | Total cost | 2289763 (1567000+722763) (NRE + RE) | 932175 RE | 933175 RE | 933175 RE | 923800 RE | 60,12,088 |
| II | Total benefit | 11,41,408 | 14,11,260 | 14,11,260 | 14,11,260 | 13,48,656 | 67,23,844 |
| III | DF (Discounting Factor)@ 15% | 1/(1+r) 0.870 ( 1/1.15) | $1/(1+r)^2$ 0.756 $( 1/1.15)^2$ | $1/(1+r)^3$ 0.658 $(1/1.15)^3$ | $1/(1+r)^4$ 0.572 $(1/1.15)^4$ | $1/(1+r)^5$ 0.497 $( 1/1.15)^5$ | r = rate of margin money |
| IV | Discounted cost at 15 % (I x III) | 1992093.81 **2289763 x 0.870** | 704724.3 **932175 x 0.756** | 614029.15 **933175 x 0.658** | 533776.1 933175 x 0.572 | 459128.6 923800 x 0.497 | **43,03,752** |
| V | Discounted benefit at15% (II x III) | 993024.96 **11,41,408 x 0.87** | 1066912.56 **14,11,260** | 928609.08 **14,11,260** | 807240.72 **14,11,260** | 670282.032 **13,48,656** | **44,66,069** |
| VI | NPW (Net Project Worth) 15% | **1,62,317 (44,66,069 -43,03,752 )** | NPW= Total sum of discounted benefit at 15%- Total sum of discounted cost at 15% | | | | |
| VII | BCR ( Benefit Cost Ratio) | **1.04:1 (44,66,069/43,03,752)** | BCR= Total sum of discounted benefit at 15% / Total sum of discounted cost at 15% | | | | |
| VIII | DF @50% | 0.667 1/(1+0.5) | 0.444 $1/(1+0.5)^2$ | 0.296 $1/(1+0.5)^3$ | 0.198 $1/(1+0.5)^4$ | 0.132 $1/(1+0.5)^5$ | |
| IX | Net Benefit (Total benefit- Total cost) (II-I) | **-11,48,355** (11,41,408 - 2289763) | **4,79,085** (14,11,260-932175) | **4,78,085** (14,11,260-933175) | **4,78,085** (14,11,260-933175) | **4,24,856** (13,48,656-923800) | |
| X | Discounted Net Benefit at 50% (VIII x IX) | -765952.785 (-213352 x0.667) | 212713.74 (154612 x0.444) | 141513.16 (153612 X0.296) | 94660.83 (153612 x0.198) | 56080.992 (134550 x0.132) | -2,60,984 |
| XI | IRR | >50% | If total sum of discounted net benefit at 50% is less than Total sum of discounted cost at 15%, then IRR>50% (-260984<4303752) | | | | |

According to the norms of NABARD, the dairy project will be viable as

1 Total benefit > Total cost i. e. **67,23,844** >**60,12,088**

2 Total discounted benefit at 15% > capital cost (**44,66,069**>**1567000** )

3 BCR >1

4 IRR >50% (-260984<4303752)

The above dairy project is viable due to satisfying above four criteria

**Scheme for a Goat Farm** (100 Black Bengal Does and 5 Black Bengal Bucks):

- The farm has to be located near a forest area providing enough browsing and grazing facilities. No concentrate feeds will be fed to the goats.
- The goat shed has to provide a floor space of 8 Sq.ft/doe, 12 Sq.ft/buck with a dry kuchha floor, thatched roof with wooden partition walls for bucks and does.
- It is envisaged that, the does will kid thrice in two years with an average of 1.5 kids per kidding. The rage of mortality among kids and does have been considered to be about 20% and 5% respectively.
- The old does may be replaced in 2 lots, one in the 4$^{th}$ year and the second lot during the 5$^{th}$ year replacing 50 does each time.
- The sale of progenies is to be made at the age of about one year at an average of R.1500/- per progeny irrespective of sex. It is expected that, the higher price for castrated male goats will help in leveling the price of both female and male progenies at an average saleable price of Rs.1500/- per animal. The disposal of old does may be made @ Rs.1500/- per doe.
- In order to make the scheme feasible, the enterpriser needs to be provided with full amounts of both non-recurring and recurring expenses of the first year as loan from the bank with 12.5% interest per year. The depreciation charge will be @ 20% per year on the total amount of non-recurring expenditure.
- The repayment of loan will start from the second year. Full clearance of the interest and principal loan will be made by the end of the 5$^{th}$ year.

