2022
EDITION

EDITED BY
Dr. Parkash Singh Brar
Dr. Shahaji Phand
Dr. Jaswinder Singh
Dr. Arunbeer Singh
Dr. Sushrirekha Das

Imparting Skill among Youth for Scientific Rearing of Livestock

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana
&
National Institute of Agricultural Extension Management (MANAGE), Hyderabad

GADVASU, Ludhiana & MANAGE,
Hyderabad

Imparting Skill among Youth for Scientific Rearing of Livestock

Programme Coordination

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab

Jointly Published By

Directorate of Extension Education,
GADVASU, Ludhiana, Punjab
&
MANAGE, Hyderabad

Imparting Skill among Youth for Scientific Rearing of Livestock

Editors: Dr. Parkash Singh Brar, Dr. Shahaji Phand, Dr. Jaswinder Singh, Dr. Arunbeer Singh, Dr. Sushrirekha Das

ISBN: 978-93-91668-15-0

Citation: Dr. Parkash Singh Brar, Dr. Shahaji Phand, Dr. Jaswinder Singh, Dr. Arunbeer Singh, Dr.Sushrirekha Das (2022). Imparting Skill among Youth for Scientific Rearing of Livestock [E-book]. Hyderabad: Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana & National Institute of Agricultural Extension Management, Hyderabad, India.

This e-book is a compilation of resource text obtained from various subject experts of GADVASU, Ludhiana & MANAGE, Hyderabad, on "Imparting Skill among Youth for Scientific Rearing of Livestock". This e-book is designed to educate extension workers, students, research scholars, academicians related to veterinary science and animal husbandry about the value addition of livestock products and their potential in creatingentrepreneurial opportunities. Neither the publisher nor the contributors, authors and editors assume any liability forany damage or injury to persons or property from any use of methods, instructions, or ideas contained in the e-book. No part of this publication may be reproduced or transmitted without prior permission of the publisher/editors/authors. Publisher and editors do not give warranty for any error or omissions regarding the materials in this e-book.

Published for Dr.P.Chandra Shekara, Director General, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, India by Dr. Srinivasacharyulu Attaluri, Program Officer, MANAGE and printed at MANAGE, Hyderabad as e-publication.

MESSAGE

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

In India, livestock products contribute widely to the livelihood of the masses. Apart from domestic consumption, export of these products is contributing to National income. However, potential of value addition and processing of livestock products, particularly, milk, meat and egg has not been realized to its maximum and there is a dire need to push entrepreneurial outlook amongst youth through channel of value addition. It will help them in establishing themselves in a much better way and they can be job creators than job seekers. Further, this would help in increasing their income beyond regular direct sale to market.

It is a pleasure to note that, SAU- Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab and MANAGE, Hyderabad, Telangana is organizing a collaborative training program on “Imparting Skill among Youth for Scientific Rearing of Livestock” from 18-20 May, 2022 and coming up with a joint publication as e-book on “Imparting Skill among Youth for Scientific Rearing of Livestock” as immediate outcome of the training program.

I wish the program be very purposeful and meaningful to the participants and also the e-book will be useful for stakeholders across the country. I extend my best wishes for success of the program and also I wish SAU- Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab many more glorious years in service of Indian agriculture and allied sector ultimately benefitting the farmers. I would like to compliment the efforts of Dr. Shahaji Phand, Center Head-EAAS, MANAGE and the Director, SAU-GADVASU, Ludhiana for this valuable publication.

Dr. P. Chandra Shekara
Director General, MANAGE

FOREWORD

India with 1.3 billion people is the second most populous country in the world. With more than 50% population under the age of 35 years, it is also one of the youngest populations globally. Tackling such a huge young population in term of education, employment, and livelihood security is a very daunting task. It is practically impossible for the government to provide Govt. jobs to everyone. At this juncture, need of the hour is to divert the focus of youth towards self-employment and entrepreneurial ventures. Livestock industry including dairy, poultry, goatry, etc is one of the oldest industries in the country and most of the rural youth are well versed with livestock farming. We need to ignite the entrepreneurship skills in the youth through sensitization them about status and scope of livestock farming in the country.

GADVASU has always been on forefront in providing knowledge and training on livestock farming and related activities to the young entrepreneurs and farmers. I am really delighted that our university is conducting a free online training program on "*Imparting Skill Among Youth For Scientific Rearing of Livestock*" for the Extension officials of state/central animal husbandry departments, veterinarians, faculty of SAUs/KVKs/ICAR institutes, etc. from 18-20 May, 2022 in Collaboration with MANAGE, Hyderabad. The lectures of this online course are designed to apprise the participants to various avenues in livestock and related sectors and their scope for entrepreneurship. I hope that the participants from different parts of the country will be immensely benefitted from this online course by interactions with the expert resource persons selected for this training.

The compendium for the above said training programme has been designed to provide firsthand knowledge to the readers. I wish participants will have a fruitful and informative interaction.

Dr. Parkash Singh Brar
Director of Extension Education,
GADVASU, Ludhiana

PREFACE

This e-book is an outcome of collaborative online training program on **"Imparting Skill among Youth for Scientific Rearing of Livestock"** conducted from 18-20 May, 2022. This e-book is intended is to provide insights to all extension workers, faculties, researchers and students about the scientific rearing of Livestock. The readers shall get latest information on dairy, poultry, goat farming, feed manufacturing, silage /mineral mixture/uromin lick and bypass fat making, value addition of milk etc. This information will help them to develop entrepreneurial skills among youth.

The potential of livestock farming and its allied activities remains untapped. Now realizing the enormous potential of livestock sector, the Govt is also promoting livestock and allied activities based entrepreneurship for youth through various schemes and modules. There is a dire need to attract unemployed youth towards self-employment and entrepreneurial ventures. This will help them in earning their livelihood and also stop brain drain to developed countries in search of greener pastures.

The editors thank all the resource persons for devoting their time to develop this resource material. They also express gratitude MANAGE, Hyderabad for the financial support to the training program. The editors are thankful to the Honorable Vice-Chancellor, GADVASU Ludhiana, Dr. Inderjeet Singh for the constant encouragement forthis training and e-book creation for the participants. The editors hope that this e-book will help participants as well as other extension people across the country to gain valuable information on livestock rearing and value addition.

The valuable suggestions for future improvements are always welcome.

Dr. Parkash Singh Brar
Dr. Shahaji Phand
Dr. Jaswinder Singh
Dr. Arunbeer Singh
Dr. Sushrirekha Das

CONTENTS

Chapter 1

FACILITIES PROVIDED BY GADVASU FOR BUDDING ENTREPRENEURS

Parkash Singh Brar and Jaswinder Singh

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab

---

Guru Angad Dev Veterinary and Animal Sciences University, was established in 2005 and started functioning from April 2006. Main aim of establishing this university was to provide adequate professionals of veterinary science and allied sectors. To begin with there was only one college, College of Veterinary Science, which was established in 1969 as a constituent college of Punjab Agricultural University. Looking at demand of the state this college was upgraded to a University and College of Fisheries and College of Dairy Sciences and Technology were added in year 2008. Later on School of Animal Biotechnology was also upgraded to College of Animal Biotechnology. Another College of Veterinary Science started functioning in year 2019 at Rampura Phool in District Bathinda. These colleges are offering Bachelor's, Master's and Doctorate degrees in veterinary sciences, fishery sciences, dairy sciences and animal biotechnology apart from a number of short courses, certificate courses and diplomas. These courses make the students ready for international market and inculcate skills in them to become entrepreneur.Veterinary Polytechnic College at Village Kaljharaniin district Bathinda was opened to offer diploma in Veterinary Science and Animal Health Technology in 2010.

Many years back, students were taking admission in Universities to secure Govt. jobs. Scenario has changed now; youngsters have to think of starting their own venture. There is lot of scope in livestock sector; one can go for faming of various species of livestock, milk and meat processing, animal feed manufacturing, marketing etc. Under programmes sponsored by Indian Council of Agricultural Research like Rural Awareness Work Experience, Experiential Learning, Institutional Development Plan students are given required knowledge, skills through hands on training while working in different sectors. The aim of such programmes is to make them job providers rather than job seekers.

- **To Spread Awareness About Livestock Sector:**

The youngsters who are unable to get admission in livestock related professional courses are imparted skills by the university through various modes. Most important is to make people aware about opportunities in livestock sector. Many well-educated people are unaware about contribution of livestock sector to national and state GDPs, mechanization of various operations, processing and marketing of products. Guru Angad

Dev Veterinary and Animal Sciences University (GADVASU) has three Krishi Vigyan Kendras (KVKs) and four Regional Research and Training Centers (RRTCs) under its administration, evenly distributed in the state. Apart from these outreach centers, the University works in close collaboration with line departments such Punjab Agricultural University (PAU), State Animal Husbandry Department, State Dairy Development Department, State Fisheries Department, Cooperative societies (Milkfed, Markfed, IFFCO etc), Banking Sector, Agricultural Technology Application Research Institute (ATARI), Punjab Agricultural Management and Extension Training Institute (PAMETI), certain NGO's etc to spread awareness, motivation, capacity building and hand holding of farmers. Fortunately, GADVASU, PAU, ATARI, PAMETI, CIPHET are situated close by in same campus, which helps farmers to gain more knowledge in single visit.

The University tries to spread awareness through various methods such as:

(a) *Pashu Palan Melas*: Two Pashu Palan Melas are organized at the main campus in months of March and September every year along with Kisan Melas of Punjab Agricultural University. Due to COVID from September 2020, these have been held in virtual mode. All new technologies developed by the University are demonstrated in these melas. Thronged by lacs of farmers, many inputs developed by both the Universities and private companies are sold in these melas. Regional melas are organized at KVKs and RRTCs for farmers who are unable to travel to main campus and for regional specific technology demonstrations.

(b) *Mass Media*: Regular TV talks, radio talks and articles in newspapers, magazine are being published by the scientists of university to make people aware about latest developments in livestock rearing.

(c) *Publications*: The Directorate of Extension Education, Guru Angad Dev Veterinary University has published 29 books; 19 in Punjabi, six in English and four in Hindi. A monthly magazine 'Vigiyanak Pashu Palan' is also published in Punjabi language and it has more than 6000 subscribers. Leaflets on almost all-important aspects of livestock have been prepared and distributed free of cost on farmer fairs. Rotatory calendars on important issues of various species have also been prepared and given to farmers.

(d) *ICT based approach*: The University is keeping pace with the time and newer technologies for spreading awareness.During the COVID period a digital magazine named *'Pashu Palan Sunehe'* was started. It is being published after every two months and sent in various online platforms including farmer WhatsApp groups. A video also entitled *'Pashu Palan Sunehe'* is prepared and posted on University You Tube Channel and farmer groups on regular basis. It is much liked by the

farmers as it has a segment filmed at farm and recommendations on livestock issues for coming months. The You Tube 'GADVASU Farmer Friendly e Extension' has more than 90 videos posted on it prepared by subject matter specialists. Five Apps on Precision dairy farming, Pig farming, Goat farming, Reproduction, GADVASU services prepared by the University can be downloaded from Google Play store. First MOOC on Pig Farming in the country has been prepared and uploaded on web for benefit of farmers.

(e) *Celebration of Important days*: All important days related to agriculture and livestock are celebrated at either main campus of the University or at outstations to aware youth about ventures in livestock.

(f) *Off campus awareness*: Field level trainings (especially for women), awareness camps at village level and exposure visits are also arranged for the budding farmers to inculcate the scientific information on livestock farming.

- **Motivation of Youth:**

  Farmer led extension is much more effective than any other method. Outstations have identified and developed Farmer Field Schools where other farmers come and learn from the farmer about any venture, a particular farmer wants to go for. By seeing and knowing benefits for venturing in livestock from successful farmer, others get motivated to adopt the venture. Success stories of such farmers are also published from time to time.

  Farmers who have excelled in areas such as Cattle farming, Buffalo farming, Fish farming, Goat farming, Pig framing, Poultry farming or Processing are given Chief Minister Awards on Pashu Palan Melas to encourage and motivate budding farmers to adopt livestock farming.

  Under various schemes, like Farmer FIRST, RKVY, ARYA etc to motivate farmers, inputs from the University are given to entrepreneurs asstart ups so that by practicing new techniques, getting benefits, they are able to start livestock related ventures.

- **Capacity Building:**

  The University imparts specialized training to budding entrepreneurs on various aspects at very nominal fees. Further, to promote entrepreneurship among women, the university provides free training to them. Training on Dairy farming and poultry farming are of two week duration and on pig, goat, fish farming, value addition of milk/meat of one week duration.

The performa for enrollment in these training programmes is posted on website of the University (www.gadvasu.in) as well as in certain issues of monthly magazine 'Vigiyanak Pashu Palan'.

At regular intervals workshops and seminars are organized by Directorate of Extension Education and Colleges. The schedule of trainings to be held in published in magazine also.

- **Hand Holding:**

Hand holding is must to make a new entrepreneurship successful. The budding entrepreneurs remain in touch with the University through various modes. Pashu Palak Tele Advisory Kendra established by the University with financial support from NABARD has dedicated mobile phone numbers where farmers can talk to experts on various difficulties/problems faced by them in routine. Daily about 40-50 farmers take advice through this center. Budding entrepreneurs become members of farmer associations which are running under technical guidance of the University. During regular meetings of these associations, they learn about business skills from other farmers. Presently regular meeting of dairy, goat, pig and poultry farmer associations are going on.

University has also established Farmer Information Center where all the information and inputs can be taken by youngsters who want to adopt livestock sector as their business. Literature, inputs, information on trainings can be had from this center.

In case of any disease outbreak at farm/village level, the University provides expert services to diagnose and control the disease.

The University puts in all efforts to make youngsters aware, skilled and successful entrepreneurs though all possible and modern ways of extension.

Chapter 2

LIVESTOCK REARING IN INDIA WITH SPECIAL REFERENCE TO DAIRY FARMING

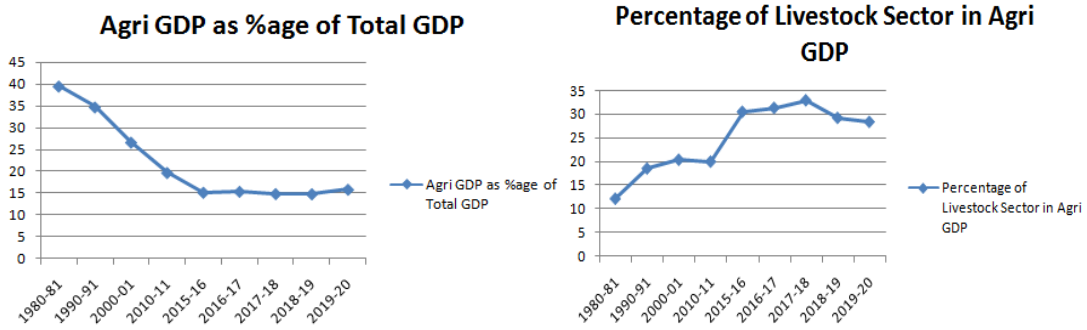
R K Sharma and Jaswinder Singh

Department of Veterinary and Animal Husbandry Extension Education

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

---

Agriculture is the backbone of India. However, its contribution as a whole, in the total GDP of the country is on decline since 1980-81. It was 39.54 percent of total GDP in 1980-81 which fell to 15.89 percent in 2019-20. However, one of its components i.e. livestock sector showed impressive growth during the same period. The contribution of livestock sector in Agri GDP was 12.19 percent in 1980-81 and it jumped to 32.90 percent in 2017-18. In the last five years, the contribution of livestock sector remained between 28-33 percent. It clearly shows that livestock sector has great potential in improving contribution of agriculture in GDP of the country.

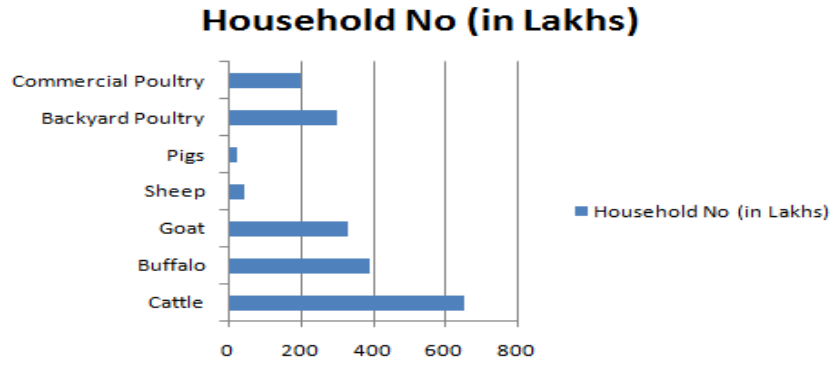


Livestock sector has many sub-components, most important being cattle farming, buffalo farming, goat farming, sheep farming, pig farming, backyard poultry, commercial poultry farming etc.

If we examine the comparative economics of various enterprises related to livestock sector, the most lucrative business comes out to be Catfish-Pangas farming which provide maximum returns per acre of land utilized. However, on the basis of individual animal, it is the pig farming that provides maximum monthly returns followed by buffalo farming.

S No	Enterprise	Unit	Returns per acre	Returns/ animal/month
1	Dairy Farming	10 CB Cows	Rs 65,250/-	Rs 1,088/-
2	Dairy Farming	10 Buffaloes	Rs 70,250/-	Rs 1,171/-
3	Goat Farming	21 Adults	Rs 1,19,538/-	Rs 498/-
4	Pig Farming	11 Adults	Rs 1,13,000/-	Rs 3,283/-
5	Fish Farming (Carp)	2.5 Acre	Rs 93,600/-	NA
6	Fish Farming (Catfish-Pangas)	2.5 Acre	Rs 3,32,000/-	NA

In spite of maximum profitability in pig farming, most of the Indian rural folk prefer cattle farming to other related enterprises. Pig farming is only concentrated in North-Eastern region of the country. Approximately 2629.12 lakh households in India are engaged in livestock farming out of which 653.44 households deal with cattle farming and 391.80 households possess buffaloes.



Constraints in Sustainability of Dairy Farming Sector

Following are some of the constraints which hinder growth of dairy farming sector. These need to be addressed quickly and effectively for sustainability of dairy sector in our country.

The herd size or livestock unit is usually very small. There is lack of proper and scientific nutritional interventions for different categories of animals. There is insufficient coverage of prophylactic vaccination among dairy animals. There is very little value addition of animal produce at farm level. The farmers are usually exploited by middlemen. There is no MSP system of livestock produce. Linkages with consumer market are poorly established. Livestock farming is not considered at par with agriculture or industry. There is no concrete culling policy for diseased animals, stray/wild animals, unproductive or low producing animals. Subsidized and non-credit linked insurance schemes are lacking. Door step extension services are either very poor or very costly.

Initiatives Required to Uplift Dairy Sector

Dairy sector needs drastic changes if it is to compete with the world leaders. Following are some of the steps that can be initiated to improve the dairy farming status in our country.

1. **Development and promotion of entrepreneurship in dairy farming through Livestock Business Incubators:**

Skill development among youth and establishment of Livestock Business Incubation Centres (LBICs) in all states will provide a major boost for improving our livestock sector by harnessing youth energy. This way, the success rate of newly started enterprises will improve significantly. The problems faced by existing entrepreneurs will also get resolved. The budding farmers will learn the art of preparing detailed project proposals through business consultancy of such incubation centres.

Moreover, the Government at Centre is encouraging our youth to become entrepreneurs by launching many schemes like PMKVY. Establishment of Livestock Business Incubators in each state can make the youth realize their dreams through practically knowing the constraints and opportunities in dairy farming.

2. **Conservation of existing high-quality germ plasm, its further improvement, if possible and its extensive exploitation over time and space:**

Bull mother farms for both buffalo and crossbred bulls should be strengthened and newer farms should be established to cater to the ever-increasing needs of the dairy animal population. Semen production of area specific breeds of high genetic potential should be encouraged and distributed aggressively among the AI centres. Certification of elite animals available with the farmers also needs to be strengthened. Exploring markets of germ plasm in adjoining states and outside country in a systematic way can also pave way for financial independence of Semen Processing Centres.

3. **Breeding Policy vis-à-vis milk demand:**

Most of the existing livestock farmers are poor. They have no access to credit, insurance or market. The increasing number of unproductive animals day by day is putting intense burden on limited feed resources. Many a time, the farmer's emotional bonding and love for a particular breed of animals overpowers the real economics of milk and meat for value addition and marketing.

Milk yielding potential of cows on small and marginal farms is quite low as compared to those on large sized farms. If these gaps are narrowed down through improvement of milk yield and adoption of scientific management practices at small and marginal farms, it will certainly boost dairy sector. The income of dairy farmers will automatically rise.

The strategy of cross-breeding of dairy cattle has significantly improved the milk production

potential especially where green fodder is available in plenty. Under prevailing climatic conditions, it is advisable to keep the exotic blood level between 50.0 and 62.5 per cent. This can be maintained through *inter-se* mating with genetically superior progeny tested cross-bred bulls. However, the exotic inheritance level can be further raised in farms having superior management strategies (Anonymous, 2012).

Non-descript, low producing buffaloes and even buffaloes of recognised breeds can be improved through selective breeding with elite buffalo bulls. It is expected that introduction of germ plasm of high producing buffalo bulls in farmer's herd can result in 8-10 per cent genetic improvement per annum (Bhat, 1999).

An incentive policy should be followed for fast genetic up-gradation of above said animals which implies production and use of semen of the highest genetic merit only. It is, hereby, suggested that quantitatively, there should be at least 4% increase in annual milk production up to 2030. All the dairy animals have to be registered and properly identified for accurate records and incentives. For the implementation of this policy, a special task force needs to be recruited for creation of specific infrastructure and training facilities. The state governments must provide financial support for quality control, bio-safety, monitoring and other technical activities.

4. Development of regulatory protocols and rules for quality check of commercial feeds and fodders:

Since major chunk of recurring costs goes to animal feeds, the industry people often exploit the small dairy farmers by supplying concentrate feeds manufactured with nutritionally poor ingredients. There must be some fool proof regulatory mechanism available in each state to check the quality of available commercial feeds.

5. **Aggressive approach towards improving nutritional status of dairy animals:**

The approach should be stepwise and the stages may vary according to the availability of existing resources in a particular area. It should begin with starvation prevention followed by alleviating nutritional deficiencies of different categories of dairy animals. The next stage could be meeting nutritional requirements for production and reproduction and the last could be manufacturing designer foods.

i. Nutritionally poor straws (wheat or paddy straw, maize stovers etc), otherwise available in abundance, could be enriched through urea treatment. It will increase TDN value by about 12% units. If half of the wheat straw (~20 million tons) produced annually in one state (State of Punjab) is enriched through urea treatment, 2.2 million tons of more milk could be produced annually. This milk will be worth Rs 7,000 crore annually with input of 0.35 million tons of urea costing Rs 1,225 crore per annum and Rs 750 crore labour cost.

ii. Nutritional deficiencies could be prevented very effectively and cheaply through inclusion of high quality mineral mixture and Uromin Licks in the diet of animals.

iii. The production status in potentially high producing animals could be enhanced by adding bypass fat or bypass protein in the concentrate ration of those animals. The advice through extension personnel for preparing balanced ration for high yielding animals can also sustain their production level for a longer period of time.

iv. Feeding of designer foods can affect quality of milk produced by those animals. This way, milk with higher CLA (Coagulated Linoleic Acid) could be produced that can fetch premium price.

6. Buffalo to Cattle Ratio:

Buffalo is often preferred to cattle especially in small farming set-up in Punjab. Buffaloes are known for high disease resistance and longer production life. Moreover, the consumers have great liking for buffalo milk owing to its higher fat content.

Lal and Chandel (2017) conducted a study in Sirsa district of Haryana and found herd size and rearing of high yielding animals to have positive impact on total factor productivity in milk production.

Birth of male buffalo calf is not much condemned by the farmers since male calves also fetch some money to them. Even male calves can be reared up to few years of age for the purpose of selling them as meat source. This way the farmers' income can get significant boost (Saxena *et al*, 2017).

7. Extension in existing buffalo farm units with diversifying goals:

Buffalo meat is the healthiest meat. It is lower in intramuscular fat, cholesterol and calories, at the same time, it is higher in essential amino acids, biological value and iron contents. It is the backbone of Indian meat exports. However, this aspect of buffalo farming has not been fully exploited. The farmers have not been encouraged to raise buffalo bull calves on scientific lines.

Most of the male buffalo calves are either sold to middlemen immediately after weaning or they are left to die because of hunger. The male buffalo calf at three month of age usually weighs around 40-50 kg and it can fetch only Rs 1,500/-. At nine month of age, the calf usually weighs around 100-120 kg and it can fetch Rs 4,000/-. If the same calf is well fed and reared for 18 months, it usually acquires a body weight of 400 kg. Such a bull calf can fetch the farmer Rs 24,000/- or more. Thus, rearing male buffalo calves for meat purposes is very lucrative venture for improving farmer’s income.

There is an assured market for selling male buffalo calves. The farmers can make a contract with a Pune based NGO for selling the male buffalo calves of 18 month age at a predetermined price.

8. Exploitation of buffalo milk with distinct compositional advantages:

Buffalo milk is high in fat, protein, SNF contents. These characteristics put buffalo milk on a higher

podium for the manufacture of Mozzarella cheese and coagulated milk products. This compositional advantage of buffalo milk has not been exploited at national or global level. Governmental support can make buffalo "the dairy animal of 21st Century".

9. Scientific Way of Dairy Waste disposal:

There is generation of some quantity of waste material (Dung, urine etc) at each dairy farm. At commercial units, the same could be produced in vast quantities. Scientific utilization of this waste material can generate huge sum of money. A dairy farm with 250 adult units can possibly generate 50 quintals of dung daily. This dung, if cycled through a biogas plant can produce at least 200 units of electricity daily, 15 quintals of dry slurry and 320 kg of biogases. The net savings could be to the tune of Rs 90,000 per month.

10. Replicating suggestive model of GADVASU:

Veterinary University at Ludhiana recommends *Livestock Aggregation Model* for improving the livestock farmer's (especially small dairy farmers) income in the Punjab state. This model is purely theoretical. No data is available to predict the success of this model. Still, the success of dairy farming under this model appears to be a possibility with rearing a minimum of 200 milch animals by a group of like-minded farmers. However, it is an uphill task to bring the small and marginal farmers under the umbrella of such models. Lots of efforts will be needed for building and maintaining farmers' trust in the transparency and functioning of this model. Profit distribution criteria among farmers of the Group are another facet of the problem. The effective monitoring and control over the activities of the Group is also an important aspect of the success of this model. The supportive evidence for the success of this model includes the establishment of more than 2000 commercial dairy farms in Punjab state during the last two decades. The farmers rear crossbred cattle especially HF crosses with herd size of 30 to 300heads or even more. These animals are of high genetic make-up. The farmers follow scientific practices related to breeding, feeding, healthcare and general management of animals. The success of such initiatives can be replicated under the suggested cluster approach. The cluster network approach can also be followed for value addition of milk.

11. Herd size for Economic Viability:

Rearing of 2-3 milch animals in mixed farming system may not be a viable option for the farmer, but, they are simply following the trend. The economic viability of a dairy farm depends upon many factors including area under fodder cultivation, layout of animal shelter, production potential of animals, method of milking, type of milking area and labour availability.

For sustaining a dairy venture, the farmer must get at least 50 per cent profit over different costs. This could be possible only when he maintains a dairy farm of medium size i.e. a farm with at least 8 adult

units (Kaur *et al*., 2012).

12. Development of Rendering Units:

Around 8 per cent of total bovine population is lost every year due to natural death. Besides this, 60 per cent sheep and goat, 85 per cent pigs and 95 per cent poultry are slaughtered. This leads to huge production of by products (1.0 metric tonnes). However, due to non-availability of rendering units at village, block and district level, there is tremendous loss of revenue of livestock farmers. Establishment of around 20 By-product Processing Units in one region will fetch around Rs 600 crore annually. Thus, there is huge scope of improving farmer's income through organised carcass disposal and by-product utilization.

13. Reducing Calf Mortality:

Calf is the future asset of the dairy farm. In India, majority of calf deaths occur during first two months of their life. Gastroenteritis, worm infestation, pneumonia and bloat are the major causes of mortality in calves (Shrivastava *et al*., 2014). Adoption of better management practices lead to survival of calves and they turn into future heifer. This way, a farmer can save the value of purchasing a heifer for replacement.

14. Pooling of inputs like machinery and products to harness more profits:

The farmers in a particular area can pool their resources to reduce cost of production. Same way, they can pool their produce (output) to increase margin of profit.

References:

Anonymous (2012) *Annual Report 2011-2012*. Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India. New Delhi.

Bhat, P N (1999) Buffaloes. In: *An introduction to Animal Husbandry in the Tropics* (eds. W J A Payne and R Pradesh, T Wilson). Blackwell Science, USA. Pp. 325-404.

Kaur, I, Singh V P, Kaur, H and Singh, P (2012) Cost of milk production in Punjab: A pre-requisitefor pricing policy. *Indian Research Journal of Extension Education,* Special Issue **(Vol I):** 313-21.

Lal, P and Chandel, B S (2017) Total Factor Productivity in milk production in Haryana. *Agricultural Economics Research Review***30** (2) 279-284.

Saxena, R, Singh, N P, Choudhary, B B, Balaji, S J, Paul, R K, Ahuja, U, Joshi, D , Kumar, R and Khan, N A (2017) Can Livestock Sector be the Game Changer in Enhancing the Farmers' Income? Reinvesting Thrust with Special Focus on Dairy Sector. *Agricultural Economics Research Review***30**: 59-76.

Shrivastava, M, Nanavati, S and Mishra, A K (2014) Studies on factors influencing mortality rate in buffalo calves. *International Journal Agricultural Sciences and Veterinary Medicine***2** (4): 41-46.

Chapter 3

BACKYARD POULTRY FARMING FOR ECONOMIC UPLIFTMENT OF SMALL FARMERS

Daljeet Kaur

Department of Livestock Production Management,

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

---

Traditional backyard poultry rearing has been practised in India since time immemorial and was the primary source of animal protein and supplemental income for the impoverished rural poor, as well as the only supply of poultry egg and meat for city people before to poultry industrialisation. While giving a definition to backyard poultry production, Mandal et al (2006) stated that it is a low input or no input business that is characterised by indigenous night shelter systems, scavenging systems, little supplementary feeding, natural hatching of chicks, poor productivity of birds, local marketing, and no health care practise.

In India, the poultry industry is separated into two sub-sectors: a highly organised commercial sector, which accounts for about 80% of total market share, and an unorganised sector, which accounts for about 20% of total market share. Backyard poultry accounts for 20% of India's poultry business, which is valued over $800 billion, according to the Indian government's National Action Plan for Egg and Poultry-2022 (NAPEP). According to the 19th Livestock Census of India, over 30 million farmers in India are involved in backyard poultry. The unorganised sector, often known as backyard poultry, is critical in providing additional income and family nourishment to the lowest of the poor.

Rural backyard poultry, despite contributing significantly to national egg production, is still the most neglected. This is despite the fact that their poultry eggs and meat are far more expensive than commercial poultry. Urban and semi-urban areas consume 70% of poultry goods and eggs, whereas rural consumption is fairly low. Private poultry producers are also not able to attend to the needs of major rural consumers and to the consumers of the north-eastern states and other difficult regions. It is well known fact that a fairly significant proportion of the landless and marginal farmers eke out their living from poultry and other small ruminants.

Backyard poultry is a powerful instrument for impoverished upliftment because it requires no infrastructure. Rural backyard poultry can give nutrition supplementation in the form of valuable animal protein, in addition to income production and poverty alleviation. There is ample evidence to support the significance of rural backyard poultry husbandry in improving food and nutrition security and lowering

livelihood insecurity for the poorest households.

As a result, the Indian government has been focusing on expanding meat and egg production from backyard poultry for many years, and several programmes to encourage backyard poultry output have been established.

Backyard Systems of Poultry Farming

- Poultry in these systems are housed at night but permitted to roam freely during the day.
- To supplement scavenging, they are frequently fed grain in the morning and evening.
- The birds will return at night if food is regularly provided at the house.
- Housing improvements will be beneficial.
- Why Birds are less likely to nest and lay eggs in the bush if they are more comfortable in the nest boxes offered.

Advantages of Backyard poultry farming

- It's a sort of organic farming that produces eggs and meat with no hazardous residue. It is an environmentally beneficial strategy. Backyard poultry birds are particularly active in pest management, supply manure, and are necessary for special festivals and traditional rites.
- Provides employment to small-scale and marginal farmers in rural areas.
- Gives rural communities a boost in income.
- Helps to improve backyard soil fertility (15 hens create 1-1.2 kg of manure per day).
- When compared to industrial chicken farming, products from rural poultry farming demand a premium price. Brown shelled eggs are nearly twice as expensive at the local market.
- Backyard poultry farming in a free range system provides egg and meat with absolutely little or very little investment.
- Lessens protein deficiency in vulnerable groups such as pregnant women, nursing mothers, and children when eggs and meat are produced under free range settings rather than intensive chicken farming.

Birds suitable for Free Range Scavenging System

In rural areas, chicken reared in backyard are generally ‘Desi type’ which are low producing with respect to egg and meat (Ghosh et al., 2005). The desi chicken breeds adopted in free- range backyard conditions for centuries contribute about 11% of total egg production in India (Kumaresan et al., 2008). Their contribution to the total egg yield has been dormant for the last few decades due to their low productivity (50-60 eggs per annum). Usually non-descript desi birds are reared but in some areas, local breeds and crossbreeds derived from them are also reared. Specific improved varieties of birds are now

available for meat or eggs and few varieties for dual purpose.

The significance of backyard rural poultry farming in India is well recognized, several research organizations thereby developed different backyard chicken varieties which have been reared by farmers from many parts of the country successfully. These improved varieties include: Dual purpose Vanaraja, Giriraja, Swarnadhara, Gramalakshmi, Gramasree, Srinidhi, Kamrupa, Narmadanidhi, Pratapdhan, Jharsim, CARl Debendra, CARI Hitcari, CARI Upkari, CARI Shyama, CARI Nirbheek. Egg type Gramapriya, Athulya, Krishi layer, Swethapriya, CARI Sonali, CARl Priya. Meat type Krishibro, CARIBRO Vishal, CARIBRO Dhanraja, CARIBRO Mrityunjay, CARIBRO Tropicana.

Guru Angad Dev Veterinary and Animal Sciences University has developed two strains of RIR inheritance and has also synthesized a new egg laying strain 'Punjab Red' keeping in view the need of the farmers and climatic conditions of the state. The stock is expected to be more popular with the small/ marginal farmers as brown eggs fetch a premium. Since the birds tend to be heavier at the end of lay, the income from the spent-up hens is also higher than white leghorn females.

Characteristics of Chicken Breeds suitable for Backyard Poultry Farming

Punjab Red Layer

- Layer variety known for brown shelled eggs
- Birds produce 240-260 eggs in a year
- Reddish brown plumage fetches good premium on spent hens and male birds
- This improved variety is suitable for backyard poultry farming in Punjab with minimum management demands.

Giriraja

- Giriraja stand for the "King of the jungle fowl".
- It is released by the Karnataka Veterinary Animal & Fishery Sciences University, Banglore.
- It is a synthetic strain bred which yield high quality and quantity of meat and eggs.
- It is sturdy, has excellent adaptability to environmental condition.
- Giriraja do not demand sophisticated management condition / farming systems.
- It has attractive appearance; it produces three times in growth and egg production over and above the local / desi birds.
- They are multi - coloured birds.
- They reached body weight of 1.5 to 2.0 kg at the age of 18-20 weeks.
- The average adult weights are 3.5 to 4.0 in females and 4.5 to 5.0 in males.
- The quality of meat is less tender than that of broiler but taste is like that of desi birds.

- Age at first laying is 24 weeks.
- Annual egg production is 150 eggs with an average egg weight of 55g.
- The colour of the egg is brown.

Vanaraja

- Suitable bird for backyard farming in rural and tribal areas, developed by the Project Directorate on Poultry (ICAR), Hyderabad.
- Vanaraja are capable to protect themselves from predators due to their relatively light and long shanks, which are otherwise a major problem observed in birds reared in backyards.
- It is a dual purpose, multi-coloured bird with attractive plumage.
- It is adaptable to the scavenging system of rearing with better immune status against common poultry diseases.
- Vanaraja males attain moderate body weight at 8 weeks of age under regular feeding system.
- They reached body weights of 2.0 kg by 20 weeks and above 3.5kg by 40 weeks of age.
- The hen lays 160-180 eggs in a laying cycle.
- The colour of the egg is brown.

Nirbheek

- It is a dual purpose low input technology active and large bird.
- They are pugnacious in nature with high stamina and majestic gait.
- They are able to save themselves from their predators in all climatic zones of the country.
- They attain body weight of 1.35 kg at 20 weeks of age.
- Average age at sexual maturity is 5-6 months.
- Annual egg production is around 198 eggs, with an average egg weight of 54 g.

Gramapriya

- Gramapriya a layer type variety developed at Project Directorate on Poultry, Hyderabad, for free range farming in rural and tribal areas.
- They are multi-coloured plumage and lays brown eggs with an average egg weight of 55-60 g
- It is hardy and livability is very high.
- The body weight at 21 weeks ranges from 1.2 to 1.5 Kg.
- The annual egg production is about 150-160 eggs under field condition in farmers backyards.
- The male bird’s meat is tender and especially suitable for tandoori preparations.
- The performance of the birds can be further enhanced in free-range condition with minimum supplementary feeding.

- Two varieties of Gramapriya are available i.e. White Gramapriya and Colored Gramapriya.
- The white variety gives more number of eggs compared to the coloured variety.
- The feather colour of colored Gramapriya bird is mostly brown and occasionally multiple color is also seen.
- Because of its moderate body weight, the bird can easily escape from predators, which is otherwise a major threat in backyard.
- Initial brooding up to 6 weeks in nursery unit is required before these birds are let out for semi free-range or free-range management.

Swarnadhara

- This breed yield 15-20 eggs more than Giriraja in a year and was released by the Karnataka Veterinary Animal Fishery Sciences University, Bangalore in 2005.
- Swarnadhara chickens have a high egg production potential along with better growth compared to other local varieties and are suited for mixed and backyard farming.
- They are smaller in size with a lighter body weight, which makes them easier to escape attacks from predators such a jungle cats and foxes.
- The bird can be reared for its eggs and meat.
- Age at maturity is around 22-23 weeks of age.
- Hens attain a body weight of about 3 kg and the cocks about 4 kg.
- Swarnadhara hens lay about 180-190 eggs in a year.

Benefits of such improved Chicken breeds under Backyard Poultry farming

The germplasm developed for backyard farming has the following features.

- They are multi-coloured plumage, thus have camouflagic characters to protect themselves from predators.
- They can thrive well under adverse environmental conditions like poor housing, poor management and poor feeding.
- They do not possess Broodiness behavior.
- Their eggs and meat has similar nutritional value, aroma and taste are similar to Desi hen.
- These birds can thrive well and perform better even in adverse environmental conditions.
- These birds are sturdy and resistant for most of the common poultry diseases because of its high immune competence.

- These birds has better feed efficiency even with diets containing low energy and protein diets based on common feed ingredients available in rural / tribal areas like rice bran, broken rice, small millets (like foxtail millet, finger millet, pearl millet etc.).
- At eight weeks of age males of these germplasm weighs about 1250 g with a feed conversion ratio of 2.2 under intensive rearing practice.
- Mortality is less than 2.0 % up to eight weeks of age.
- The eggs are heavier (50 to 60 g) and color of the egg is brown or tinted, attractive and resembles that of Desi hen.
- Fertility and hatchability of their eggs are 87 and 80 % respectively, and the farmer can get more number of chicks from a these birds compared to a Desi hen by using broody hen
- It can perform better in backyard conditions by eating green grass and insects available in the fields.
- The performance of Desi hens can also be improved by crossing them with males of germplasm developed for backyard farming.
- These birds can give a fairly handsome return with bare minimum night shelter.
- On an average 15 rural chicken per house can provide enough chicken and eggs for the family.
- Poultry also serves as an efficient waste disposal system by converting leftover grains, kitchen wastes, insects, worms, maggots, fish, marine wastes etc. into valuable protein.
- A group of 15-20 chickens produce 1.0 to 1.2 kg manure per day, which directly or indirectly contributes to village economy.
- The most preferred quality chicken and egg come from this sector, which is sold at a premium market price.
- Backyard Poultry can act as an engine for economic growth through eradication of rural poverty.

Performance of improved chicken breeds against Desi birds

Particulars	***Improved Breeds***	***Desi Birds***
Weight of Day Old Chick	*40-50 g*	*20-25 g*
Body Colour	*Multi Coloured*	*Multi Coloued*
Body Weight at 8 weeks	*Above 1.5 kg*	*Average 0.5 kg*
Period required to attain 1 kg body weight	*8-10 weeks*	*25-30 weeks*
Survivability	*Above 90 %*	*40-30 weeks*
Adult body weight (male)	*4.5 -5.0 kg*	*1.2 – 1.5 kg*
Adult body weight (female)	*3.5 -4.0 kg*	*1.0-1.2kg*
Quality of meat	*Less tender than Broiler*	*Hard, fibrous*

Taste	*Like Desi*	*Desi*
Meat % without skin (dressed)	*Around 60 %*	*40-50%*
Age for first egg laying	*22-24 weeks*	*30-35 weeks*
Brooding behaviour	*No*	*Yes*
Annual egg production	*150-170*	*50-60*
Average egg weight	*50-55 g*	*35-40 g*
Egg. Colour	*Brown*	*Brown*
Additional poultry feed required	*A little amount*	*Nil*
Management	*Low*	-

How to Start Backyard Poultry Farming?

1. Source of fertile eggs or young chicks – ICAR centres, State Animal Husbandry Departments and NGO's produce fertile eggs as well as young chicks suitable for this system of farming.
2. Interested farmers can purchase these fertile eggs to hatch them under local desi broody hens.
3. Farmers may also purchase young chicks (6 weeks) to start the backyard poultry farming.