**TABLE-1**

**Non-recurring Expenditure:**

| Sl. No. | Particulars | Amount in Rs. |
|---|---|---|
| 1 | Cost of 100 does with transportation @ Rs.3,000/- each | 3,00,000/- |
| 2 | Cost of 5 bucks with transportation @ Rs.5,000/- each | 25,000/- |
| 3 | Construction cost of goat shed @ Rs.160 per Sq.ft (100 X 8 + 5 X 12) = 860 Sqft X Rs.160 | 1,37,600/- |
| | **Total :** | **4,62,600/-** |

**TABLE-2**

**Recurring Expenditure for 5 Years:**

| Sl. No. | Particulars | Amount in Rs. |
|---|---|---|
| 1 | One Attendant @ Rs.3,000/- per month<br>Rs.3,000 X 12 months = Rs.36,000/-<br>Rs.36,000 X 5 years | 1,80,000/- |
| 2 | Contingency @ Rs.5000/- per year<br>Rs.5000 X 5 | 25,000/- |
| 3 | Veterinary expenses @ Rs.30/- per animal per year (Rs.30 X 105 animals = Rs.3150)<br>Rs.3150 X 5 years | 15,750/- |
| 4 | Insurance @ 4% per year per animal<br>Rs.3,00,000 + Rs.25,000 = Rs.3,25,000/-<br>Rs.3,25,000 X 0.04 | 65,000/- |
| 5 | Depreciation @ 20% on Rs.4,62,000 = Rs.92,520/- (Rs.92,520 X 5) | 4,62,600/- |
| 6 | Interest @ 12.5% | 232325/- |
| | **Total :** | **9,80,675/-** |

**TABLE-3**

**Animal Chart:**

| Particulars | 1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year | At the end of 5th Year |
|---|---|---|---|---|---|---|
| No. of does | 100 | 95 | 90 | 85 | 100 | 100 |
| No. of bucks | 5 | 5 | 5 | 5 | 5 | 5 |
| No. of kidding | 1 | 2 | 1 | 2 | 1 | -- |
| No. of progenies | 150-30=120 | 285-57=228 | 135-27=108 | 225-51=204 | 150-30=120 | 120 |
| No. of kids retained for stock replacement | -- | -- | 50 | 50 | -- | -- |
| No. of progeny sold | -- | 120 | 228 | 58 | 146 | -- |
| No. of old doe sold | -- | -- | -- | 50 | 35 | -- |

**TABLE-4**

**Receipts:**

***(Amount in Rs.)***

| Year | Sale Proceeds of progenies | Sale proceeds of old does | Sale proceeds of manure | Total |
|---|---|---|---|---|
| 1st | -- | -- | 3,000/- | 3,000/- |
| 2nd | 3,00,000/- | -- | 3,000/- | 3,03,000/- |
| 3rd | 5,70,000/- | -- | 3,000/- | 5,73,000/- |
| 4th | 1,45,000/- | 1,50,000/- | 3,000/- | 2,98,000/- |
| 5th | 3,65,000/- | 1,05,000/- | 3,000/- | 4,73,000/- |
| Cost of stock at hand Rs.1500/- per progeny and Rs.2500/- per doe | 1,80,000/- | 2,50,000/- | -- | 4,30,000/- |
| **Total :** | **15,60,000/-** | **5,05,000/-** | **15,000/-** | **20,80,000/-** |

**TABLE-5**

**Repayment of Loan :**

Depreciation amount will be utilized for payment of capital money.

***(Amount in Rs.)***

| Year | Interest Paid | Depreciation Paid | Principal Loan Paid | Total |
|---|---|---|---|---|
| 1st | -- | -- | -- | -- |
| 2nd | @12.5% of Rs.5,19,750 = 1,29,938 for 2 years (64,969 X 2) = 1,29,938/- | 20% of 4,62,600 = 92,520 | -- | 2,22,458/- |
| 3rd | Rs.5,19,750 – 92,520 = 4,27,230 X 12.5% = 53,404 | 40% of 4,62,600 = 1,85,040 | -- | 2,38,444/- |
| 4th | Rs.4,27,230 – 1,85,040 = 2,42,190 X 12.5% = 30,274 | 92,520 (20%) | -- | 1,22,794/- |
| 5th | Rs.2,42,190 – 92,520 = 1,49,670 X 12.5% = 18,709 | 92,520 (20%) | 1,49,670 – 92,520 = 57,150 | 1,68,379/- |
| **Total :** | **2,32,325/-** | **4,62,600/-** | **57,150/-** | **7,52,075/-** |

**NB :** Total amount of loan obtained in 1st year =

4,62,600 + 36,000 + 5,000 + 3,150 + 13,000 = Rs.5,19,750/-

i) Total receipt in 5 years = Rs.20,80,000/-

ii) Total liabilities in 5 years = 9,80,675 + 57,150 = Rs.10,37,825/-

iii) Total profit – Rs.10,42,175/-

**Source :** 1. APICOL (APEDA)

# Augmenting Production in Dairy Cattle and Buffalo Through Nutritional Intervention

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## Introduction

Income of arable farming is insufficient to meet the need of the rural household. Dairying assumes critical importance in supplementing the income of rural farmers. Ruminants have the ability to convert inedible low digestibility plant material to high quality edible food product. As per 2012 census, India posses 48.12 million indigenous milch cattle, 19.42 million exotic milch cattle and 51.05 million milch buffalo. India ranks first in milk production accounting for 18.5% of world production, achieving an annual output of 146.3 million tones during 2014-15 as compared to 137.69 million tonnes during 2013-14 recording a growth of 6.26%. Whereas, FAO has reported 3.1% increase in world milk production from 765 million tones in 2013 to789 million tones in 2014.The Per capita availability of milk in India has increased from176 g/day in 19990-91 to 322g/day by 2014-15. It is more than the world averages of 294g/day in 2013.

As per 2012 census, Odisha posses 10.31 million indigenous cattle, 1.31 million cross bred cattle and 0.726 million buffalo. Over the two decades, ending in 2014-15, milk production in Odisha has increased from 5.8 lakh metric tonnes (LMT) in 1994-95 to 19.0 LMT exhibiting a annual growth rate of 6.4 per cent. Milk production in the districts of Malkangiri, Koraput, Jajapur, Debagarh, Subarnapur and Baleshwar is rapidly growing at a rete of 10 per cent or higher. However, six districts of Cuttack, Puri, Ganjam, Jagatsinghapur, Baleshwar and Jajapur remain major milk sheds accounting for 40 per cent of states milk production. Specie-wise, the milk production in Odisha is cattle based and the share of buffalo milk is merely 1 5percent in total production. Regarding utilisation, the dairy farmers in the State retain only 25 per cent of the milk at household level, sell about 60 per cent as fluid milk and convert only 18 per cent of the milk into value added dairy products. Though the milk production is encouraging, the production potential of majority of superior livestock remains unexploited. There are several constraints to milk production such as poor nutrition and limited management. This paper briefly describes nutritional constraints and suggests the nutritional approaches for enhancing the milk productivity.

## Background for lower milk production

Most of the feeds available for feeding of animal consist of crop residues, grasses, tree leaves. There is limited availability of good quality forage which leads to lower production capacity because of imbalance of nutrients and low digestibility of the available feed. The primary constraint to milk production is an inefficient utilisation of feed because of deficiency of critical nutrient in the diet. The deficient nutrient may be essential for the growth of rumen microbes which ferment the feed as well as those required to balance the protein to energy ratio.

Dairy cows undergo tremendous adaptive changes during transition period from late gestation to early lactation. During last 3 week of pregnancy nutrient demand by foetal calf and placenta is at maximum level (Bell, 1995), but dry matter intake may be decreased by 10-13% as compared with the intake during early dry period. After calving the initiation of milk synthesis and rapidly increasing milk production increase the demand for glucose for lactose synthesis, but dry matter intake is lower at that time. The cow mobilises its body reserve and looses weight that is cow is in negative energy balance. The physiological and pathological changes associated with negative energy balance are ketosis, displaced abomasum and retained placenta (Duffield et al, 2002) and may impair the immune system and there is increase incidence of infectious disease such as mastitis and metritis ( Kremer *et al.* ,1993). After calving there is heavy drainage of calcium from the body through milk, at that time animal is unable to maintain normal serum calcium level. This leads to fall in serum calcium level in cows and the animal suffers from milk fever. These following situation decreases the milk production in animals and causes severe looses in dairy farming.