What types of management practices are required under backyard system?

Rearing Chickens

1. It is beneficial and convenient for the farmers to get hatching eggs of Giriraja/ Vanaraja/ others for hatching under broody local/ desi hens available with them in the villages.
2. This practice would help them to brood young chicks.
3. Hatching eggs of about 10 to 12 could be set under broody hens for hatching.
4. The chicks have to be well protected by covering with bamboo baskets or by keeping them in confined area to protect from predators like crows, eagle, kites, etc.
5. The following vaccination schedule can be followed by the backyard poultry keepers at community level for effective vaccination and

Vaccination Schedule

Age (in days)	***Vaccine***	***Dose***	***Route***
1	*Marek's Disease*	*0.2 ml*	*S/c*
7	*Ranikhet disease (F1 /B1 Strain)*	*One Drop*	*Eye*
15	*Infectious Bursal disease (IBD)*	-	*Oral (in drinking water)*
30	*Ranikhet disease (Lasota strain)*	-	*Oral (in drinking water)*
84	*Fowl Pox*	-	*Wing web prick*
112	*Ranikhet disease (R2B strain)*	*0.2 ml*	*I/m*

6. By 6 weeks of age, the birds are let loose during day time in the open field; picking up grains in the threshing yard, worms and insects in the manure pits, greens in the fields.

7. If these facilities are not available, the birds may be fed with kitchen waste from local hotels, left over food from houses and grains.

Housing for Scavenging or Backyard Poultry

A well-designed chicken house is an important aspect of poultry rearing's long-term sustainability. A proper poultry house will keep birds safe from the extremes, predators, injuries, and theft. The house must provide a stable atmosphere in which the birds feel "at ease" both during the day and at night, as well as protection from predators and secure nesting boxes. The birds must be able to grow, sleep, and lay eggs in a stress-free environment.

Before designing a proper poultry shed, many factors must be taken into account.:

- It should have an area of two square feet per bird to avoid crowding with proper ventilation and scope for easy cleaning.
- It should provide protection from predators.
- The design can vary based on the climatic conditions in a particular region to allow prevention from excessive heat, cold or water.
- Affordability is an important criterion and locally available materials can be a good option to consider.
- The most important aspect for any shelter design is light and heat conservation.
- In this way, the birds will have ready access to their main diet of insects and seeds that they obtain for themselves and the amount of supplementary feed to be provided by the farm family will be reduced.
- Any feed of grain of household scraps that is offered should be given inside the shelter.
- If this is regularly provided in the evening, it will help to train the birds to willingly enter the enclosure before nightfall.

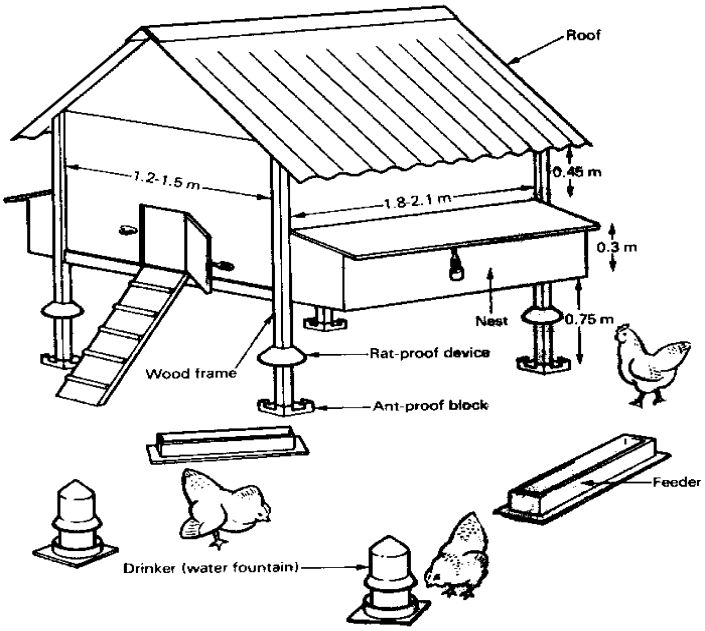


Fig.1: Suitable housing coop design for Backyard rearing of poultry birds.

Fig.2: Model of Housing coop

Feed resources under free-range rearing

Due to geographical, meteorological, and agricultural conditions, the availability of feed resources for scavenging varies greatly. However, under the backyard poultry-rearing system, the feed resources accessible to the poorest family are:

1. To meet their energy needs, the birds will eat farm-grown grain such as maize, jowar, and millets.

2. They will hunt for insects, worms, larvae, snails, termites, maggots, and marine wastes, among other things.

3. Feed supplementation when scavenging supplies are scarce owing to seasonal variations.

4. One of the options for extending the scavenging feed resource base has been to use unusual feed

resources such as termites, maggots, and worms.

5. Feeding the backyard chicks should be done according to their age, as shown below:

For the chicks of 0-2 weeks:

- The first feed is finely broken rice or other tiny grains or bread crumbs.
- Skimmed milk or butter milk should be supplied for drinking instead of plain water all the time.
- After a week, chick mash is introduced, which is made from finely broken rice, ragi, cambu, wheat, or maize grains, as well as small amounts of vitamins, minerals, antibiotic feed additives, and coccidiostat.

After 2 weeks:

- The amount of chick feed is gradually raised. Wet mash is added after 6 weeks, along with juicy, finely chopped greens like Lucern.
- Some finely chopped onions and garlic may also be added.
- Depending on their age, the amount of chick required will range from 10 g to 50 g. (0-8 weeks).

After 8 weeks

Grower mash, which is loaded with vitamins and minerals and has all of the needed ingredients for good growth at a low cost, must progressively replace chick mash. Depending on maturity, the amount supplied each grower per day ranges from 50 to 80 g. (8-20 weeks). Around the 18th week, layer mash that has been properly vitaminised and mineralised is introduced. There are plenty of finely cut greens as well as water.

Proper timing of feeding the chickens?

Regularity of feeding is also important as the birds will soon learn and expect to have their feed in the punctual time, if they are in good health.

The chicks are fed 5 to 6 times a day in small quantities upto 8 weeks of age.

After providing clean drinking water, the birds should be let out early in the morning (just before daybreak) in the backyard premises. Some grains, roughly 15 g per bird, can be thrown out for the birds to choose later. Greens, vegetable clipping, or kitchen trimmings can be fed shortly before noon, finely chopped and

combined with mash.Late in the evening, some more grains similar to the early morning feed can be given. This will tempt all birds to return to their right shelter after the day's roaming.

These schedules can be adjusted to meet the needs of individual farmers, but consistency is necessary to train the birds to adjust to these timings.

How to multiply the birds at village level:

1. When the birds reached about 5 months of age, cocks may be introduced with the female birds (one cock to every 6 to 8 hens)
2. Surplus cocks of backyard system birds may be used for mating local/desi hens at different locality for upgrading them.
3. Local / desi cocks should not be kept along with backyard system hens.
4. The hatching eggs so produced can be hatched to produce chicks under local desi broody hen.

Breeding Management:

Sound breeding policies are essential for profitable backyard chicken production.

- Use males with faster growth rate with good conformation for breeding.
- One cock is suitable for 5-6 hens in one breeding season.
- It is better to collect fertile eggs from those hens which produce more number of eggs.
- Keep the fertile eggs in a clean, well ventilated cool place out of sunshine.
- Set the fertile eggs to the brooding hen (s). The eggs should be set preferably within 10-12 days after collection.

How to hatch Chicks from fertile eggs using a Brooding Hen?

- **Identify / Obtain a good broody hen:** A broody hen is one that sits on eggs and is constantly on the nest, creating a clucking sound that is distinct from the cackling sound that chickens make after they lay eggs. Her underside will have a strip of bare skin. You'll know she's broody if she squawks or gives you a harsh peck to warn you away.
- **Characteristics of a good broody :**
    - **a.** Medium sized birds are best.
    - **b.** They should be healthy, plump and yet fit.
    - **c.** They take over a laying nest box in the chicken shed where they spend most of the day, emerging once to eat and do a huge dropping.
    - **d.** They are ideally tame, of a quiet temperament and yet protective.

e. They may cluck angrily at disturbances.

- **Preparation of Nesting Box.**
    a. A broody hen wants a quiet place to set. So, the brooding area should be somewhere **quiet, dark, clean, draft-free and isolated** from the rest of the flock and safe from potential predators.
    b. Plenty of nesting material should be placed in the nesting box so as to provide cushioned to the eggs as well as adequate insulation from the cold.
    c. Many different **kinds of nesting materials such as straw,** Kiln –dried pine shavings may be used. Don't use anything slippery, such as newspaper.
    d. The nest and nesting box should be lightly treated with a good quality insect power.
    e. If the nest becomes soiled (by yoke and white from a broken egg for example) the nesting should be promptly replaced by fresh material.

When to introduce the broody hen to the Nesting Box?

a. It is better to put her into her nest for the very first time after nightfall, when she will be quieter and more amenable.

b. If you are not sure about your hen, before placing fertile eggs under her, test her for a couple of days to see if she sticks tight to the nest, by placing her on golf balls, artificial eggs, or regular eggs.

c. Once, she is settled into her nest with crockery eggs, the dummy eggs can be exchanged for the setting of fertile eggs.

d. Place food and water near the hen's nest and be sure that she has fresh food and water daily. The hen will take care of the rest. She will turn and tend the eggs.

e. In 21 days, the eggs if fertile will begin to hatch. Thus, a new crop of backyard chicks are produced.

Conclusion:

Even in metropolitan areas where commercial eggs and poultry meat are plentiful, backyard farmed eggs and meat command a higher premium due to consumer acceptance. Aside from providing a consistent supply of high-quality animal feed, backyard poultry raising provides revenue prospects, particularly for tribal communities' poorer members. Backyard farming will undoubtedly help the economic situation of the majority of rural/tribal families from lower socio-economic classes.

References:

Mandal A.B., Tyagi P.K. and Shrivastav A.K., Research Priorities in Poultry Nutrition and Feed Technology to 2020. In: Sasidhar, P.V.K. (Ed.). Poultry Research Priorities to 2020, Proceedings of National Seminar, November 2-3, Central Avian Research Institute, Izatnagar, 96-114, (2006).

Ghosh M.K, Ahmed F.A, Buragohain R, Pathak P.K, Bhattacharya M. Growth performance of Vanaraja birds in high altitude areas of Arunachal Pradesh under Backyard system of management. XXII Annual conference and National Symposium, Indian Poultry Science Association, Directorate of Poultry Research, Hyderabad from 2-4 February, 2005, 198. 21.

Kumaresan A., Bujarbaruah KM., Pathak KA., Chettri B., Ahmed SK. and Haunshi S. 2008. Analysis of a village chicken production system and performance of improved dual purpose chickens under a subtropical hill agro- ecosystem in India. Tropical Animal Health Production, 40, 395-402.

Chapter 4

GOAT FARMING- A PROFITABLE VENTURE

Mandeep Singla

Directorate of Livestock Farms,

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

---

The goat species (*Capra hircusaegarius*) is an important component of farm animal genetic resources. Together with sheep, and partly because of their size, both are commonly called "small ruminants". Goats have been associated with mankind since the dawn of agriculture and the domestication of animals. Goats were domesticated as early as 7000-8000 BC, as evidenced by archaeological remains collected in Asia. Since then, it has been involved in development of many aspects of human culture like religion, tradition, folklore, nutrition, livelihood and economics. It is particularly important in tropics and subtropics, where it is used as a major source of meat, milk, fibre, skin and manure in many traditional societies. There is also a tendency to keep goats as a stock of wealth (poor man's bank) and sell them proportionally when the demand for funds raises or their number rises.

Goats provide products and services which are important for humans throughout the world. In the developed countries, goats are valued mainly for milk, fibre and meat; while in the developing countries, they are valued mainly for meat, followed by milk, fibre and skin. The socioeconomic importance of goats is greatest in developing nations, where they fulfill socioeconomic, cultural and recreational needs. Their small size is especially relevant and relates directly to economic, managerial and biological advantage over other species. The small size of the goat contributes to its popularity. Goats in addition to meeting daily food needs (milk and meat), are easily sold as a source of cash, provide insurance and are valued in religious ceremonies like gifts during marriages. This species acts as silver lining in Indian subcontinent especially for poor and landless marginal farmers. Poor and landless farmers often increase the size of their flocks to achieve greater food and economic security.

Present status

Goats constitute about 28 percent of total livestock population and 14 percent of total meat

production of country (BAHS, 2020). In year 2019-20, 103.6 million goats and 56.5 million sheep yielded 1.2 and 0.8 million tones (MT) of meat with average 11.5 kg and 14 kg yield per animal, respectively (BAHS, 2020). Additionally, goats produced 5.85 MT of milk (3% of national production) with average 0.44 liter per goat per day in same year. India is one among the largest exporters of sheep andgoat meat to the world. Major export destinations of India are United Arab Emirates, Saudi Arabia, Qatar, Kuwait and Oman. During 2015-16, India earned Rs. 446 crores through export of live goat/sheep and Rs. 871.08 crores through goat/sheep meat amounting 22,060.15 tones (excluding edible offal). The socio-economic contribution of small ruminants relates to large sizes of small ruminant populations; wide distribution across various agro-ecological zones and production systems; and diversity of breeds. Small ruminants are exchanged for crops in many pastoralist communities, and used for ceremonial purposes and for paying traditional doctors.

Societal contributions of goats

Livelihood concept is explained in terms of capabilities, assets (stores, resources, claims, and access), and activities that play interconnected roles in the wellbeing of households. The term coping is generally defined as an effort to prevent or diminish distress associated with threats, shocks, harm, or loss. In India, small landholders dependent mainly on crops are at greater risk of seasonal and climatic variations especially rainfall. Many parts face challenges of droughts and floods posing severe threats to livelihood of small landholders. The key part of resilience is the diversification of activities and use of different resources to increase household income as well as stability even when uncertainties prevail. The arid and semi-arid harsh conditions affect cattle more than goats and sheep. The ability of goats and sheep to graze, utilize poor quality forages, walk long distances, and withstand drought makes them better assets to sustain the livelihoods of pastoralists.

Goats are suited for diverse climatic conditions and play critical role in almost all the agro-climatic zones of India. Their contribution is more significant is eco-fragile, calamity prone and agriculturally less suited areas. About 70 per cent of the landless agricultural labourers, marginal and small farmers in the country are associated with goat husbandry. About 33 million households predominantly small land holders are engaged in rearing of goats (4.5 million in sheep farming) in India (19^{th} livestock census, 2012). In pastoral societies in India, goats are kept as a source of additional income and as an insurance against income shocks of crop failure. They are not only an important source of income and employment for them, but also a vital source of animal protein for the family. A number of micro studies concluded that the goats have great social and economic relevance in poverty reduction and social equity.

Women empowerment through goats

In many poor economies, women often don't own assets in the household or have control or power over assets and their use, and yet these women are over-burdened by the plight of looking for food for the household. Gender equality contributes to economic growth; however, it is not as clear that economic growth contributes to gender equality. The household role distribution and asset ownership determine the extent to which these assets can be converted into income generating activities. Goats play a critical role in the livelihoods of rural households, where they are often the property of poor women and children. A case study of Ethiopia shows that goats distributed to women farmers brought about substantial changes in their lives by enhancing food security and diversifying the livelihoods. Thus, through women empowerment positive social changes in the society can be rapidly taken up.

Compatibility of goats for small land holders

Goat production as against large ruminant and non-ruminant production plays greater role in reducing poverty, ensuring food security and overall household wellbeing particularly in rural regions of resource poor countries. Goats can quickly multiply, are resilient and easily convertible to cash to meet financial needs of the rural producers. The rural poor who cannot afford to maintain a cow or a buffalo find goat as the best alternative source of supplementary income and milk. Goat rearing has distinct economic and managerial advantages over other livestock because of its less initial investment, low input requirement, higher prolificacy, shorter generation interval and ease in marketing. Goats are largely reared on extensive system using common resources, forest land and crop residues. Goats are well suited for mixed or integrated farming systems i.e. backbone for small landholders. Due to acceptability for wide variety of feed resources goats fits well with sylvipasture, agro-forestry etc. The adaptive capacities of goats to arid and semi-arid conditions make them one of the best assets for subsistence, food security, and livelihood for small holder farmers. They provide significant means through which landless, small land owners, pastoralists, and agro-pastoralists can escape the poverty trap as in times of emergency they can be used as moving bank. Goats are more efficient in converting poor quality feed resources into quality meat compared to most of other farm animal species. In most of the Asian and rain-fed based economies, investment for other inputs is also less for goats than other farm animals. Due to smaller size goats are more suitable for transport, marketing and even domestic consumption thus have significant contribution in improvement of diet of economically weaker sections of the societies throughout the globe. Additional advantageous features of goats are higher feed use-efficiency from coarse roughages and high tolerance to tannins and diseases, as well as

marketability within one season. Goat rearing can provide part time self-employment without affecting the main occupation for small and marginal farmers.

Conclusion

Small ruminants provide livelihood support to the poor underprivileged landless, and marginal farm households. The goat production systems are mainly subsistence-oriented but in view of the rising demand for meat, there is a great scope for their commercialization. Nonetheless, these animals have been grossly neglected in development programs and their potential for enhancing livestock growth remains untapped.

Since this is the only sector, which provides direct livelihood and income generating opportunities to landless and marginal farmers and the other vulnerable sections of the society, formulation of appropriate schemes for inclusive development of this sector is essential. The second component includes harnessing of the untapped potential in processing and value addition of chevon. It can be thus be concluded that goat farming in the state has a great potential to support the livelihood of small and marginal farmers.

Chapter 5

ESTABLISHMENT OF FEED MILL FOR MANUFACTURING DAIRY AND POULTRY RATIONS

Parminder Singh

Directorate of Extension Education,

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

---

The success of livestock farming is largely dependent on the continuous supply of good quality nutritious feeds at competitive price. Feed alone constitute about 60-70 per cent of total cost of production of livestock products. Therefore, it needs more attention though other factors are also important for remunerative return from livestock enterprises. Dairy branded feed is catering to only 17-20 percent of potential in India because most of the farmers make homemade feed or get the feed customized according to their choice of ingredients. In contrast 85% broiler and 45% layer branded feed is being used pan India, resulting in production of 2 kg plus broilers with FCR around 1.5 in 35 days and above 300 eggs per annum in commercial flocks. So there are ample opportunities to start new feed mill so that scientific feed is made which in turn will reduce the cost of rearing by increasing the performance and side by side reduction in diseases.

India's animal feed industry, which is currently at $15 billion, is poised to double and touch $ 30 billion in the next five years to cater to the growing protein requirements of the country, a report published by Yes Bank. The report — The Indian Feed Industry – Revitalizing Nutritional Security Knowledge — was released at the Global Grain Food and Summit which was held in December 2021 at Pune. The per capita meat and milk consumption is growing, especially in China and India, and is projected to remain high in the European Union, North America, Brazil and Russia. With changing income levels and more people eating fish, meat and chicken, there will be a higher requirement of processed dairy, aqua and poultry products, which in turn will result in higher feed requirement.

With multinational companies eyeing the lucrative Indian markets, the animal feed industry in India will have to increase their capacities keeping in mind the quality issues to leverage on the growing demand for compound feed. According to estimates by leading industry sources, the demand for animal protein and

dairy products in India will increase the compound feed consumption volumes to 38 million tons by 2027. In India, at present, cattle accounts for 7.5 million tons, aqua industry consumes one mt while the poultry industry consumes around 13 mt of the feed, with soy meal and corn being the prime consumables. In volume terms, at present, an estimated 26 mt of feed is required in the country. Policy measures also needed to be taken to improve milk productivity of cattle which stood at 5-10 liters against 15-20 liters globally. Good feed is one of the ways of achieving this. The feed sector in India is at an inflection point with the emergence of modern dairies ranging from 50 animals to upwards of 500 animals.

Punjab produces 13.35 million ton of milk per annum. The annual growth rate of milk production is around six percent and the per capita availability of milk is 1225 g per day (GDVASU Handbook 2022). To produce this amount of milk, there is need of around 95.2 and 5.7 million ton of green fodder and concentrate respectively. There is deficit of 24.7 percent in fodder and 35.2 percent in concentrate availability. This gap between demand and supply is likely to widen further due to increased pressure to grow more food grains, oilseeds, pulses and commercial crops resulting into no increase in area under forage crops. Similarly there are 75 lakh broilers and one crore layers in Punjab producing 5638 million eggs per annum. Poultry alone needs 6.6 million ton of feed per annum.

To produce such a huge amount of feed, there is a need of proper processing and mixing of feed. In high yielding animals or birds; lot of feed additives are being used which require inclusion in very small amounts. Feed is being made in pellet & crumbs with heavy machinery and boilers to increase its digestibility. So, in coming year's lot of feed will be made through proper grinding and mixing which will require idle machines. A scientific feed mill is the need of the hour.

Financial Assistance

NABARD is an apex institution for all matters relating to policy, planning and operations in the field of agricultural credit. For feed processing plant with very large outlay, a detailed project reports will have to be prepared. Banks provide financial assistance for the following purposes.

(a) Construction of factory building, godowns for raw materials as well as for finished products, office, canteen, generator room, essential quarters, etc.

(b) Purchase of equipments such as grinder, feed mixer, pelletizer, elevators, feed packing units, etc.

(c) Miscellaneous equipments such as transformer, generators, weighing scales vehicles etc.

(d) Margin money for working capital requirement for one cycle of operation. The cost of land is not considered for loan. However, if land is purchased for establishing a feed processing plant, land cost can be treated as party's margin money up to a maximum of 10 per cent of the total cost of project.

Scrutiny of Scheme by the Bank: After the scheme is submitted to the Bank, it is examined for technical feasibility and economic viability.

(a) Technical Feasibility:

This would briefly include:

(i) Availability of raw material such as grains, brans, oil cakes, mineral mixture, molasses, fish meal, vitamins, etc.

(ii) Feed formulation and technical norms

(iii) Infrastructure available for feed testing, procurement of raw material, marketing of different feeds, experience of the entrepreneur.

(b) Financial Viability:

This would briefly cover:

(i) Project outlay, sources of funds and loan requirement

(ii) Raw material cost, expenses on fuel, labour, transport commission to be paid and other overheads

(iii) Output costs i.e. quantity and sale price of different feeds, number and sale price of empty gunny bags.

(iv) Income Expenditure statement and annual gross surplus

(v) Cash flow analysis - Benefit Cost Ratio(BCR), Net Present Worth (NPW) and Internal Rate of Return (IRR)

(vi) Repayment Schedule i.e. Repayment of principal loan amount and interest Other documents such as loan application forms, security aspects, margin money requirements, etc. are also examined.

A field visit to scheme area is undertaken for conducting techno economic feasibility study for appraisal of the scheme. Sanction of Bank loan and its disbursement: After ensuring its technical feasibility and financial viability, the scheme is sanctioned by the Bank. The loan is disbursed in two or three stages against construction of various civil structures, purchase of plant and machinery, miscellaneous fixed assets and margin money for working capital requirements. Constant follow up and supervision of the scheme is done by the Bank.

Lending Terms

i) Unit Cost: The Unit Cost depends upon the capacity of the feed mixing unit, type of feeds to be manufactured and also the infrastructure required.

ii) Margin Money: In case if the feed mixing unit is integral part of the commercial poultry or dairy

scheme, the down payment is based on the category of beneficiary. However, in respect of feed processing plant of larger size, the margin money is normally 25 per cent of the total cost of the project.

iii) Interest Rate: It depends upon the RBI guidelines and also the individual banks. The present rate of interest for ₹2.00 lakhs and above is linked to primary lending rates of banks which vary with the type of investment, beneficiary and also the credit rating.

iv) Security: Security will be as per RBI guidelines issued from time to time.

v) Repayment period of loan: It depends upon the gross surplus generation in the scheme. The loan will be repaid in suitable monthly or quarterly installments usually within a period of 5-7 years. Wherever required, the grace period is also considered.

vi) Insurance: The building and other assets such as poultry sheds, equipments may be insured against natural calamities.

Format of bankable project for feed plants

Introduction: It should cover the name of the company, location of plant, activities, products, capacity of plant and project outlay

Company: It should cover the location of registered office, date of formation, registration and authorized share capital. It should also cover the date of incorporation and commencement of business, the objectives, areas of operation, subscribed share capital.

Promoters and their background: Name and address of promoters, their background, experience and net worth.

Management of the company: Persons looking after the day to day management, their background, experience, etc. should be covered.

Project Profile:

i) **Land and location**: This should cover the area of land, location of the plant, distances from nearby town, availability of approach roads, power and water supply and other communication including schools, banks, hospitals, etc.

ii) **Civil Structures**: Name of the Architect, type of structures proposed, drawings and detailed cost analysis of various civil structures along with the present position of implementation may be indicated.

iii) **Plant and Machinery**: The major plant and machinery (imported and indigenous separately), sources of supply, specifications and quotations for various items of equipment need to be given.

iv) **Technical collaboration**: The name of the technical collaborators for monitoring and marketing of the products along with their addresses and the type of collaborations should be indicated. Technical collaboration fee/royalty to be paid should also be indicated.

i) Manufacturing process: It should cover the manufacturing process of feed (mash/ pelleted feed) in the form of flow chart, proportion of various feeds to be manufactured and the composition of the different feeds.

vi) Infrastructural facilities:

a) Raw Material:

The feed ingredients (grains, cakes, brans, fish meal, molasses, vitamins, minerals, etc.), source and method of procurement, basis of price fixation, agreements if any for regular supply of raw material may be indicated.

b) Packing material: The type of packing material required (jute/plastic bags), source of supply, capacity and price of bag, approximate quantity required per month and method of purchase need to be furnished.

c) Utilities:

* Power: The total power requirement of the unit, source of power supply, position of power supply in the area and stand by arrangements made by the company, whether permission is obtained or applied to the State Electricity Board for power connection.

* Water: The source of supply, quantity available vis-a-vis daily requirement and arrangements made for supply of water.

* Fuel: The requirement of coal, diesel and gas, source of supply, adequacy of availability and cost of material may be mentioned.

* Steam: Quantity required, source and capacity of boiler.

* Transportation: The mode of transportation of raw material as well as feed, whether owned or hired vehicles, availability of vehicles and cost per kilometer.

* Laboratory: Whether the company is planning to set up a laboratory for testing the raw material as well as feed, specification of laboratory equipment, quality and cost, the proposed tests to be carried out and the adequacy of man power for carrying out these tests.

vi) Pollution Control: The type of measures proposed for controlling the air pollution inside the unit and also for the employees of the company.

vii) Man power: It should cover the technical skill and unskilled laborers required their availability and source, method of recruiting them and also their salary structures/wage rates should be mentioned.

Marketing and business prospects:

a) The product mix, capacity of the plant, year-wise capacity utilization and actual quantity of products produced per year.

b) Areas of marketing of the product and strategies i.e. Talukas, district or state-wise quantities proposed for sale, methods of sale, agencies/contractors, method of transportation of products, incentives or commission proposed to be paid, expenditure on publicity and brand name should be indicated. It should also cover the proposed marketing network in terms of staff and material.

c) Market survey for raw materials as well as for the products to be sold covering the demand/supply position, other sources of supply of products, the average price of products for the last 4-5 years and also the potential for selling the products should also be covered.

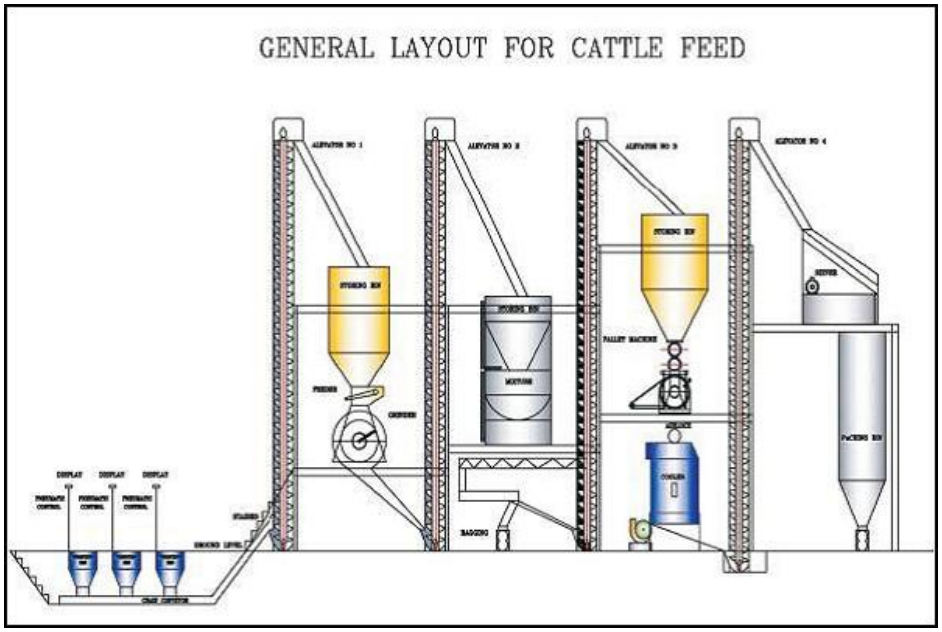
Socio-economic benefits:

The number of villages, farmers and number of animals benefited and also number of persons employed either directly or indirectly in this activity.

SWOT Analysis:

The strengths, weaknesses, opportunities and threats should be discussed separately.

Poultry feed will continue to be a leader but livestock and aqua feed will be game changer. Continued growth of Indian industry is expected in the coming decades, mainly due to increase in domestic demand for milk, egg, meat and aqua products. Therefore, future of this industry is bright. Branded feed is expected to produce around 54 million tons of all types of feed in near future.


GENERAL LAYOUT FOR CATTLE FEED

Chapter 6

MANUFACTURING OF NUTRITIONAL SUPPLEMENTS AND SILAGE FOR DAIRY FARMS

Jaswinder Singh, Jaspal Singh Hundal*, Arunbeer Singh, and Akshita Chadda

Department of Veterinary & Animal Husbandry Extension Education

**Department of Animal Nutrition*

Guru Angad Dev Veterinary & Animal Sciences University (GADVASU),Ludhiana, Punjab-INDIA

The dairy industry is an evergreen industry in India and is achieving new heights with every surpassing year. Feed is the major and regular input of all dairy farms and it accounts for 70-75% of the total cost of milk production. The feed of dairy animals is primarily comprised of green fodder, wheat straw, and concentrate. The latter is a dense source of nutrients and is the costliest among the three. Wheat straw- as a filler contributes bulk to the ration. Green fodder- the natural, essential and economic source of nutrients for dairy animals. Presently, India is facing a deficit of 11.24, 23.4, and 24.78% in green fodder, dry fodder, and concentrates, respectively (Roy et al 2019). Nearly 80% of dairy animals are under the possession of landless, marginal and small farmers. These resource-poor farmers having 2-5 animals still adhered to traditional feeding style, which leads to imbalance and deficiency of various nutrients that further affecting the production and reproduction of the animals. Sensitization and capacity building of these farmers about the importance of scientific and balance feeding and nutritional aid will help in overcoming the deficiency of nutrients thereby helping in improving the overall performance of the animal. Feed sector has enormous opportunities for youth to venture into. Few important ones are discussed here-

1. **Mineral Mixture**: Minerals are inorganic elements that originate in the earth and cannot be synthesize in the body, needed in small amounts for the proper functioning of the body. Out of about 40 mineral elements that occur in nature around 20 minerals are considered essential. These essential minerals are further classified into two groups.

i) Macro minerals (major minerals): Required in relatively large amounts (100 mg or more) and are expressed in terms of percentage. The important major elements are calcium, phosphorus, magnesium, sodium, potassium, chlorine, and sulfur.

ii) Micro minerals (minor minerals or trace minerals): Required in trace amounts (<100 mg per day) and are expressed in terms of part per million (PPM) or mg/kg diet. The important trace elements are iron, copper, iodine, cobalt, manganese, zinc, fluorine, selenium, molybdenum, chromium, nickel, silicon, tin, and vanadium

Function of minerals

i) Constituent of skeletal structure like bones and teeth

ii) Regulating acid-base equilibrium

iii) Structural constituents of soft tissues.

iv) Essential components of many enzymes, vitamins, hormones, pigments, etc.

v) Required for proper growth, normal body maintenance, production, and reproduction of dairy animals.

The diets low in minerals affect the animal metabolic functions, thereby leading to an impact on growth, milk production, and reproduction efficiency.

Bureau of Indian Standards (BIS) has recommended two types of mineral mixtures for dairy animals:Type 1 and Type 2. (Table 1).

Table 1 - BIS specification of mineral mixture with and without salt

Sr No.	**Mineral**	**Type 1**	**Type 2**
1	Moisture (%), Max.	5.0	5.0
2	Ca (%), Min	16.0	20.0
3	P (%), Min	9.0	12.0
4	Mg (%), Min	4.0	5.0
5	Salt (%), Min	22.0	
6	S (%), Min	1.4-2.3	1.8-3.0
7	Fe (%) Min	0.3	0.4
8	Zn (%), Min	0.64	0.80
9	Cu, %, Min	0.078	0.10
10	Mn (%), Min	0.10	0.12
11	Co (%), Min	0.009	0.012
12	I (%), Min	0.02	0.026
13	F (%), Max	0.05	0.07
14	Acid insoluble ash, (Max)	2.4	3.0
15	Total ash (%) DM basis	81-85	78-85

Different mineral ingredients are required for the manufacturing of mineral mixture along with the percent mineral content in each (Table 2)

Table 2– Different sources of minerals and mineral content

Mineral	**Source**	**Mineral, %**	**Bioavailability**
Calcium	Calcium carbonate	35-40	Intermediate
	Dicalcium phosphate	Ca 23- 25	High
	Limestone	38.5	Intermediate
Phosphorus	Dicalcium phosphate	16-18	Intermediate
	Sodium Phosphate	21-25	High
Magnesium	Magnesium sulphate,	10-17	High
	Magnesium oxide	50-52	High
	Magnesium carbonate	21-28	High
Iron	Ferrous sulphate	19-20	High
Manganese	Manganese sulphate	22-32	-
Copper	Copper sulphate	23-25	High
Zinc	Zinc sulphate	22-24	High
Cobalt	Cobalt sulphate	20	-
Iodine	Potassium iodide	75	High
	Potassium iodate	50-52	-

Table 3: Formula of the mineral mixture without salt for dairy animals

Ingredient	Percentage
Dicalcium Phosphate	50.00
Limestone powder	29.20
Magnesium Sulphate	5.00
Magnesium oxide	9.20
Magnesium sulphate	0.450
Ferrous Sulphate	1.50
Copper Sulphate	0.400
Zinc Sulphate	3.00
Potassium Iodate	0.050
Cobalt Sulphate	0.050

Sodium Thiosulphate	1.150
Total	100

Most of the Mineral mixture preparations are without salt, so separate supplementation of salt is recommended in the compounded cattle feed @ 1/100 Kg, further mineral mixture can be added @ 2kg/100 kg of concentrate. Individually mineral mixture can be fed as given below

i) Calves: 20-30 gm/day
ii) Animals producing up to 10 kg of milk: 50-60 gm/day
iii) Animal producing 10-20 kg of milk and breeding bull: 80-90 gm

In the Market different types of mineral, mixtures are available like plain, fortified (Mineral and vitamins are simply mixed), and chelated mineral mixture (Mineral(s) are bonded with some organic moiety). Accordingly, their market-rate varies, but generally, a plain mineral mixture is recommended. GADVASU have developed three types of area-specific mineral mixtures (central, south-west and sub mountainous) as per the mineral profile of animals, fodder, and soil of the area. Depending upon regional scenario and type of animals, one could enter into this sector.

ii) Urea-Molasses-Mineral Block (UMMB): Also known as Uromin Lick or Pashu Chat. It is a technique to provide the animal with a constant source of nutrients throughout the day.

Technique: i) Hot method: Take 1200 g molasses and 400 g urea in a big-sized iron pan. Heat and mix them for half an hour on slow heat. This product is called uromol. While Uromol is still hot, a premix containing mineral mixture, 600g; starch, 600 g; deoiled groundnut cake, 400 g; deoiled rice bran, 400 g; common salt, 400 g and bentonite (a binder) 100 g is added to it and again mix thoroughly. The whole contents will be then put into a brick-forming die and pressed through a hydraulic press.

ii) Cold process: Take molasses 900g, urea 300g, mustard cake 300g, de-oiled rice bran 300 g, wheat flour 450g, mineral mixture 450g, calcium oxide 120g, salt 120g, and guar gum 60g. The heat generated by mixing calcium oxide with urea and molasses helped bind the urea and molasses via the Maillard reaction. Guar gum acts as a binder.

Being a blend of energy, protein, and minerals, its regular feeding, especially during the lean period ensures the balance of nutrients intake and thereby helps in normalizing the production and reproduction efficiency of the animal. One uromin lick of approx. 3 Kg weight is usually kept in the manger for licking by animals and it lasts for one week. Uromin licks made by cold process are usually soft in nature so, it is better to cut the lick into seven-piece and then fed one piece on daily basis to avoid the large intake in a single day. Also don't feed uromin lick to animals of less than six months of age or to monogastric animals like pigs, horses etc.

iii): Bypass fat: Fat is an excellent source of energy and is usually recommended during the period of low dry matter intake like during the transition period and during heat stress. But supplementation of common edible fat sources over a certain limit (>5 % of DM intake) may result in lower digestibility of nutrients especially fiber due to the depressing effect on rumen cellulolytic microbial activity. Alternatively, Bypass fat, which is solid at room temperature, can be given to overcome this problem. The quality of bypass fat mainly depends on the type of fat source and its production process.

Technique: i) Weigh and heat 4 kg rice bran oil in the aluminum pan.

ii) Add 120 mL of H_2SO_4 to 500 mL water.

iii) Put acid solution in the pan having hot rice bran oil and boil for 5 minutes.

iv) Dissolve 1.6 kg of calcium oxide in 10 L water and this solution in the pan.

v) Mix and boil for 30 minutes on low flame. Sieve the mixture using a muslin cloth and wash till free of alkali.

vi) Dry mixture under sunlight and add 50 g butylated hydroxy toluene (BHT) powder in 10 kg bypass fat. This mixture contains 84 % bypass fat and 7-8% calcium.

Being a rich source of energy, feeding of bypass fat leads to enhancing the overall performance of the animal. It can be included in the ratio @ 2% level. Individually, bypass fat can be supplemented @ 150-200 grams per animal per day depending upon the animal's physiological condition and season.

4) Silage Making: Being natural feed, green fodder is necessary for dairy animals and it helps in i) nutrient absorption from the ruminal wall, ii) rumination , iii) ruminal motility iv) maintenance of milk fat and v) provides bulkiness to ration. For meeting green fodders requirement, farmers depend upon cultivated /purchased green fodder, crop residue, gathered grass, pasture land and grazing on common land. Fodder is presently cultivated on about 5% of the gross cropped area against the recommended 10% area (Roy et al, 2019). Sorghum, Berseem, Lucerne, Maize, Bajra, fodder cowpea, and oats are the major cultivated fodders across the country. But the fragmentation of land over a generation, stagnancy in agriculture production, and price force the farmer to sow the cash crop in the maximum area to earn his livelihood. Farmers this practice takes a toll on fodder cultivation and the area under fodder. Some major fodder deficit states of countries are given below

Table 4 : Fodder deficit in some major states/UT of India

S No	State/UT	Fodder deficit(%)	S No	State/UT	Fodder deficit(%)
1	Chandigarh	97.90	2	J&K	53.0
3	Uttarakhand	55.50	4	Bihar	28.4

5	Jharkhand	67.70	6	Odisha	44.8
7	Rajasthan	32.70	8	Goa	34.20
9	Chattishgarh	33.10	10	UP	23.60
11	Andhra pradesh	62.90	12	Tamil Nadhu	36.00

(Source : Roy et al 2019)

The above table clearly depicts the disparity and shortage of fodder in major states of the country. Lack of quality fodder during the lean period and farmers' inability to feed the animal on high-priced concentrate feed, forced them to keep their animals on either wheat straw alone or with little bits of cakes. This makes the animal deficient in the various nutrient, which results in poor health and immunity, decrease in production, poor infertility etc. During the lean period, fodder prices shoot up to double-level as compared to prices in glut season. It is therefore necessary to conserve the surplus fodder during the glut season of Rabi and Kharif season either by making silage or by haymaking.

Small and marginal farmers can cater to this opportunity of fodder scarcity by making silage and hay and selling it to the other livestock farmers in lean periods. Farmer can do this venture singly or collectively. Collectively they can lend the panchayat land (shamlat) or other lands for the pit formation. They can grow the green fodder in their own field or they can purchase the green fodder in glut season from the big farmers having surplus fodder. The various Govt departments are also promoting community-based silage making.

Generally, crops with high carbohydrate contents (10-15% sugar on dry matter basis) are used for silage making. The most commonly used crops are Maize, Jowar, Oat and Bajra. Quality fodders are those fodder that is harvested and fed at an appropriate and recommended stage when fodder is enriched with nutrients. Early harvested fodder crop is low in dry matter and the late-harvested crop is high in lignin content which lowers its digestibility.

Table 5: Best harvesting stage of some fodder crops

S.NO	**Fodder crop**	**Stage of harvest**
1	Maize	Dough stage
2	Charri/sorghum	From ear formation to grain formation
3	Bajra	At the time of ear formation
4	Napier Bajra	At the height of 1 meter
5	Oat	50% flowering stage
6	Rye grass	First harvesting at 45-50 days and next after 25-30 days

Providing quality and fresh fodder round the year to dairy animals is a very tedious, cumbersome, and

laborious job at the farmer level because it requires strategic sowing and harvesting which demands extra labour. So progressive and large dairy farmers started venturing into silage making to reap the benefit of maximum nutrients in fodder. But for small/medium farmers it seems implausible due to the dearth of land, labour, and other resources. So, commercial silage is the best way to provide them quality fodder round the year. Sensing the potential in the silage sector, many innovators, and companies already invested in it and earning good profits. They even started purchasing fodder crops directly from the farmers to match the demands.