**Approaches for improvement of production performance**

**Feeding strategy in early lactation**

It is usually refers to the first 100days of lactation. At the beginning of this phase, cow will achieve peak milk production but feed intake is lower. So cows loose body weight. At the end of early lactation, peak dry matter will be achieved no weight loss occur. Feed intake is an important factor for maintenance of high milk production. Animals should be encouraged to maximise their dry matter intake during early lactation and mid lactation to maintain peak milk production as long as possible. Each additional kg of dry matter consumed can support 2-2.4 kg more milk. Maintaining good rumination is essential in early lactation. It is important to feed at least 40% of the dry matter as forages. About half of the forages should have a particle length of 2.6 cm to effectively stimulate chewing. High quality forages should be fed during this period to improve dry matter intake. Fresh feed should be always available in the feeding trough to encourage feed consumption. During early lactation the level of neutral detergent fibre and acid detergent fibre should be 28 and 19% to maximise feed intake. To avoid digestive problems, concentrates should be provided @ 0.5-0.7 kg/day for the first weeks. Protein is critical during early lactation as the amount of body protein that can be metabolized is very limited compared with body fat. Thus dietary protein should be 17-19%. About 30-35% protein should be ruminally undegraded while 30% should be soluble protein.

1. Concentrate should be fed several times of a day.
2. Feed should be available to the animal at least 20 hours per day.
3. Forage should be checked to ensure it contains enough long fibre.
4. Protein supplement should be fed along with energy supplement which results in higher milk fat percentage than feeding them separately.

**Mid lactation**

Mid lactation period is the period from day 100 to 200 after calving. At the beginning of this phase, cows will have achieved peak production. Peak dry matter intake has also occurred. So there is no weight loss. Main target during this period is to maintain peak milk production as long as possible. For each extra kg of milk at peak production, the average cow will produce 200-225 kg more milk for entire lactation. Thus the main strategy during mid lactation is to maximise dry matter intake. Animal should be fed high quality forages and the level of effective fibre should be maintained as that of early lactation. Concentrates should not be more than 2.3% of the body wt. Protein requirement in the mid lactation is lower than early lactation that is 15-17%.

**Strategies to enhance milk production**

**Treatment of crop residues to improve digestibility**

Local feed resources particularly agricultural crop residues are commonly used as roughages for feeding of dry cow in tropics ( Wanapat *et al.,* 2012). Rice straw is abundantly available throughout the year in large quantity. The treatment of crop residues with alkalis to improve digestibility is a well researched and established technique. Urea treatment of crop residues increases the nitrogen content as well as intake (Tuen *et al*., 1991) and rate of digestion (Ibrahim *et al*., 1989), volatile fatty acid ( propionic acid ) production and milk production ( Gracia- Martinez *et al*., 2009). Glucose is important for milk synthesis (Rigout *et al*., 2003). Urea treated straw provide energy and protein source to rumen in the form of propionic acid and microbial protein. So there is improvement of milk synthesis efficiency and milk yield. Molasses is also used for feeding of animal along with urea. This method provides nitrogen and readily available source of energy to the rumen microbes to utilise urea.

**Bypass nutrients**

Bypass nutrients are the nutrient fractions, which get fermented at a lower degree in the rumen and become available at the lower part of the gastrointestinal tract for subsequent digestion and absorption. Bypass nutrients provide a steady supply of nutrients instead of sudden burst from soluble nutrients (Walli *et al.,*1995). If such feed nutrients are allowed to degrade in the rumen to a limited extent, it is possible to increase the net nutrient availability to host animal for milk production and growth.

**Bypass starch**

Starch is hydrolysed to glucose in the rumen by the action of amylase enzyme. Glucose is then converted to various volatile fatty acids via lactic acid. If starch is enzymatically digested in the abomasum then more glucose can be made available to the animal. This has been shown by treating the starch with sodium hexametaphosphate at alkaline pH (Choo *et al.,*1991). The natural sources of bypass starch such as corn grain, rice polish *etc.* should be used especially in the ration of high yielding animals.

**Bypass protein**

Ruminal microbes don't provide adequate protein for meeting the nutrient requirement of the mammary gland for milk production. Major portion of the good quality dietary protein

must escape ruminal degradation and pass to abomasum and small intestine to supply sufficient amounts of amino acids. Therefore, dietary proteins should be fractioned into rumen degradable protein (RDP) and undegradable dietary protein (UDP). Feed should be formulated in such a way that it is able to provide 60 percent UDP of the total CP in the diet which helped significantly in improving milk production in cows fed on crop residue based diet (Walli *et al.,*1994). Chatterjee and Walli (2003) has studied the effect of formaldehyde treated mustard cake on milk yield and milk composition in Murrah buffaloes and reported that daily yield of milk protein, fat, SNF was higher and feed cost was lower. Chandrasekharaiah *et al*.(2008) revealed that feeding of bypasss protein is beneficial even in medium yielding animal.