Advantage of making silage:-

1. It can be used during scarcity of green fodder like in the month of June or July.
2. Minimum loss of nutrients compared to other methods of preservation.
3. Succulent feed is made available round the year.
4. It requires less area for storage as compared to hay.
5. Helps in control of weeds as the fodder is harvested from the field at the bloom stage.
6. No danger of fire to silage.
7. It is a palatable and laxative feed.
8. Compared to pasture there is less infestation of worms and parasites with silage feeding.
9. The inclusion of raw organic waste like poultry excreta is possible through silage.
10. Decrease the anti-nutritional factors present in various fodder crops as given below

Green fodder	**Anti nutritional facter**	**Quantity**		**% Decrease**
		Green fodder	**Silage**	
G. Grass	Nitrate (ppm)	392	300	23
Bajra	Oxalate (%)	2.1	1.3	62
N. Bajra	Oxalate (%)	2.6	1.4	54
Punjab Sudex charri-1	Prussic acid (ppm)	90	0	100

(Gupta et al, 2006)

Silage can be made either in a seamless bag or as bale in a silage baler machine. A silage baler machine, depending upon capacity can make a bale of different capacities ranging from 50-1000 kg.

Steps in silage making:

Silo pit

- Silo pit must be at higher altitude/elevation to prevent seepage or rain water into silo pit.
- Location of silo is such that it is easy to distribute the silage to animals.
- It should be away from milking room/collection room to prevent its flavour creeping into milk.
- The bottom of silo must be free from moisture and usually should be above the water table.
- The walls of silo should be strong enough to withstand pressure of gases and there should be no entrance of fresh air.

Harvesting of fodder crop

- Crops at pre-flowering to flowering stage should be harvested.
- After harvesting, green fodder should be chaffed by using chaff cutter machine.
- 80% and 20% of crop must be chopped 1-3 cm and 3-5 cm, respectively for better packaging and quality silage preparation.

Filling of silo

- After chaffing, start to fill green fodder in a pit.
- It is better to spread a layer of hay or straw at the base.
- Chaffed fodder should be evenly spread throughout the silo and pressed to expel the maximum air out and trap the minimum air in silo.
- After making 4' thick layer of ensiling mass, press it manually or with tractor to expel maximum air out of silo
- Follow the same procedure until complete filling of the pit.
- Silo pit filling should be completed within 1-2 days (preferably within one day).
- After thorough pressing, top should be covered with polythene followed by soil layer of 6 inches depth. Plug all possible areas of air or water entry.
- It will require 45 days to make good quality of silage

Characteristics of good silage:-

- Smell: Pleasant or vinegar type
- Colour: Bright and light green.
- pH: 3.8-4.2

- Lactic acid content: >4%
- Acetic acid content: 1-3%
- Butyric acid content: < 0.13%
- Ammoniacal nitrogen: <10% of total nitrogen

How to remove the silage

- Silage quality can deteriorate rapidly during feed out
- If exposed silage surface open to air for longer periods of time, yeast and mold become active and result in silage heating which ultimately leads to DM and energy losses.
- So, feed out rate should be sufficient to avoid heating at the silage face.
- Feed at least 4- 6 inches of silage per day from pit or bag
- Minimum disturbance of the feeding face, to minimize air penetration.
- Silage should not be removed prior to the time of feeding.
- There should be little to no silage left at the base of the face after feeding is done for the day

Feeding of silage

- After 45 days, silage is ready as feed for animals.
- Feeding of silage should start gradually i.e. 2-5 kg and after a week feed it at the rate of 20-30 kg/animal/day.
- Feed the silage at least 4 hours before milking of after milking.
- Feeding of damaged or discoloured silage should be avoided

Bale silage: Also known as balage. Generally, these bales are 4 feet wide and 5 feet diameter. Farmers can store these bales anywhere they need it. Plastic bags are economical alternative to traditional silage storage system for small farmers. It is an effective way for preserving feed with minimum nutrient loss. The silage is completely sealed in the bag or tube. It has the additional advantage as all the acid is retained in the silage unlike that of pit silage where it seeps out as effluent loss. No problem of spoilage after opening as the single bales have to be open at the time of use and in tube silage surface exposed is very less

Farmers/unemployed youth can venture into either fodder cultivation to supply the same to silage-making firms or in silage making as balage (bale of silage). Many companies are already started a contract fodder cultivation system at a pre-decided price. Silage demand will increase significantly in the coming time due to enhanced focused on dairy as well as the improved knowledge level of dairy farmers. Moreover, silage making and selling is now not an area-limited venture. Anyone can supply a bale of silage to any state having fodder scarcity/demand, directly to commercial farmers, calamity-affected areas, and milk

cooperatives across the country. Interested youth/farmers can contact startup incubators unit functional at various state agricultural universities/institutes to avail the benefits of the prevailing scheme and technical guidance.

Chapter 7

INTEGRATED FARMING SYSTEM (IFS) FOR ENHANCING SUSTAINABLE RURAL LIVELIHOOD SECURITY

Y.S. Jadoun, Jaswinder Singh and Akshita Chadda

Department of Veterinary and Animal Husbandry Extension Education,

Guru Angad Dev Veterinary and Animal Sciences University(GADVASU), Ludhiana, Punjab

---

In the present situation the demand and supply for food has changed due to higher population and the shift of people in the cropping pattern. The per capita availability of land is decreasing day by day because of growing in the population. So, in order to meet out the demand of increasing population to produce more quantity by maintaining the quality of food in limited area. By adopting the integrated farming system which requires lesser space and ensures higher productivity of the system is the only option which left out for us. The practice of cash return farmers will improve the economic condition of the farming community.

Integrated farming system (IFS) represents an appropriate combination of farm enterprises *viz*. Cropping systems, horticulture, livestock, fishery, poultry, forestry and the means available to the farmers to raise them for profitability. It interacts effectively with environment without dislocating the ecological and socio-economic balance on one hand and attempt to meet the national goal on the other. The farming system in its actual sense will help in different ways to lift the economy of agriculture and standard of living of the farmers of the country as a whole.

Key principles of IFS

Cyclic: The farming system is basically cyclic (organic resources – livestock – land –crops). Therefore, management decisions linked to one component may affect the others.

Rational: Using crop residues more judiciously is an important route out of poverty. For resource-poor farm families, the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production.

Ecologically Viable: Linking ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

Objectives of IFS are:

- To identify present farming systems in specific areas and access their relative feasibility.

- To frame farming system model involving main and related enterprises for different farming situations.
- To ensure optimal utilization and safeguarding of available resources and effective recycling of farm residues within system and;
- To maintain viable production system without damaging resources/environment.
- To increase overall productivity of farm household by complementing main allied enterprise with each other.
- To maintain environmental excellence& ecological stability.

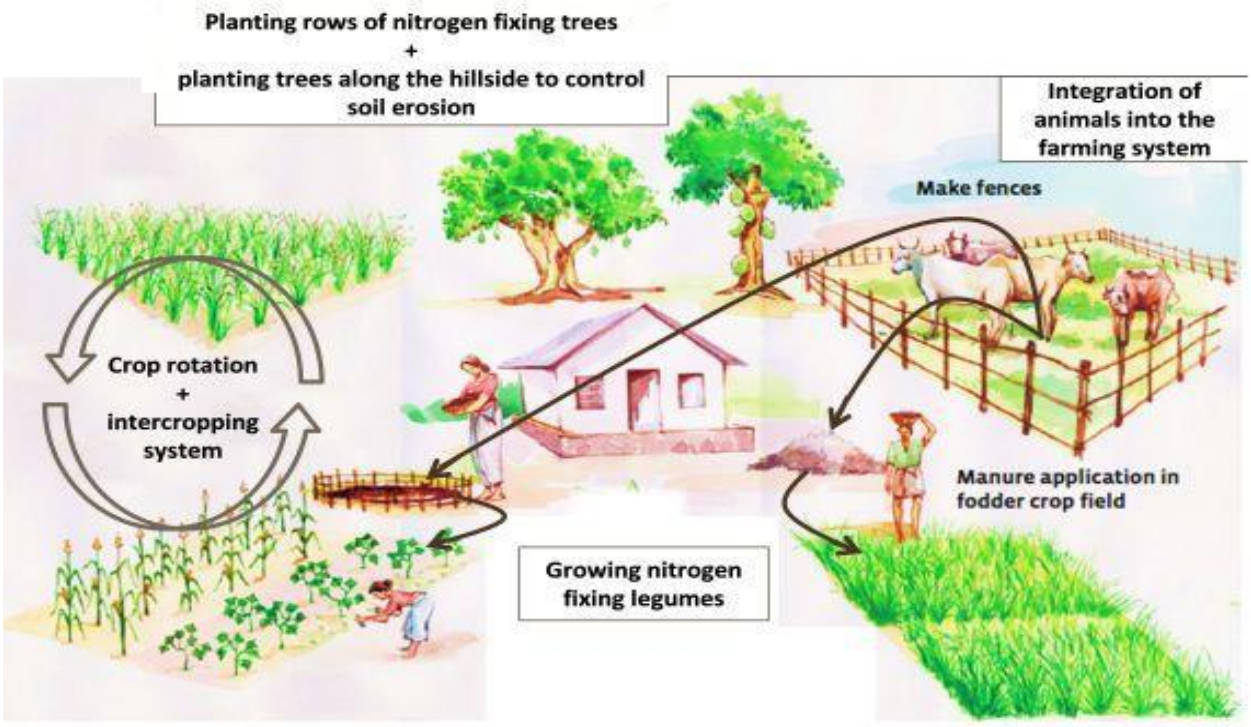


Fig 1. Integrated Farming System Model

Goals of Integrated Farming Systems (IFS):

- Provide a stable and constant income transformation of the system's productivity
- Achieve agro-ecological stability through the reduction in the build-up of pests and diseases, through natural cropping system management and the reduction in the use of chemicals (inorganic fertilizers and pesticides).
- Maximize return from the unit area
- Maintaining soil status and fertility

- Exploiting the byproduct of one component of the farming system as an input in other
- Reducing environment pollution
- Increasing cost-effective yield per unit area, per unit time, profitability & sustainability
- Provides balanced nutritious food to the farming community & pollution free environment
- Income round the year
- Solve the energy, fodder, fuel & timber crisis
- Rural employment generation
- Improve the socio-economic status (SES) of the farm families.
- Reduced expenditure & increased net profit

Components of Integrated Farming Systems (IFS):

- Crop Husbandry
- Livestock
- Poultry
- Duck farming
- Horticulture/Vegetable Farming
- Aquaculture
- Bee Keeping
- Sericulture
- Mushroom Cultivation
- Agro-forestry
- Bio-gas Plants
- Miscellaneous Enterprises

Types of Integrated Farming System

- Crop-livestock farming system (CLFS)
- Crop-livestock-fish farming system (CLFFS)
- Crop-livestock-poultry-fish farming system (CLPFFS)
- Crop-poultry-fish-mushroom farming system(CPFMFS)
- Crop- fish - poultry farming system(CFPFS)
- Crop-livestock-fish-vermicomposting farming system (CLFVFS)
- Crop-livestock-forestry farming system(CLFFS)
- Agri-silvi-horticulture system (ASHS)

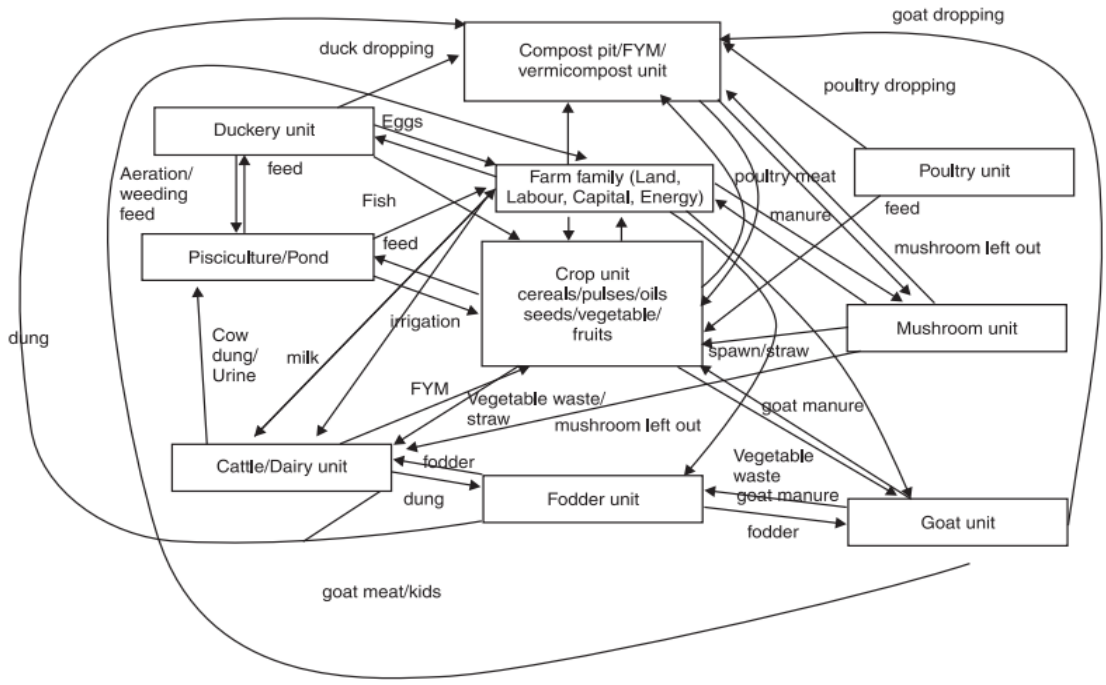


Fig.2 Input-output flow diagram of developed IFS Module (Source: Kumar *et al.* 2018)

Scope of Farming System

Integrated Farming enterprises include crop, livestock, poultry, fish, horticulture, sericulture etc. A combination of one or more enterprises with cropping system when carefully chosen, planned and executed gives greater dividends than a single enterprise, especially for small and marginal farmers. Farm as a unit is to be considered and deliberate for effective integration of the enterprises to be combined with crop production activity.

Combination of Farm Enterprises Depends on Many Factors Such as:

- Soil and climatic features of the selected area.
- Availability of the resources, land, labor & Capital.
- Present level of utilization of resources.
- Economics of proposed integrated farming system.
- Managerial skill of farmer.

The Characteristics of Integrated Farming System Research

- It is holistic or system oriented,
- It is problems solving: involvement of farmers in problem identification and solving process,
- It is farmer participatory,

- It emphasizes extensive “On Farm” activities.
- It envisages location specific technology solutions,
- It adopts bottom up approach,
- It recognizes Indigenous Technology Knowledge (ITK)
- It is gender sensitive,
- It ultimate objective is sustainability,
- It focuses on actual adoption,
- It recognizes interdependence among multiple clients.

Advantages of Integrated Farming System

In an integrated system, livestock and crops are produced within a coordinated framework. The by-product of one component serves as a resource for the other. For instance, manure is recycled to improve crop production; crop residues and by-products feed the animals, supplementing often inadequate feed supplies, thus contributing to improved animal nutrition and productivity.

The result of this cyclical combination is the mixed farming system, which exists in many forms and represents the largest category of livestock systems in the world in terms of animal numbers, production and the number of people linked with it. Animals play key and manifold roles in the functioning of the farm, and not only because they provide livestock products (meat, milk, eggs, wool, and hides) or can be converted into prompt cash in times of need.

Animals transmute plant energy into useful work: animal power is used for ploughing, transport and in activities such as milling, logging, road construction, marketing, and water lifting for irrigation. Animals also provide manure and other types of animal waste. Excreta have two vital roles in the overall sustainability of the system.

The advantages of IFS include pooling and sharing of resources/inputs, efficient use of family labour, conservation, preservation and utilization of farm biomass including nonconventional feed and fodder resources, effective use of manure/animal waste, regulation of soil fertility and health, income and employment generation for many people and increase economic resources. It improves space utilization and provides diversified products. The IFS is part of the strategy to safeguard sustainable use of the natural resources for the benefit of present and future generations.

Productivity: IFS offers an opportunity to increase economic yield per unit area per unit time by virtue of escalation of crop and allied enterprises.

Profitability: Use byproduct of one component at the least cost. Thereforedecreasein the cost of production

and form the linkage of utilization of waste material and elimination of middleman interference in most inputs used. Working out net profit/ BC ratio is increased.

Sustainability: Organic supplementation through actual utilization of byproducts of allied component is done thus providing an opportunity to sustain the potentiality of production base for much longer periods.

Provide Balanced Food: Components of varied nature are linked to produce different sources of nutrition.

Environmentally Friendly: In IFS waste materials are effectively recycled by linking appropriate components, thus minimize environment pollution.

Improvement Nutrient Recycling: Effective recycling of waste material (crop residues and livestock wastes) in IFS. Therefore, there is less reliance to external inputs – fertilizers, agrochemicals, feeds, energy, etc. & also contains several nutrients (including nitrogen, phosphorus and potassium) and organic matter, which are important for maintaining soil structure and fertility. Through its use, production is augmented while the risk of soil degradation is reduced.

Income throughout the year: Due to collaboration of enterprises with crops, eggs, milk, mushroom, honey, cocoons silkworm, it provides flow of money to the farmer round the year.There is higher net return to land and labour resources of the farm families.

Adoption of Innovative Technologies: Large farmers fully utilize technology. IFS farmers, linkagesthe dairy / mushroom / sericulture / vegetable. Money flow whole year gives an inducement to the small/ original farmers to go for the adoption technologies.

Providing & saving energy: Excreta is the basis for the production of biogas and energy for household use (e.g. cooking, lighting) or for rural industries (e.g. powering mills and water pumps). Fuel in the form of biogas or dung cakes can replace charcoal and wood & identify an alternative source to reduce our dependence on fossil energy source within short time. Actual recycling technique the organic wastes available in the system can be exploited to generate biogas. Energy crunch can be postponed to the later period.

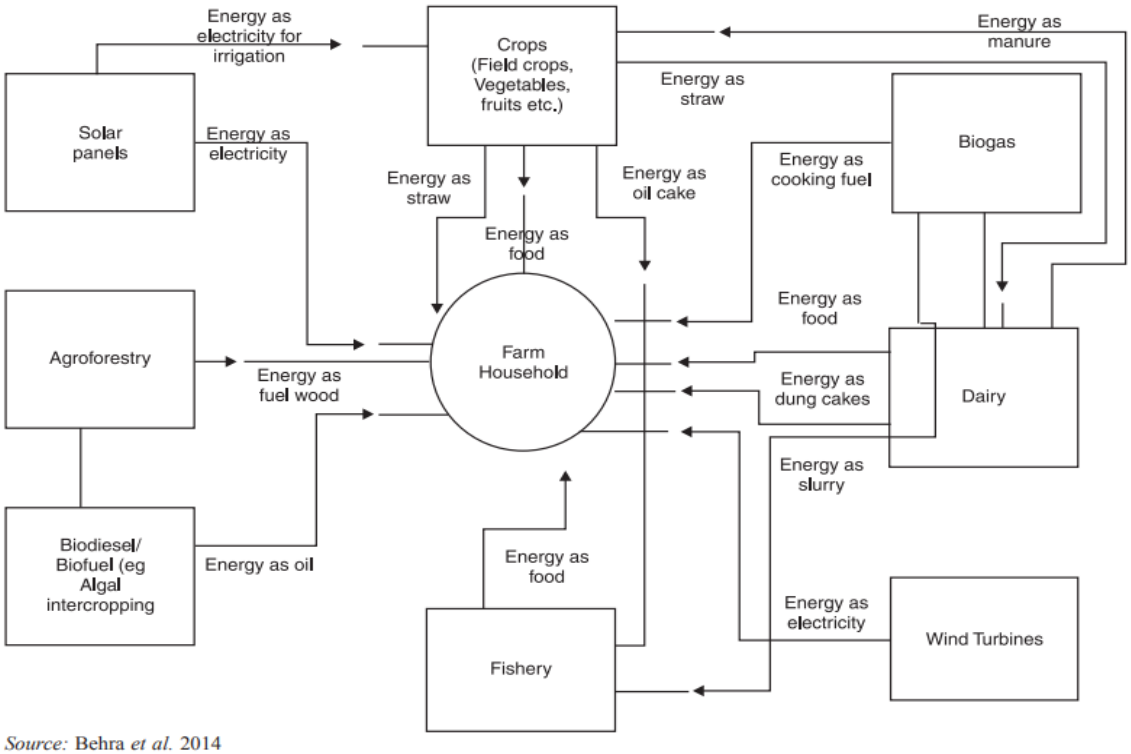


Fig 3. Energy flow among different components of the energy (E)-IFS Module

Meeting Fodder crunch: Every piece of land area is well utilized. Plantation of perennial legume fodder trees on field boundaries and also fixing the atmospheric nitrogen. These practices will greatly solve the problem of non – availability of quality fodder to the animal component linked.

Resolving Fuel and Timber Crisis: Linking agro- forestry properly the production level of fuel and industrial wood can be enhanced without determining effect on crop. This will also significantly reduce deforestation, conserving our natural ecosystem.

Creation of Employment Opportunities: Combing crop with livestock enterprises would increase the labour requirement significantly and would help in reducing the glitches of under employment to a great extent. IFS provide adequate scope to employ family labour round the year.

Agro – industries: When one of produce linked in IFS are increased to profitable level there is surplus value adoption leading to development of allied agro – industries.

Increasing Input Effectiveness: IFS provide good scope to use inputs in different component with greater efficiency and benefit cost ratio.

The overall benefits of crop-livestock integration can be summarized as follows:

- Agronomic, through the retrieval and maintenance of the soil productive capacity;
- Economic, through product divergence and higher yields and quality at less cost;

- Ecological, through the decrease in crop pests (less pesticide use and better soil erosion control)
- Social, through the reduction of rural urban migration and the creation of new job opportunities in rural areas.
- It helps improve and conserve the productive capacities of soils, with physical, chemical and biological soil recuperation. Animals play an important role in harvesting and relocating nutrients, significantly improving soil fertility and crop yields.
- It is rapid, efficient and economically sustainable because grain crops can be produced in four to six months, and pasture formation after cropping is rapid and inexpensive.
- It helps increase profits by reducing production costs. Poor farmers can access fertilizer use from livestock operations, especially when rising petroleum prices make chemical fertilizers unaffordable.
- It results in greater soil water storage capacity, mainly because of biological aeration and the upsurge in the level of organic matter.
- It provides varied income sources, guaranteeing a buffer against trade, price and climate fluctuations.

Table1. Economic Viability of Integrated Farming System Research models developed in different states of the Country

State	Prevailing system	Net return	Integrated Farming System	Net returns	References
Tamil Nadu	Rice-rice-blackgram	8,312	Rice-rice-cotton + maize	15,009	Shanmugasundaram *et al.* (1995)
			Rice-rice-cotton + maize + poultry /fish	17,209	Shanmugasundaram and Balusamy (1993)
	Rice-rice	15,299	Rice-rice-Azolla/Calotropis + Fish	17,488	Balusamy (2003)
	Rice-rice-rice-fallow-pulses	13,790	Rice-rice-rice-fallow-cotton + maize + duck cum fish	24,117	Ganeshan *et al.* (1990)
	Cropping alone	36,190	Cropping + fish + poultry	97,731	Jayanthi *et al.* (2001)
			Cropping + fish + pigeon	98,778	
			Cropping + fish + goat	13,1118	
	Rice	22,971	Rice + fish	28,569	Balusamy (2003)
			Rice + Azolla + fish	31,788	
Goa	Cashew	36,330	Coconut + forage + dairy	32,335	Manjunath and Itnal (2003)
			Rice-brinjal (0.5 ha) + Rice-cowpea (0.5 ha) + mushroom + poultry	75,360	
Madhya Pradesh	Arable farming	24,093	Mixed farming + 2 cow	37,668	Tiwari *et al.* (1999)
			Dairy (2 cows) + 15 goats + 10 poultry + 10 duck + fish	44,913	
Maharashtra	Cotton (K) + Groundnut (S)	(-) 92	Blackgram(K) - Onion (R)-Maize + cowpea	1,304	Shelke *et al.* (2001)
				3,524	
			Crop + dairy + sericulture	5,121	
			Crop + dairy		
Punjab	Crops (rice-wheat)	81,200 (gross)	Crops (rice-wheat) + dairy	15,4000 (gross)	Gill (2004)
			Fish + piggery	113,200 (Gross)	
Uttar Pradesh	Crops (Sugarcane-wheat)	41,017	Crops (sugarcane+wheat)+dairy	47,737	Singh (2004) Singh *et al.* (2006)
	Crops alone	66,371	Crop + Dairy	103,615	
			Crop + Dairy + Horticulture	107,467	
			Crop + Dairy + Apiary	134,382	
			Crop + Dairy + Vermicomposting	139,472	
Karnataka	rice–rice system	21,599	Rice-fish (pit at the center of the field) – poultry (reared separately)	62,977	Chnnabasavanna and Biradar (2007)
			Rice-fish (pit at one side of the field) – poultry (shed on fish pit)	49,303	
Bihar	Rice-wheat	22,234	Cropping + poultry + goatry + mushroom	89413	Kumar *et al.* (2017).

Source: Kumar *et al.* 2018

Some lessons learned and recommendations:

- The maintenance of an integrated crop-livestock system is dependent on the accessibility of adequate nutrients to sustain animals and plants and to maintain soil fertility.
- Animal manure alone cannot encounter crop requirements, even if it does contain the kind of nutrients needed. This is because of its comparatively low nutrient density and the limited quantity available to small-scale farmers. Alternative sources for the nutrients need to be found.
- Growing fodder legumes and using them as anadd-on to crop residue is the most practical and cost-effective method for improving the nutritional value of crop residues. This amalgamation is also effective in reducing weight loss in animals, particularly during dry periods;
- Given their indigenous knowledge and experience, local farmers are perfectly able to apply an integrated system. In routine practice, however, relatively few adopt this system, mainly because they have limited access to credit, technology and knowledge. The crop-pasture rotation system is complex and needs a substantial capital outlay for machinery and implements.
- Associations of grain and livestock producers are useful for filling these slits and can promote the adoption of a crop-livestock system;
- Veterinary services are normally unable to reach poor small farmers in remote areas. Therefore, for livestock production to be improved; more attention needs to be paid to making veterinary care accessible, particularly in terms of prevention;
- Better livestock management is needed to safeguard water. Livestock water demand includes water for drinking and for feed production and processing. Livestock also have an impact on water, contaminating it with manure and urine. All of these aspects need to be given due consideration.
- Intensification of agriculture through suitable incorporation of small livestock has the potential to decrease the land needed for agricultural production and relieve the pressure on forests.

The further thrust of IFS is: There is a necessity to create the database on farming system in relation to type of integrated crop-livestock farming system, set-up, economics, sustainability etc. under different farming condition.

- Developing research modules of farming system is necessary under different holding size with varying economically viable and socially acceptable systems.
- The assessment and refinement of the technologies developed at research station at farmer’s field.
- Need to prepare a contingent planning to counteract the climatic threats under diverse farming situation.

- Need to prepare a policy draft for the consideration of planners for its promotion at large scale with nominal financial assistance either through short/ medium/ long term credit facilities.

Conclusion

Integrated farming system seems to be the answer to the glitches of increasing food production, for increasing income and for improving nutrition of the small-scale farm families with limited resources without any antagonistic effect on environment and agro-ecosystem. The IFS provides a progress of money to the farmer round the year by way of disposal of milk, meat, eggs, edible mushroom, honey, silkworm cocoons, etc. This will help a resource-poor farmer to get out of the clutches of moneylenders/agencies. Recycling of organic wastes reduces the requirement of chemical fertilizer. Further, biogas production can meet the household energy requirement. Thus, IFS goes a long way in solving energy crises.

Chapter 8

MARKETING OF MILK AND MILK PRODUCTS

Inderpreet Kaur

College of Dairy Science & Technology,

Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana, Punjab

---

Punjab, one of the smallest states, covers only 1.53% geographical area of the country. The state has been one of the world's most remarkable examples of agricultural growth in India. Rice-wheat system in the farming economy of Punjab has not only attained its potential but also led to depletion of soil and water reserves of the state. The technology has shown the signs of fatigue; the income growth has slowed down and employment has shrunk. The livestock sector is an important sub-sector of Punjab agriculture.

Livestock Sector is one of the remunerative alternatives to the wheat-rice system in Punjab which provides regular income and employment to the households especially small and marginal farmers. This regular source of income acts as a cushion to the inclement weather linked risks to seasonal income from crop sector. The contribution of livestock sector to Punjab's agriculture and allied GDP has increased from Rs. 727.08 crore (30.0%) during 1980-81 to Rs 53,157.70 crore (40.6%) during 2019-20. Till now, the growth in Dairy sector is demand based and self-driven. The growth rate of this sector is very consistent and has remained above 5 per cent in last 5 decades. Milk production in Punjab is increasing throughout the year in spite of decrease in bovine population. Punjab is the only state where dairy production system is characterized by rural as well as modern commercial farms. Both are backbone of the state's dairy production system contributing 13.39 million tonne (6.38 per cent) milk to national milk pool of India (209.9 million tonne) with only 2.16 per cent dairy animals. The state stands first in terms of per animal milk productivity as well as per capita milk availability (1225 gm/day vs 407 gm/day) in the country. The value of output of livestock sector has increased by 419 percent in last two decades. The livestock sector has grown at 6.43 percent in last decade. Within the livestock sector dairy has important place as out of total value of output of the sector, 80 per cent is being contributed by the dairy sector.

Dairy development has a very important place in the rural development of India as it can increase the income and employment of small and landless agricultural laborers. The dairy business plays an important role in alleviating poverty and improving nutritional security. To supplement the income, small and medium farmers have shifted to the dairy business in particular, which consumes their extra family labor and

requires less land resources and generates regular cash income.

Dairy sector is Market driven:

The importance of animal products as a source of quality food has increased manifold. Household expenditure are also showing increasing trends towards the animal products and decreasing trends towards the cereals. Between 1983 and 2011, the share of animal products in the total food expenditure increased from 21.8% to 25.0% in urban areas and from 16.1% to 24.2% in rural areas.

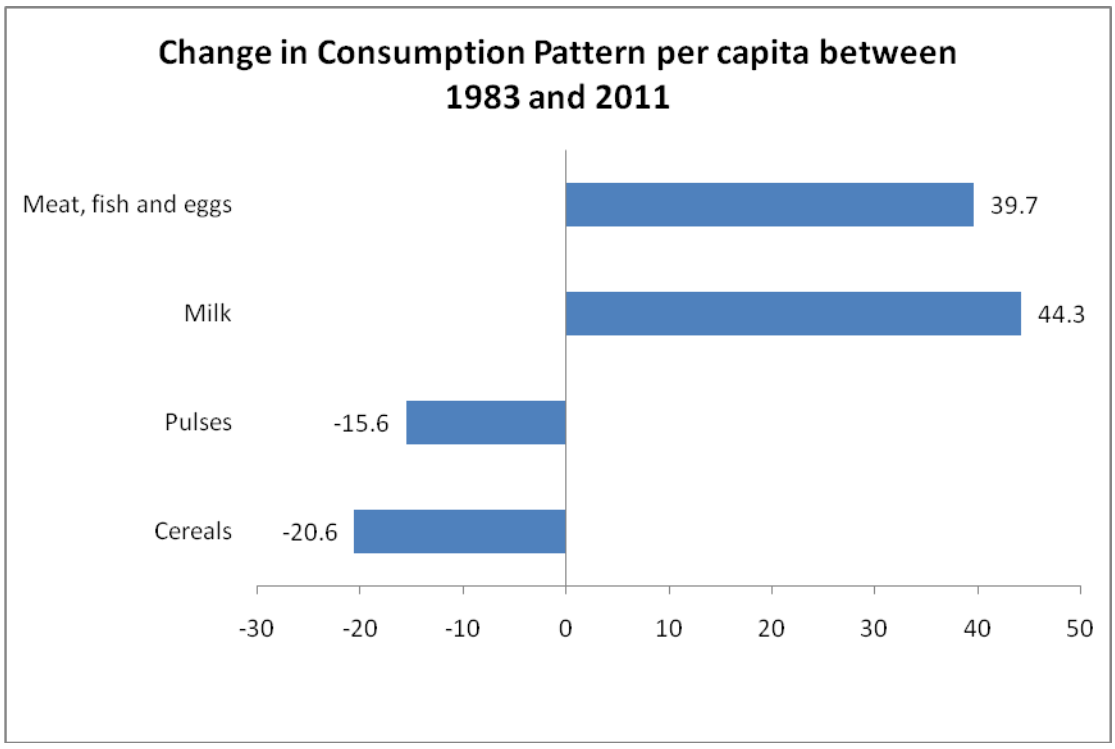


Figure 2: Change in Consumption Pattern per capita between 1983 and 2011

Figure 2 showing that between the period 1983 to 2011, consumption of cereals has been declining (declined by 20.6 percent) and pulses have shown the same trend in this period as declined by15.6 per cent .Food expenditure pattern of population is changing, In recent times, major portion of budget has been spent on livestock products. per capita consumption of milk has increased by 44.3 percent in period of 1983 to 2011-12. In various studies, Expenditure elasticity of demand for dairy have been estimated to be 0.99–1.32 for urban areas and 1.15–1.96 for rural areas (Sharma et al., 2008), this means that demand growth is expected to be higher in the rural areas

Marketing of Milk and Milk products in Punjab:

The total milk production in Punjab in the year 2019-20 was 13.35 million tonnes Most of the milk production is done in rural areas. A large portion of the milk that comes in the market is produced by small dairy farmers. These small dairies are found unorganized throughout the state. There is no doubt that the cooperative has made some place in the marketing of milk in the rural areas but still the milk supply is

dominated by the unorganized sector (private dairies, vendors. The share of organized sector is only 35%. The unorganized market, which is made up of dairy and confectionery, still dominates the market. Both the consumer and the milk producer are exploited in the private and unorganized market.

The most important component in the marketing of milk is the rate of milk as it mainly affects the income and profit of the producer. Thus in order to increase the marketing of milk through the organized sector, higher prices of milk should be offered to the producers by the major players in the organized sector like cooperatives and other private plants. Milk collection needs to be improved to bridge the gap, which will help reduce the cost of transportation by (especially small) farmers. Milk and milk products are marketed in Punjab through the following channels:

1) Manufacturers - Consumers
2) Producers - Dairy users
3) Producers - Confectioners - Consumers
4) Producer - Dairy - Confectioner - Consumer
5) Producers - Cooperative Milk Plant - Consumers
6) Producers - Private - Milk Plant – Consumers

Out of all these channels, number 1 and 5 channel is more useful for the producer. Milk production in the state is small in scale and spreads across the state. Therefore marketing of milk through cooperative society is most beneficial. In this way the producer gets the right price of milk and there is more profit. This type of marketing connects the village milk producer with the city consumer. Most of the milk plants are found in cities only because the urban consumer has no direct contact with the village milk producer. In addition, if the farmer markets milk directly, he gets huge profit but because of shortage of milk per farm, it is not possible for every farmer to market directly. Therefore, farmers should keep in mind the following to make marketing more efficient:

1) There are about 50 such houses in each village which produce 8-10 liters of milk per day. Together they can sell milk by forming an organization and branding themselves, which will increase their profits.

2) In addition, dairy farmers can sell milk by forming a farmer producer company. The government is also encouraging farmers to become farmer producer companies. Any farmer who is above 18 years of age and owns buffaloes and cows can become a member of Kisan Farmer Producer Company. To become a member you need to fill out a membership form. The fee is Rs.100 and Rs.50 for women farmers. Farmers who are milking in the unorganized sector like dairy or confectionery should consider leaving that channel and forming a farmer producer company or becoming a member. That way they can increase their income.

3) Farm level processing is another way to increasing shelf life of milk and that will result in better

bargaining power as well. Dairy farmers can make milk products like cheese, milk, butter, cream etc. and make their own outlets and sell them.

4) Nowadays everyone has a smart phone and can advertise their farms by posting photos and videos of Dairy on social media like Facebook, WhatsApp. They can order milk and milk products by giving their phone number on social media. Dairy farmers can show the cleanliness of their farm through photos and videos which will motivate the buyer to get milk from it.

5) Cooperative Societies need to increase their coverage in the villages of Punjab. As more and more farmers become members of the co-operative society, so the co-operative society needs to be formed in such a way that advance payment can be made to the producer and milk procurement can be increased.

6) Brand Building in case pf milk products will help the farmer for better marketing as well as sustainability of dairy business. Brand names attract customers. Customers prefer brand names and sales outlets based on product types. Creating a place in the minds of the customers by providing a distinct brand value that thrives on heritage, quality, nutritional benefits, price, and needs is very important.

7) Apart from organized marketing, small farmers need to find such resources so that they can compete with the cost of big operators. In addition to the size of the farm, proper financial and business management is essential for financial success. It is important to make decisions based on profit. Trade and production records must be accurate.

With the above mentioned changes, farmer can bring the efficiency in business. Marketing is very important as profit margins will be decided with the decision of farmer to stay in which marketing channel.

Chapter 9

ESTABLISHMENT OF MINI MILK PROCESSING PLANT

Narender Kumar* and Gursharn Singh

College of Dairy Science & Technology,

Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana, Punjab

---

A mini dairy processing plant is generally a composite-multiprocessing dairy processing plant established with a clear mandate to process the small scale dairy farmers produce at their premises. The mini dairy processing plant is generally established by individuals, societies and shelf help groups depending on litre per day capacity (LPD). Therefore, a one stop solution to process the milk on-farm by mini dairy processing plants can largely solve the untapped problem of raw milk handling and processing. In addition the product made on farm processing would be of better quality as of fresh milk is directly being processed into value added dairy products viz.-a-viz. milk cake, peda, curd, lassi, ghee, sterilized flavored milk/whey drinks. Nowadays, there is an ever-growing demand for the value added dairy products due to changing habits, supermall display concept, and change in the lifestyle/economics pattern of the society. Time taken between milking and delivery to the milk collection centre may prevail and even cooling and processing is carried out off the farm. There is a need to diversify the agriculture and to opt for value addition to milk to increase the farmers' incomes from milk processing in particular the state of Punjab.

Dairy Plants

Processing plant involves procurement of milk, chilling, standardization; homogenization, pasteurization, and packaging of different milk variants and value added dairy products. Design and plant layout depends up on the capacity, type of machinery and the type of dairy product to be processed. Majorly, of dairy processing plants are classified as small, medium and large scale. Mainly, liquid milk, composite milk product and creameries type of processing plant are categorized depending upon the choice of processing for a specific product. Generally, mini dairy processing plant of 2000 to 10000 LDP is capable of processing multiple products like liquid milk, paneer, ghee, curd, lassi, ice-cream and flavored milk.The milk quality is determined by examining microbial and chemical quality-related attributes and is addressed by good laboratory practices. We know that the poor quality of milk impactsall the segments of the dairy industry. So, it is imperative to maintain the quality of milk during the whole supply chain starting from milk production, handling of milk, cold chain storage, processing, packaging, distribution and retailing to

maintain the overall quality of the dairy product. Improving the safety and quality of milk products fetch a good price for the milk produced by the dairy farmers as well as benefit the milk processors. Therefore, high production of premium quality milk is very important emphasizing the good manufacturing practices (GMP) to achieve the best quality of milk and milk products from the "field to fork". Mini milk processing plant capacity ranged from 1000 to 10,000 LPD (max.) is recommended for better plant economics and profitability. In this type of mini dairy processing plant, the following products may be processed and packaged.

- Liquid milk
- Paneer
- Curd
- Lassi
- Flavoured milk
- Ice-cream
- Khoa, peda
- Ghee, etc.

Mini dairy processing plants are established to cater the need of, on-farm processing of value-added milk products of premium quality milk products.Farmers directly link to the nearby commercial market, milk production and processing possible at the dairy farm level, initiation of new dairy processing ventures, delay in milk processing is prevented as of on-farm processing of milk, higher earnings to the dairy farmer and recognition to small scale dairy processors begins with the establishment of small dairy processing plant.

Dairy processing plants

Processing plant involves procurement of milk, chilling, standardization; homogenization, pasteurization, and packaging of different milk variants and value-added dairy products. Design and plant layout depend upon the capacity, type of machinery and the type of dairy product to be processed. Majorly, dairy processing plants are classified as small, medium and large scale. Mainly, liquid milk, composite milk product and creameries type of processing plant are categorized depending upon the choice of processing for a specific product. Generally, a mini dairy processing plant of 2000 to 10000 LDP is capable of processing multiple products like liquid milk, paneer, ghee, curd, lassi, icecream and flavoured milk.

Machinery involved in milk processing plants

A mini dairy processing plant is generally involved basic machinery to execute the cooling, heating, mixing, pressing, cutting and packaging of composite dairy products. The dairy processing plant includes machinery

likewise homogenizer, cream separator, mixing system, sterilizer, form & fill machinery, paneer & cheese cutting, moulding equipment, clean in place (CIP) storage system and circuits, Vat for ageing, ice cream freezers, pasteurisers, etc.

Establishment of milk processing plant

Processing of milk required processing building which includes raw milk reception dock (RMRD), main processing hall, provision for the manufacture of other products, cold storage, clean in place (CIP), laboratories (chemical and microbiological analysis), quarters, office, garages, security post etc. The factory building for the milk reception, quality control, processing, packing and storage of milk requires about 500 sq. ft. (46.45 sq. meter) area for handling 500 to 2000 litres of milk. The essential sections of a milk processing plant are given in below. The milk processing plant shall have facilities of receiving the milk (Raw Milk Reception Dock) - consisting of can conveyor, can washer, weighing balance, dump tank etc., Processing Hall (comprising of cream separator, chiller, homogenizer, pasteuriser and other related machinery, milk storage tanks, packing area for packing of liquid milk, quality control laboratory-for testing the quality of milk and milk products, utilities area-for, generator set, water treatment plant for treating the dairy effluents before releasing to the fields., maintenance area and office area-for all the essential staff.