**Bypass fat**

Animal has limited ability to maintain positive energy balance during early lactation which causes metabolic stress on animal (Bell,1995).This results in metabolic disorder and suboptimal milk production (Drackley, 1999). With limited dry matter intake the energy intake of animal can be enhanced by making diet energy dense through incorporation of fat. Bypass fat due to their inertness in rumen can be supplemented at a higher level than active fat. As fatty acids are absorbed directly from lower intestine, it is easy to modify fatty acids profile of milk. Effect of Ca-LCFA (bypass fat) on milk yield and FCM yield is more in primiparous cows than multiparous cows (Sklan *et al.,*1994) and more in early and peak lactation.(Schneider *et al.,*1988).

**Maintenance of ruminal health**

In order to satisfy the energy requirements of lactating animals, we have to maintain the ruminal pH and microbial health. If there is an imbalance or inadequate diet, particularly with regard to its energy and long fibre content, it might lead to subacute ruminal acidosis resulting in decreased milk production. The balance of normal rumen fermentation is not only influenced by the supply of nutrients available for fermentation but also by the physical form of roughages (Martens, 1997). An adequate amount of physical fibre is essential in maintaining proper rumen function and avoiding the risk of metabolic disorder and suppression of fibre digestion (Bhandari *et al*., 2008). Ruminants require a long form of roughage fibre ( NRC, 2001) which is useful for maintenance of normal rumen function and has been associated with adequate salivation, optimal rumen pH for microorganisms and energy supply ( Yang *et al.,* 2001). About half of the forages should have a particle length of 2.6 cm to effectively stimulate chewing. Feeding frequency should be increased to avoid daily variation in the rumen pH which helps in stabilising the rumen environment. Rumen buffer plays an important role in nutrition of high yielding animal as they are fed large quantity of concentrate which results in low rumen pH, acidosis, increase propionate production, depression in crude fibre digestibility and in milk fat percentage.

**Amelioration of anoestrous in buffalo/cattle**

Anestrus is one of the most commonly occurring reproductive problems in cattle and buffalo in India, affecting livestock productivity and economics to a great extent. High milk production and excellent fertility are desirable traits for a profitable dairy enterprise. Infertility due to cyclicity failure or anestrus means a loss in milk production and profitability from dairy farming (Prasad and Gowda, 2005). Efforts should be made to improve fertility in

dairy animal by reducing inter calving period and curing anaestrous through supplementation of vitamins and minerals (Garg *et al.,* 2005). Supplementation of trace minerals in the form of chelates along with fat soluble vitamin A, $D_3$ and E prevent the occurrence of anoestrous or repeat breeding in farm animals. Minerals play a vital role to augment production and reproduction of farm animals and their deficiencies cause impairment of body function (Coarch, 1996). Green fodders, ad libitum water and mineral mixture should be given to increase efficiency of reproduction.

**Reduce the risk of metabolic diseases**

Low blood calcium (< 8.0 mg/dl) or hypocalcemia during the first week of lactation is correlated with milk fever, elevated somatic cell count, delayed uterine involution, metritis, depressed feed intake, and reduced milk yield. Milk fever is an important diseases of high yielding animals which cause sever economic losses. The nutritional strategy to prevent occurrence of milk fever are divided into three parts;

1. Low calcium strategy- This works by ensuring that the dairy cow is mobilising calcium so when they are switches to milk production.
2. Dietary cation anion balance strategy- Normally the rations fed to herbivores have lower dietary cation anion value which is evidenced by alkaline urine. The calcium looses in alkaline urine is low and animals suffer from milk fever. The acidifying diet fed to the animal before calving will increase ca loses through urine and this ca lose enhances ca absorption and prevent predisposition of milk fever.
3. Drenching/pasting commercial ca preparation- The best result is obtained if the first dose is given before calving with a second dose 24hours later.

**Reference**

Bell, A.W. 1995. Regulation of organic nutrient metabolism during transition from late pregnancy to early lactation. *Journal of Animal Science*, **73:** 2804-2819.

Bhandari, S.K., Li, S., Ominski, K.H., Wittenberg, K.M and Plaizier, J.C. 2008. Effects on the chop lengths of alfalfa silage and oat silage on feed intake, milk production, feeding beahiour, and rumen fermentation of dairy cows. *Journal of Dairy Science*, **91:** 1942-1958.