Site and building

The unit should be located as centrally as possible within a given milk-producing area, near a source of water, or in a place where water is available. The site should be cool and well-ventilated. Sometimes not all these conditions can be met. The most important factor is the availability of water. It should be remembered that on average five litres of water are required to process one litre of milk. Milk is a highly perishable commodity and gets influenced by environmental conditions. Milk quality and shelf life depend largely on the surroundings in which milk is manufactured, packaged, transported and finally stored. Building type, flooring, roof type, walls, type of paint/coatings, ceiling, etc., are all important parameters that are taken into knowledge while establishing the dairy processing plant. A new building can be constructed or an already constructed building can be refurbished and used for milk processing. For a new building, the walls should be built of local stone and the inner walls lined with a lime-cement mixture for easy cleaning, the cement floor should have a 2 to 3 percent slope for draining water used in cleaning, windows should be sufficient to provide adequate ventilation. The floor of the room should be dug to a level of some 1.5 m below ground, with windows or openings made in the upper walls to lower the temperature of the processing hall. Building size will of course depend on the quantity of milk received during the peak production period. An average quantity of milk that can be processed by a small-scale unit amounts to 100 to 500 litres per day. For these quantities, the building area should be approximately 50 sq. m. The milk processing plant should be

established at the appropriate site, and plant layout should be considered concerning reception, processing, storage, parking area and roads connectivity to the plant.

The milk processing plant shall have the following essential facilities like Raw milk reception dock (RMRD), processing hall, storage area, production area, packing area, cold store and utility area, etc. Road connectivity, nearest market, type of location, etc. are taken into account during the finalization of land for the processing plant. Hall constructed, single and multi-level story design may be used for the installation of machinery for the processing plant. During the finalization of plant and equipment peak load of milk,the processing is also considered for better plant management and energy conservations.Natural and artificial lighting should be provided and the work environment should be pleasant for personnel working inside the processing plant.

Legally, canteen, locker and other recreation facilities are also required to maintain inside the premises of the production area. The safety of workers and a proper working environment is also required Adequate lighting, proper ceiling height and type of floor must support the working of employees working inside the dairy processing plant.

Dairy plant utilities

A boiler is equipment used to produce steam for the processing of equipment. Steam is the main source of heating for dairy processing and requires a prior estimation of the capacity of the boiler based on the capacity and usage of equipment and their actual running time. Peak requirement of steam usage during is used to finalize the purchase of the boiler. Many types of equipment are to be operated by steam and their steam consumption is observed to find the peak load requirements of steam at particular steam pressure. Loss of pressure due to leakages, number of bends, sudden contraction and enlargement of pipe is also considered. Milk plant requires a range of pressure from 2-5kg per cm^2 pressure for the operation of most steam-based dairy processing equipment.

Refrigeration is required for chilling of milk cold storage of milk and milk products. Cooling is the most essential requirement for dairy products. Coldwater is required for (pasteurizer, jacketed vats, etc.) of different processing equipment during the processing of value-added products. The requirement of chilled water is fetched by Ice Bank Tank (IBT) of required capacity. Depending upon the peak load in summer the capacity and purchase of the refrigeration plant system are calculated.

A three-phase electricity supply is required for milk processing plants; standby generators may be in connection with processing and storage section sections. Electricity is required for running different types of machinery, lighting and general-purpose equipment and the operating load is calculated. For better conservation of energy and its management high star rated lightening system, energy-efficient pumps and

motors with variable frequency drives are installed in the dairy processing plant.

Water is the most essential utility required for processing, cooling operation, drinking and washing of equipment for the dairy plant. Soft water (hardness less than 35 ppm) is required to meet the plant water requirement by using a water softener. For liquid milk processing ratio of 1:1 is used however for multiple products it ranges in ratio from 1: 3.

Conclusion

Milk is presently handled and managed by milkman, middleman, and class contactors and we require a one-stop solution to process the milk on-farm by mini dairy processing plants which can largely address and solve the untapped problem of raw milk handling and suitable processing of milk into varied milk products. Also, the product made on-farm processing would be of better quality as fresh milk is directly being processed into value-added dairy products *vis-a-vis* milk cake, peda, curd, lassi, ghee, sterilized flavoured milk/whey drinks.

Chapter 10

ROLE OF SHGS & FPOS IN PROMOTING LIVESTOCK ENTREPRENEURSHIP

Arunbeer Singh, Jaswinder Singh and Y S Jadoun

Directorate of Extension Education,

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

---

The profession of animal husbandry in India dates back to centuries. Large farmers, marginal farmers as well as landless agricultural laborer, all raise dairy cattle on a small or large scale. Animal husbandry is a source of employment and additional income. But in the last few years, people have been moving away from livestock farming. There are many reasons for this change - land redistribution, crop cycle, migration to cities, small families, labor shortages, lifestyle changes, instability in milk prices, rising cost of animal feed, cost of treatment of animals, etc. Due to declining interest in animal husbandry, the best breeds of dairy animals are being lost as the traditional livestock keepers are abandoning their stocks. Many indigenous breeds of cattle are on the verge of extinction. Commercial and large dairy farms are focusing on raising foreign breeds of cows for their higher yield. These cows are suffering from diseases due to intolerance to the weather of our country. Due to the use of medicines for the treatment of animal diseases, the chemical residue in milk is increasing. Leaving animals is degrading both health and society.

On the contrary, due to the growing population in villages and cities, the demand for milk has been steadily increasing. Adulteration in milk and milk products is also on the rise due to insufficient supply of milk. In cities, people are forced to drink adulterated or substandard milk despite the high price of milk. Today there is a need to revive dairy farming and backyard units so that it can generate nutritious food, employment and income. Young entrepreneurs must take up animal husbandry as a profession. Consideration should be given to setting up livestock units or marketing milk through collectives. At the same time animal husbandry has to be transformed into a business. Profits can be increased by controlling cost or production. Livestock farmers can be organized into a variety of collectives to increase their bargaining power while allowing urban consumers to have access to quality products.

Farmer Interest Group

Farmer Interest Group (FIG) is formed by farmers/ youth for the fulfillment of common needs and goals. FIGs are mostly informal groups of locals with common goals. Farmers can seek the help of line departments for the formation of the group. Farmers can procure raw material (fodder/ straw/ feed/

medicines etc.) in larger volumes collectively through the group. In this way, the higher the purchase volume, the lower the purchase price, which indirectly benefits each individual. Farmers can also contribute for purchase of machinery for milk processing by mutual consent. The main advantage of working under such a group is that a large investment can be made by several individuals when it is not possible for a single farmer to do so. If a single producer takes a small quantity of the product to the city for sale, then he/ she will be able to make a small profit from it due to high cost. On the contrary, milk can be collected in bulk and transported to the city at a lower cost, which will reduce the individual cost of producers and increase profits.

Self Help Group

A self-help group is a group of people from similar economic class. A group of 10-20 members is best for forming a group. The purpose of such a group is for the members to solve their problems through joint venture and savings. Self-help groups formed by women are generally considered to be more successful. Weekly or monthly meetings are held for the better functioning of the group where members can find solutions to their financial or employment problems through negotiations. All members of the group must save in a joint account. It is also important to keep track of the transactions.

Those wishing to form a self-help group meet and agree to form a group. Only one person from a family should be a member of the group so that maximum number of families can join it. As the meetings continue, plans for the formation and functioning of the group are drawn up. This work can be done with the help of a professional or line departments such as already funnctional groups, NGOs, Krishi Vigyan Kendras, Universities, Animal Husbandry Department, Department of Agriculture, DDM-NABARD. Banks etc.

At the time of formation of the group, written rules for group functions should be prepared. The members should also be trained to create different types of accounts. SHGs can apply for a bank account in the name of the group after one or two meetings after the formation of the group. After this all the members collect the fixed amount as per the rules and deposit it with one member who can deposit this capital in the bank account. This member acts as the treasurer of the group. SHGs work in two main ways.

i. Depositing savings

ii. Creating a means of earning

Self-help groups are formed on the principle of regular savings. It is important for all members to save and deposit in one account. The members can avail this amount of savings as a loan if required. Loan terms like amount, interest, terms of loan etc. are decided by the group. Interest rates are generally kept below market rates. Penalties imposed by the group are levied on non-fulfillment of loan repayment conditions. The member can use the loan amount as per his requirement. Details of money transfers by the group are

recorded in writing.

By forming groups, members can also start economic activities. SHGs can create and market a product at a shared cost. In this way the price of the product is determined by the group itself. Members receive a share of the earnings equal to their contribution. For example, women can raise chickens in the backyard and sell eggs through the group. By forming groups, members can also access training centers to start a new enterprise. The group can also take a loan from a bank based on their savings account to start or advance a business.

Cooperative Society

State level dairy cooperatives set up cooperative societies in villages for procurement of milk. To strengthen the cooperative society, raw material in the form of animal feed is made available at the farmers' doorstep. The cooperatives also extend extension services to the farmers affiliated with the society. In addition, experts examine the animals and treat the animals. Medication for basic treatment of animals is also distributed as and when required.

In the last few years, the farmers have been frustrated by the low price of milk offered by the cooperative society. The price of milk is determined based on the value of milk fat. With this fixed price, the farmer does not get much benefit. In particular, the milk of crossbred cows is of very little value. In order to give a fair price to the dairy farmers, bonus should be provided on the basis of milk quality so that more farmers join the co-operative society and also improve the quality of milk.

Progressive Farmers' Association

Farmers and livestock keepers can also form Progressive Farmers' associations to expand their business. The association can be registered as a society. The help of a lawyer and a chartered accountant is required for this purpose. It is not possible to do business directly through the society, but the members of the society can venture into business by other means. Progressive Farmers' Associations carry out various activities for the benefit of its members. These associations participate in diffusion of innovations and technology among its members through fairs, meetings, seminars etc.

Farmer Producer Organization

The Department of Agriculture, Cooperation and Farmers' Welfare started a pilot project to establish 250 FPOs under RKVY in 2011-12. Farmer Producer Organization is a group of primary growers. It is made by uniting the producers of a particular product for its marketing and profit sharing. To form this organization, farmers can choose from a number of legal options such as Producer Company under Indian Companies Act (2013), Co-operative Societies Act, Multi State Co-operative Societies Act, Society Registration Act (1860), Section 8 Company etc. There are many technical aspects to the process of forming a producer company, so

the help of a professional or another FPO should be sought for its formation.

In order to form a producer company for marketing of agricultural products, it is necessary to bring together at least 10 farmers who want to form an FPO. The number of farmers can be increased up to 1000. These farmers meet and form a mutual agreement to form a producer company. The benefits of forming a company are discussed at the meeting. In addition, 5 farmers are given the responsibility to become directors of the company voluntarily or by nomination or selection.

The value of the company's share and the distribution of the shares have to be decided. The authorized capital of the company is determined by the shares. The minimum paid up capital has been fixed at Rs. 1 lakh. The minimum paid up capital has been fixed at Rs. 5 lakhs. The directors of the company prepare the memorandum and articles of association with the consent of the other members. Once the documents are ready, a general meeting is called and they are approved by the members. These documents set out the rules governing the operation of the company and the roles of the office bearers.

The directors must obtain a certificate of their digital signature from an accredited organization before the registration of the company. The website of the Ministry of Corporate Affairs enlists the service providers for obtaining digital signature. The must also obtain Director Identification Number. Finally, the name of the company is proposed in the office of the Registrar of Companies. Five names can be suggested for registration. The name of the company must end with- Producer Company Limited. The proposed company name should be unique. If one of these names is approved by the Registrar of Companies, the nominated directors apply to the Registrar of Companies to register the company under that name. The application must be accompanied by the nomination of directors, office address, necessary documents including memorandum and articles of association. The company comes into existence after the Registrar of Companies issues a certificate approving the name.

Farmers can choose any option to work as a group. Different groups have their own ways of functioning. The main advantage of working in groups is that the farmer gets the raw material at a lower rate, commodity can be produced in bulk, ease of marketing, produce can be better valued and micro-enterprises can be promoted through economic activities at the village level.

Chapter 11

RECYCLING OF ANIMAL WASTE - A PATH TO ECONOMIC PROSPERITY

Amandeep Singh

Directorate of Extension Education,

Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana, Punjab, India

---

On Earth, approximate total of 8.7 million eukaryotic species are present and India as mega-diverse nation houses 10 percent of them. Out of the total mammalian species on Earth, 60 percent of mammals are livestock, mostly cattle and pigs, 36 percent are humans and just 4 percent are wild mammals. The proportion of human race in total Earth's biodiversity is 0.01 percent. Poultry makes up 70 percent of all birds on the planet, with just 30 percent being wild. Plants account for 82 percent of all biomass on the planet which is 7,500 times more than humans. According to United Nations 2017 Revision on World Population Prospects, the current world population stands at 7.6 billion and population in India stands at 1.3 billion. The Food and Agriculture Organization of the United Nations (FAO) in the year 2015-16 estimated the production of cereal crops to be 2527.7 million tonnes (MT), with 228.2 MT production in India. The world livestock population stood at 1.49 billion cattle, 1.17 billion sheep, 1.00 billion goats, 0.97 billion pigs, 0.19 billion buffaloes and 19 billion poultry. The livestock heads in India according to 20th Livestock Census are 535.78 million, which shares about 10 percent of the world's livestock population. All these trends are gigantic with ever progressive growth rates showing positive signs of development. But a question arises – what cost the planet have to pay for this development? Are these developments sustainable? Analyzing the other side of the coin, it reported that the production of organic waste in India sums upto 3000 million tonnes and it comes from agriculture, urban and industrial sources and also from domestic activities. Out of the total 3000 million tonnes, 998 million tonnes comes directly from the agriculture sector. Most of the people may say it is a waste, but in my opinion it is one of elite organic resources we possess in our country with manifold uses. The amount of waste been produced today need 1.7 Earths to provide resources and area to absorb the waste.

PRESENT AND THE FUTURE OF ANIMAL WASTE

In any livestock farm, organic wastes can amount up to 80 percent of the total solid wastes generated of which manure production can amount up to 5.27 kg/day/1000 kg live weight, on a wet weight basis. Keeping this in view, it can be said that enormous amount of organic waste in the form of dung and urine is

produced by the livestock all around the world. According to FAO (2015), total emissions from global livestock are estimated to be 7.1 gigatonnes of CO_2-equivalent per year, representing 14.5 percent of all anthropogenic green-house gas (GHG) emissions. Dairy sector contributes to 20 percent of the total GHG emissions from livestock globally.The livestock heads in India according to 20th Livestock Census are 535.78 million, which shares about 10 percent of the world's livestock population. The current dung production from bovines is estimated to be 545.67 MT. A positive growth in livestock population has been noticed due to which the waste production is bound to increase.

SUSTAINABLE ANIMAL WASTE MANAGEMENT METHODS

Sustainable livestock production refers to the successful management of resources to satisfy the changing human needs while maintaining or enhancing the quality of environment and conserving the resources. Successful management of resources include proper and efficient utilization of wastes particularly agricultural wastes, livestock waste, agro-industrial organic wastes, vegetable and fruit waste, market wastes, etc., which pose the problem of disposal and environmental hazards. India produces around 3000 million tonnes of organic wastes annually and disposal of these wastes is causing economic and environmental problems. Therefore, there is a strong urge to come up with environmentally sound and economically viable methods of waste management for ensuring sustainability in livestock production. The following are the methods which have the potential to convert livestock waste into wealth.

1. Composting

Composting is the natural process of 'rotting' or decomposition of organic matter by microorganisms under controlled conditions. The hygienic disposal of wastes from agriculture and allied sectors results in the production of organic fertilizer which is a basic and valuable input in farming. The recycling of crop residues and livestock wastes through composting methods is the key technology for production of organic manures. Many studies have reported the use of composting in the rural areas by the women and further supported its use in maintenance of agroecology. Composting animal wastes has proven to cut down the expenses on the fertilizers and can be used in the promotion of organic farming. Application of compost ensures optimum soil health which have a direct influence on plant and hence human health. There are many methods of composting which can be undertaken by the farmers to convert agriculture waste into wealth. Traditional Method, Indore Method, Bangalore Method, NADEP Method, Padegaon Method, Coimbatore Method, Passive Aeration Method, etc. can be employed for small scale composting and Windrow Method, Active Aeration Method, EM based Method, IBS

Method, etc. can be used for large scale composting of agriculture residues.

Value addition of compost

Preparing value added products from compost like compost tea, compost leachate, manure tea and compost extract will not only enhance the economy of the farmers but also provide them with excellent bio-pesticides which will reduce their farm expenses along with several environmental benefits. There is immense use of these value added products in organic farming. The products obtained from the compost are rich in nutrients and hence condition the soil.

2. Vermicomposting

Vermiculture technology refers to the production of organic manure by feeding activity of earthworms. The vermicompost is a mixture of worm castings, organic materials including humus like earth worms, cocoons and other microorganisms. Livestock waste, fruit waste, vegetable waste composted with agriculture waste for 10-15 days can be treated with worms to prepare vermicompost. Vermicompost not only provides nutrients to soil but also contributes to the biological fertility factor by adding beneficial microbes to soil. Hence, vermicompost can be considered as the better organic manure than other organic manures, thus vermicompost may be used as an ecologically sound, economically viable and socially acceptable technology for gaining the maximum from agricultural waste. People are generating their livelihood by taking the practice at entrepreneurial level which is not only providing them year round employment and but also good income. In about 60 days, the vermicompost can be obtained from livestock waste.

Value addition of vermicompost

Vermiwash and vermicompost tea are the value added products that can be obtained from vermicomposting. Both the products acts as excellent bio-pesticides and growth promoters and can be sold at remunerative prices. Farmers are using vermiwash for spraying their vegetables, crops and kitchen gardens.

3. Biogas Production

Biogas technology is another viable option for managing the agricultural and livestock wastes. Biogas is produced by the decomposition of the organic component of the animal waste by the decomposer micro-organisms. Biogas production from animals by anaerobic digestion has been traditionally a common practice in Asia, particularly in tropical areas such as Indonesia, India and Vietnam. Biogas is used as fuel for cooking and lighting purposes and in diesel engines to substitute diesel-oil. A biogas plant of 4-6m^3 can support the fuel needs of a family of 5-6 members. Biogas is an excellent cooking gas which has the potential to substitute Liquefied Petroleum Gas (LPG). The

decomposed slurry after biogas production is a good source of manure for agricultural land as it contains 80 percent carbon, 1.8 percent nitrogen, 1 percent phosphorous and 0.9 percent potash making it an excellent source of not only humus but also micronutrients for crops. A small scale biogas plant can be installed for Rs. 40,000-Rs. 50,000 with back-ended subsidy of 20-30 percent from Government of India. In an experiment at Indian Institute of Technology (IIT), Delhi, the feasibility of transporting biogas through pipes was studied and the experiment concluded with the desirable results. However, for continuous supply of biogas, daily supply of feedstock is required. Biogas can serve as a green fuel for rural households if it can be compressed and filled in LPG type cylinders.

COMPARATIVE ECONOMIC ANALYSIS OF VERMICOMPOSTING, COMPOSTING AND BIOGAS PRODUCTION

Comparative economic analysis of three different organic waste management practices viz. vermicomposting, composting and biogas production was worked out in terms of various costs associated with them. The results are presented in Table 1 are basically the costs elicited through case studies. Calculations were made to arrive at costs associated with different waste management practices when one tonne of dung and dung from one cattle equivalent is used in the particular practice. The table reveals that highest net returns per tonne of dung were obtained from vermicomposting (INR 2224.72, USD 29.42) followed by biogas production (INR 536.66, USD 7.10) and composting (INR 45.59, USD 0.60). Net returns from the dung obtained from one cattle equivalent were highest from vermicomposting (INR 11012.34, USD 145.64) followed by biogas production (INR 2656.74, USD 35.14) and composting (INR 225.68, USD 2.98). Based on the returns, profitability ranking of the practices has been done in which vermicomposting attained rank I, biogas production rank II and composting rank III. High profitability was accorded to vermicomposting because vermicompost is sold at remunerative prices. Other products obtained from vermicomposting like vermiculture and vermiwash are high value products. The profitability of biogas production was low because of high labour cost, as biogas digester needs to be charged with dung slurry daily for gas production. The construction cost of biogas plant was also high and special biogas stove and other equipment are required for its use. Biogas production can be made more profitable if it is clubbed with vermicomposting. The profitability of composting was lowest of all due to its low selling price and high production. All the dairy farmers were found to be composting their dairy waste and using it as farmyard manure because it was easy to make, require meager knowledge and not so laborious as other practices.

Table 1: Comparative economic analysis of vermicomposting, composting and biogas production

	Vermicomposting			Composting			Biogas Production		
Cost Component (all figures in INR)	**Based on Case Study**	**Per Tonne of Dung**	**Per Cattle Equivalent**	**Based on Case Study**	**Per Tonne of Dung**	**Per Cattle Equivalent**	**Based on Case Study**	**Per Tonne of Dung**	**Per Cattle Equivalent**
Total fixed investment	24000.00	1927.71	9542.17	500.00	11.23	55.58	30450.00	1112.53	5507.03
Total fixed cost	5200.00	417.67	2067.47	156.25	3.51	17.37	6155.62	224.90	1113.27
Total variable cost	21102.29	1694.96	8390.07	8946.00	200.90	994.45	13071.64	477.59	2364.07
Total cost	26302.29	2112.63	10457.54	9102.25	204.41	1011.82	19227.26	702.49	3477.35
Total returns	54000.00	4337.35	21469.88	11132.50	250.00	1237.50	33915.68	1239.16	6133.82
Net returns	27697.71	2224.72	11012.34	2030.25	45.59	225.68	14688.42	536.66	2656.47
Profitability ranking		**I**			**III**			**II**	

Average dung per cattle equivalent = 4.95 tonnes per annum

NOVEL METHODS OF ANIMAL WASTE MANAGEMENT

1. Bio-Compressed Natural Gas (Bio-CNG) or Compressed Bio-Gas (CBG)

Itis a clean and renewable energy source obtained from the wasted cow dung. Bio-CNG contains about 92-98 percent methane and only 2-8percent carbon dioxide. The calorific value of Bio-CNG is about 52,000 kilojoules (kJ) per kg, which is 167 percent higher than that of biogas.In India, Bio-CNG is estimated to replace two-thirds of India's Natural gas imports. Bio-CNG plant located in Malur in Kolar District, Karnataka, has a production capacity of 1.6 tonnes of Bio-CNG per 40 tonnes of wet waste. The gas can be stored in cylinders and sold under Carbolite; the first bottled Bio-CNG supplied to consumers in India. Each unit consists of four cylinders (each 25 kg), which could save approximately 15 percent in terms of consumption and cost compared to existing CNG/LPG. Presently, there are seventeen Bio-CNG plants operational in India, with a combined capacity of 46,178 kg per day.

2. In-Vessel Composting

Agriculture waste can be shredded into pieces of 10-15 cm, mixed with livestock dung and urine and can be composted in vessels like bins, silos, drums, poly-bags, etc. This method has the potential to compost small scale agriculture residues like spoiled grains, vegetables, fruits, market wastes, and convert them into valuable manure. Any wooden drum, plastic drum, old tin, etc. can be employed for the process and it ensures the best use of these waste objects too.

3. Decomposition by Waste Decomposer

Waste Decomposer is an enriched microbial media used for decomposing organic waste. The formula was prepared by National Centre of Organic Farming (NCOF), Ghaziabad and costs only Rs. 20/bottle. A bottle contains 30ml of media and can compost more than 10,000 lakh metric tonnes of waste in just 30 days. The media is used after dilution in jaggery and water. The media can be purchased

directly from NCOF and Regional Organic Farming Centres (RCOF). The waste decomposer is also validated by Indian Council of Agricultural Research (ICAR).

4. **Use of Biofertilizers in Composting**

These are the microbial preparations which on application to soil help in augmenting agricultural production. Preparations containing cellulose decomposing, phosphate solubilizing, potash mobilizing and nitrogen fixing microorganisms come under biofertiliser. *Azotobacter*, a nitrogen fixer, and phosphate solubilizing microorganisim, *Fraturiaausintia*, a potash mobilizing microorganism, *Aspergillusawamori*and *Bacillus polymyxa*are heterotrophs which are used as biofertilizers. Inoculation of compost, one month after starting the process, with these organisms improves the nitrogen content and phosphorus and potash availability of the mature compost.

5. **Composting Machine**

The latest addition into waste management practices is the composting machine. However, the machine cannot be used for decomposing crop residues as they are bulky in nature but can be used for composting livestock excreta, vegetable and fruits waste, kitchen waste and other types of less bulky wastes. The machine runs on electricity and composts the waste material in 24-48 hours. Though the machine is bit costly but can be purchased by a group of orchardists, vegetable growers, etc. for managing day to day wastes.

6. **Enhancing Vermicompost Production by the Use of Urine**

Urine can be used for moistening organic wastes during the preliminary composting period (before the addition of worms.). Cow urine is favoured for this process and can be daily used for moistening the vermibed. The method enhances the nitrogen content in the vermicompost and reduces time for maturation of compost. This method enables the farmer to efficiently use urine from the livestock which otherwise gets wasted.

7. **Integrating Traditional Composting and Vermicomposting**

Traditional composting is problematic as it require long time period, frequent turning of the material and loss of nutrients due to prolonged process whereas, vermicomposting do not ensure the destruction of pathogenic bacteria and weeds. To overcome these problems it is suggested to integrate traditional composting with vermicomposting. In vermicomposting, the earthworms take over both the roles of turning and maintaining the material in an aerobic condition, thereby reducing the need for mechanical operations. The two approaches can be followed for undertaking the practice: pre-composting followed by vermicomposting; and pre-vermicomposting followed by composting.

8. **Vermicomposting for Biogas Production**

Pretreatment of the substrate before the anaerobic digestion enhances the production of biogas. Agricultural residues have chitin which is a lingo-cellulosic material and hard for hard for the anaerobic microorganisms to degrade. Therefore, vermicomposting enhances the degradability of chitin by hydrolysis, thus increasing the amount of methane production. The slurry obtained after this treatment is more effective and serves to excellent soil conditioner.

9. Vermiculture-Cropping System

Worms can be directly used to decompose agriculture waste in-situ. This system consists of alternating bands of crop ridges and worm-farming troughs. Residual straw should be placed on top of the earthworm troughs, to protect earthworms from direct sunlight and bird predation. It also slows down the evaporation and provides food to worms. Other organic wastes should be added in the troughs. The worm activity takes place in the troughs and the crop residues are converted to valuable manure.

10. New Perspectives in Vermicomposting

- **Vermifiltration:**Research has been undertaken in this field for managing agriculture waste. The technique known as vermifiltration technique was involved for wastewater treatment and a few such plants are in operation too. Vermifiltration technique can be used to process wastewater using vermicompost prepared from swine manure.
- **Bioremediation:**The process of vermicomposting can also be employed as cost-effective bioremediation technique for metal and dye removal from the waste. Vermicompost has been used as an adsorbent due to its greater capacity for cation exchange and larger surface area. It can also be used for detoxifying the soils and other material as it binds with lead and cadmium.
- **Vermireactor:**For on-site organic waste management, a vermireactor fed with cow dung, kitchen waste and vegetable market waste has been developed to receive organic wastes up to 0.263 m^3 and was controlled similar to vermibins. By the use of this reactor, liquid vermicompost, solid vermicompost, vermiwash and earthworms can be harvested easily.

11. Future Uses of Biogas

The biogas can be used as vehicle fuel if the content of carbon dioxide is reduced from it. Countries like Sweden, Denmark and Switzerland have successfully tested biogas for running vehicles. Biogas can be further used as cooking fuel disseminated to households through centralized grids. Many European countries have developed biogas grids in their rural localities and serving the households by distribution of biogas for cooking. In India, it seems to be distant but achievable dream as we have the largest livestock base of the world and the waste produced by the livestock can be converted into biogas.

12. Liquid Manures

Liquid manures can be prepared from agricultural wastes and being liquid in nature can be sprayed on crops for enhancing their productivity. Liquid manures can be prepared from dung and urine, spoiled fruits and vegetables, fruit and vegetable peels, garden and yard trimmings and spent kitchen waste. The wastes are shredded and grinded, mixed with water and used in the gardens, agriculture land, etc.

13. Making Paper from Dung

In one of the recent advancements regarding the utilization of livestock waste, Kumarappa National Handmade Paper Institute, Jaipur, Rajasthan have successfully made paper from the dung. The technique will soon be transferred to Khadi and Village Industries Commission (KVIC) for industrial applications. The method will reduce the dependence and cutting of trees for paper production along with better utilization of livestock dung.

14. Waste to Energy

The Ministry of New and Renewable Energy, Government of India has come up with ambitious prgramme called as Waste-to-Energy in 2018 and is one of its kinds. It is feasible to harness energy from the agriculture waste through various methods. The biogas can be produced from agriculture waste and hence converted to electricity by using generator at household level too. The agriculture wastes can be used to heat up boilers in the thermal plants for production of electricity. All these uses can lead to effective management of crop residues with very little harm to environment.

15. Enrichment of Straws for Livestock Feeding

It is a well-known fact that straws lack essential nutrients required for optimum animal productivity, but straws form the bulk of animal ration. The poor nutritional status of straws can be enhanced by spraying urea on the straws, by treating straws with ammonia, addition of molasses and addition of minerals to the straws. Sometimes complete feed blocks are formed by the incorporation of all the stated principles and stored for feeding livestock in lean period. In this way the straws which are burned can be converted to healthy ration for the livestock.

16. Waste Management Using Geoinformatics

Massive amount of crop residues are generated in the country at every harvesting season. Huge amount of livestock waste is daily produced in millions of livestock farms both large and small throughout the length and breadth of the country. Managing such amounts of wastes is not easy by an individual or organization by using conventional tools. Therefore, geoinformatics comes to play for ascertaining the effective and efficient management of wastes. The commercial farms generating he amount of waste can be geo-tagged as resource centres (RCs). Geo-tagging will help in highlighting

such farms for better management of waste and in future if any organization, whether public or private, wish to work in area of waste management, the geo-tagged farms will serve as direct source of interest to them. Geo-tagging the farms will also bring them on map, so one can be able to easily locate them and it will be further help the farmers to enhance their sale and purchase and hence marketing of their produce.

17. Artificial Intelligence and Waste Management

The principles of artificial intelligence (AI) like artificial neural networks (ANN), natural language processing, machine learning, internet of things, etc. can be used for effectively managing waste. ANN can be used for predicting the amount of waste to be generated within a specific period of time and specific interventions for its management can be made. Machine learning and natural language processing can be used for development of expert systems and other information and communication technologies (ICTs) beneficial for the timely advisory of farmers.

18. Prakritic or Vedic Paint

Prakritik or Vedic paint was developed from cow dung by Khadi and Village Industries Commission(KVIC) which helps in reducing the harmful effects of heavy metals present in commonly used synthetic paints and has the potential to enhance farmers' income. A steady source of additional income for cattle growers is being explored by the Khadi and Village Industries Commission (KVIC) with the innovative technology of 'KhadiPrakritik' paint made out of cow dung. About 150-170 kg of dung is required to produce of 500 litres of Prakritik paint.As per KVIC, this eco-friendly, non-toxic, odourless product with anti-fungal and anti-bacterial properties could enable a farmer to earn an additional Rs 30,000 from one cow annually.According to KVIC, with an estimated potential sales of Rs 6,000 crore of these paints in the next few years, farmers could expect to get Rs 1,000 crore by selling raw cow dung, which is now largely wasted.

19. Cow Dung Logs

As per one UN report, wood obtained by cutting around five crore trees is consumed every year in India to fuel the cremation. However, to date, there seems to be no large scalegovernment plan to effectively substitute the usage of wood with products such as cow-dung logs.All the dairies in urban or semi-urban areas dispose of the cattle dung in the sewage system. This dung is a natural renewable source of energy, and such disposal leads to waste of this free fuel and pollutes water channels and loading extra pressure on sewage treatment plants.Therefore, it is felt that cow-dung logs should be promoted to be used by crematoriums on a large scale.Moreover, wood made from cow dung is very beneficial as it is environmentally friendly. These cow dungs logs can be mixed with charcoal, wood

powder to make it more strong .The price of one cow dung log ranges from Rs. 4-10/log which has a great potential to benefit a large amount of dairy farmers.

20. Other Eco-friendly Products made from Dung

Eco-friendly lamps, idols of goddess during Navratras, Ganesh Chaturthi, flower pots, bricks, etc. are being made from the cattle dung. All these eco-friendly products are in great demand already. These are easy to develop and farm women can be trained to make such items for local sale.

21. Use of Cow Urine

During the last two decades, there has been a significant sensitization of the global community to looking into environmental conservation and safe food. Organic Agriculture (OA) is now becoming mainstream all over the world. Among different organic sources, cow urine is a unique dairy product with multiple properties such as manure, antimicrobial agent, and disinfectant. It contains 95 percent water, 2.5percent urea, and the remaining 2.5percent contains mineral salts, hormones and enzymes.Cow urine contains some important minerals (about 24) beneficial for plants and humans. Cow urine has much demand because of its medicinal value and essential requirement of organic farming as a biopesticide.

CONCLUSION

As long as there is life on earth, the wastes will keep on generating. Nothing lives without generating waste but the onus lies upon us, how well we can manage the waste. Wastes from livestock and allied sectors are easy to manage due to their organic nature. There are numerous ways aptly discussed by which the waste can be converted into wealth. There is a strong need to understand the behavior of livestock farmers in terms of their knowledge, opinion, practices, attitudes, perceptions, etc. about waste management. There is a need to propagate newly developed technologies at the farmers' doorstep and make them aware about the pros of favourable and cons of unfavourable practices of waste management. Capacity building of farmers and other stakeholders, provision of subsidies and incentives on waste managemental techniques, strong legislature against misconduct, timely advisory, restrictive use of chemical fertilizers, etc. can help in managing animal waste in a better way.Creation of entrepreneurial opportunities by providing suitable technological interventions to farmers can further enhance the scale of waste management. The unemployed youth can be channelized in this direction for their livelihood security and tackling unemployment. The waste is a waste till the time its importance has not been realized, but once after undertaking a certain protocol, the waste can be converted into wealth. Conversion of waste to wealth will surely double the farmers' income as farmer can firstly earn from his produce and secondly from the waste. Thus, waste is a valuable resource with the potential to develop healthy farmers and healthy soils.

References:

Bandara, N., Hettiaratchi, P., Wirasinghe, S.C. and Pilapiiya, S. (2007). Relation of waste generation and composition to socio-economic factors: A case study. *Environmental Monitoring and Assessment,*135, 31–39. DOI: 10.1007/s10661-007-9705-3

Chima, I.K., and Nwabinye, M.V. (2017). Economic Analysis of Household Waste Generation, Disposal and Management in Umuahia Metropolis, Abia State, Nigeria. *International Journal of Health Economics and Policy*, 2(2), 47-56. DOI: 10.11648/j.hep.20170202.12

Economic and Statistical Organization (ESO). (2018). *State-wise data*. Retrieved from http://www.esopb.gov.in/Static/PDF/GSDP/Statewise-Data/StateWiseData.pdf on 09.05.2022.

Grover, P. and Singh, P. (2014). An Analytical Study of Effect of Family Income and Size on Per Capita Household Solid Waste Generation in Developing Countries. *Review of Arts and Humanities,* 3(1), 127-43.

Liu, J., Li, Q., Gu, W., and Wang, C. (2019). The Impact of Consumption Patterns on the Generation of Municipal Solid Waste in China: Evidences from Provincial Data. *International Journal of Environmental Research and Public Health*, *16*(10), 1717. https://doi.org/10.3390/ijerph16101717

Mali, K.N., Belli, R.B. and Kitturmath, M. G. (2014). Study of the socio - economic characteristics of dairy and non- dairy farmers. *Agriculture Update*, 9(1), 54-58.

Ministry of Drinking Water and Sanitation. (2015). *Solid and Liquid Waste Management in Rural Areas.* Retrieved as https://mdws.gov.in/sites/default/files/Primer%20SLWM.pdf on 29.04.2022.

Moharana, P.C. (2012). Rural Solid Waste Management: Issues and Action. Kurukshetra. Retrieved as https://www.researchgate.net/publication/265413674 on 24.04.2022.

Press Information Bureau (PIB). (2019). *First Advance Estimates of National Income, 2018-19.* Retrieved from http://pib.nic.in/newsite/PrintRelease.aspx?relid=187267 on 19.03.2022.

Roy, P., Kaur, M., Burman, R.R., Sharma, J.P. and Roy, T.N. (2018). Determinants of paddy straw management decision of farmers in Punjab. *Journal of CommunityMobilization and Sustainable Development*, 13, 203–210.

Sachan, R., Sankhala, G., and Singh, P. (2018). Correlation Analysis of Socio-Economic Variables with Adoption of Buffalo Husbandry Practices. *International Journal of Livestock Research,* 8(1), 149-157. http://dx.doi.org/10.5455/ijlr.20170507122624

Salhofer, S. (2001). *Waste Generation – modeling the amount of waste.* Institute of Waste management, BOKU – University of Natural Resources and Applied Life Sciences, Vienna.

Singh, A. (2019). *Development of a need-based and effective mobile app for promoting organic waste management among dairy farmers.* MVSc Thesis. ICAR-Indian Veterinary Research Institute, Izatnagar. 72 p.

Singh, A. and Rashid, M. (2017) Impact of animal waste on environment, its managemental strategies and treatment protocols to reduce environmental contamination. *Veterinary Sciences Research Journal,* 8(1&2), 1-12. DOI : 10.15740/HAS/VSRJ/8.1and2/1-12

Singh, A., Kumar, P. and Kour, H. (2016). A case report on cow dung composting: Traditional practice followed by women in rural areas of Jammu & Kashmir for maintaining agroecology. *The Journal of Rural and AgriculturalResearch*, 16(2), 79-80.

Singh, A., Tiwari, R. and Dutt, T. (2021b). An ICT driven intervention for transforming waste to wealth: methodic development and assessment of IVRI-Waste Management Guide App. *Journal of Material Cycles and Waste Management,* 23, 1544–1562. DOI https://doi.org/10.1007/s10163-021-01236-1

Singh, A., Tiwari, R., Chandrahas and Dutt, T. (2021a). Augmentation of farmers' income in India through sustainable waste management techniques. *Waste Management and Research,* 39(6), 849–859 DOI: 10.1177/0734242X20953892.

Singh, A., Tiwari, R., Joshi, P. and Dutt, T. (2020a). Insights into organic waste management practices followed by dairy farmers of Ludhiana District, Punjab: Policy challenges and solutions. *Waste Management and Research*, 38(3), 291–299. DOI: 10.1177/0734242X19886632

Singh, A., Tiwari, R., Panda, P. and Dutt, T. (2020b). Organic Waste Production and Utilization by Dairy Farmers in District Ludhiana of Punjab, India. *Indian Journal of Extension Education*, 56(1), 20-27.

Singh, A., Tiwari, R., Panda, P., Joshi, P. and Dutt, T. (2019). Development and Standardization of Knowledge Test for Organic Waste Management. *International Journal of Current Microbiology & Applied Sciences*, 8(08), 1443-1449. DOI: https://doi.org/10.20546/ijcmas.2019.808.168

Singh, A., Tiwari, R., Panda, P., Kour, G. and Dutt, T. (2022). Information source utilization for organic waste management with special reference to digital technologies: A qualitative study on dairy farmers of district Ludhiana, Punjab. Cogent Education, 9, 1. DOI: 10.1080/2331186X.2022.2062093

Singh, J. (2015). *Web Module for Dissemination of Need-based Scientific Dairy Practices among Farmers*. Thesis, MVSc. Sher-E-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu, p 94.

Sivakumar, K. and Sugirtharan, M. (2010). Impact of Family Income and Size on Per Capita Solid Waste Generation: A Case Study in Manmunai North Divisional Secretariat Division of Batticaloa. *Journal of Science of the University of Kelaniya Sri Lanka*,5, 13-23.

Sood, H. (2018). *Development of a Need-Based Mobile App for Commercial Dairy Farming*. Thesis, MVSc. ICAR-Indian Veterinary Research Institute, Izatnagar, p 38.

Thacker, H. (2018). *Food wastage in India.* The CSR Journal. Retrieved from http://thecsrjournal.in/food-wastage-india/ on 22.03.2022.

Tranga, P.T.T, Donga, H.Q., Toana, D.Q., Hanha, N.T.X. and Thi, N. (2017). The Effects of Socio-economic Factors on Household Solid Waste Generation and Composition: A Case Study in Thu Dau Mot, Vietnam. *Energy Procedia*, 107, 253 – 258. DOI: 10.1016/j.egypro.2016.12.144

Veeresh, S.J., Narayana, J. and da Silva J.A.T. (2011). Agricultural Bio-Waste Management in theBhadrawathiTaluk of Karnataka State, India. *Bioremediation Biodiversity and Bioavailability*, 5(1), 77-80.

Visvanathan, C. and Trankler, J. (2003). Municipal Solid Waste Management in Asia: A Comparative Analysis. In: Proceedings of Workshop on Sustainable Landfill Management on 3-5 December, 2003 at Chennai, India. pp 3-15.

Visvanathan, C. and Trankler, J. (2006). Municipal Solid Waste Management in India: A Comparative Analysis. Asian Institute of Technology, Bangkok. pp 1-11.

Wang, L. and Zhang, M. (2021) Exploring the impact of narrowing urban-rural income gap on carbon emission reduction and pollution control. *PLoS ONE*, 16(11), e0259390. https://doi.org/10.1371/journal.pone.0259390

Zia, A., Batool, S.A., Chauhdry, M.N. and Munir, S. (2017). Influence of Income Level and Seasons on Quantity and Composition of Municipal Solid Waste: A Case Study of the Capital City of Pakistan. *Sustainability*, 9, 1568. DOI:10.3390/su9091568

ISBN: **978-93-91668-15-0**

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

&

National Institute of Agricultural Extension Management (MANAGE), Hyderabad