Chandrasekharaiah, M. and Sampath, K.T. and Praveen, U.S. 2008. Effect of feeding bypass protein on milk production performance in cross bred cows. *Indian Journal of Animal Science,* **78:** 527-530.

Chatterjee, A. and Walli, TK. 2003. Economics of feeding formaldehyde treated mustard cake as protein source to growing buffalo calves. *Indian Journal of Dairy Science* **56(6):** 241-244.

Choo. B.S.,Leng. R.A., and GARG, M.R. 1991.Report of NOOB-ACIAR collaborative research project, NDDB, Anand

Corah, L.R. 1996. Trace mineral requirement in grazing cattle. *Animal Feed Science and Technology*, 59: 61-70.

Drackley, J.K. 1999. Biology of Dairy Cows During the Transition Period: the Final Frontier?, *Journal of Dairy Science*, **82:** 2259-2273.

Duffield, T., Bagg, R., Descoteaux, L., Bouchard, E., Brodeur, M., Dutremblay, D., Keefe, G., Leblanc, S. and Dick, P. 2002. Prepartum monensin for the reduction of energy associated disease in post partum dairy cows. *Journal of dairy science*, **85:** 397-405.

Garcia-Martinez, A., Albarran-Portillo, B., Castelan-Ortega, O.A., Espinoza-Ortega, A., Arriaga-Jordan, C.M. 2009. Urea treated maize straw for small-scale dairy systems in the highlands of Central Mexico. *Tropical Animal Health Production,* **41:** 1487-1494.

Ibrahim, M.N.M., Tamminga, S. and Zemmelink, G.1989. Effect of urea treatment on rumen degradation characteristics of rice straw. *Animal Feed Science Technology,* **24:** 83-95.

Kremer, W.D.J., Noordhuizen-Stassen, E.N., Grommers, F.J., Schukken, Y.H., Heeringa, R., Brand, A. and Burvenich C. 1993. Severity of experimental Escherichia coli mastitis in ketonemic and non ketonemic dairy cows. Journal of Dairy Science, **76:** 3428-3436.

Mertens, D.R. 1997. Creating a system for meeting the fibre requirements of dairy cows. Journal of Dairy Science, **80:** 1463-1481.

NRC. 2001. Nutrient requirements of dairy cattle. 7th revised edition. National research council editor. National academy of science; Washington, DC, USA.

Prasad, C.S. and Gowda N.K.S. 2005. Dietary level and plasma concentration of micronutrients in cros bed dairy cows fed finger millet and rice straw as dry roughages source. Indian Journal of Dairy Science, **58:** 109-112.

Rigout, S., Hurtaud, C., Lemosquet, S., Bach, A. and Rulquin H. 2003. Lactational effect of propionic acid and duodenal glucose in cows. Journal of Dairy Science, **86:** 243-253.

Schneider, P., Sklan, D., Chalupa, W. and Kronfeld, D.S. 1988. Feeding calcium salts of fatty acids to lactating cows. Journal of Dairy Science, **71:** 2143-2150.

Sklan, D., Kaim, M., Moallam, U. and Folman, Y. 1994. Effect of dietary calcium soaps on milk yield, body weight, reproductive hormones, and fertility in first parity and older cows. *Journal of Dairy Science*, **77:** 1652-1660.

Tuen, A.N., Dahan, M.M., Young, B.A, Vijchulatha, P. 1991. Intake and digestibility of urea treated, urea supplemented rice straw by goats. *Animal Feed Science Technology,* **32:** 333-340.

Walli, T.K. 1995 Bypass protein of some feed ingredients and the optimum level of RDP/UDP ratio in the diet for optimisation of milk production in dairy cattle. Report submitted under NDDB- NDRI Technology Mission Project.

WALLI, T.K. (1994).Bypass protein value of some feed Ingredients and the optimum RDP/UDP ratio in the diet for optimization of milk production in dairy cattle. Report of NDDB-NORI collaborative project, pp. 23.

Wanapat, M., Pilajun, R., Kang, S., Setyaningsih, K., Setyawan, A.R.(20120Effect of ground corn cob replacement for cassava chip on feed intake, rumen fermentation and urinary derivatives in swamp buffaloes. *Asian-Australian Journal of Animal Science,* **25:** 1124-1131.

Yang, W.Z., Beauchemin, K.A. and Rode, L.M. 2001. Effects of grain processing, forage to concentrate ratio, and forage particle size on rumen pH and digestion by dairy cows. Journal of Dairy Science, **84:** 2203-2216.