Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume– 5 | Issue – 03 | March - 2018 | Pages - 112

Duck Farming

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 5, Issue-03 March -2018

Happy seeder technology for managing crop residues

Swarna Ronanki*[1] and Bhargavi Bussa[2]

[1]*Scientist, ICAR- Indian Institute of Millets Research, Hyderabad 500 030*
[2]*Ph.D Scholar, ICAR- Indian Agricultural Research Institute 110 012*
**Corresponding author: swarna@millets.res.in*

Abstract

A large quantity of residue is produced from crop harvests. These residues are mostly used as feed for cattle. In order to vacate fields for timely sowing of succeeding crop, majority of these residues are burnt in situ by the farmers as they interfere with normal agricultural operations. Burning of crop stubble and residues is rapid and cheap option for farmer which causes a serious atmospheric pollution as well as human health. Besides, it also results in the loss of plant nutrients and organic carbon of the soil and thus deteriorates the soil health. A novel approach to combat this problem is the happy seeder. It is a tractor-mounted machine that cuts and lifts straw, sows seed into the bare soil, and deposits the straw over the sown area as mulch. This technology is having positive edge over the conventional practices in terms of economics, water saving, diesel saving and eco-friendly technology to manage crop residues.

Key words: Burning crop, Eco-friendly, Happy seeder

INTRODUCTION

India is mainly an agrarian country. Annually it produces more than 500 million tons of crop residues (MoA, 2012). These residues are used as feed, fodder, mulch, for thatching roof, and as a source of domestic and industrial fuel (Bisen and Rahangdale, 2017). Thus they are of tremendous value to the farmers. However, a large portion of unused crop residues are burnt in the fields primarily to clear the left-over crop after the harvest. High cost of residue removal from the field, non availability of labour, and increasing use of combines in harvesting the crops are main reasons behind burning of crop residues in the fields. Burning of residues causes environmental pollution, is hazardous to human health, produces greenhouse gases causing global warming and results in loss of plant nutrients like N, P, K and S. Therefore, appropriate management of crop residues assumes a great significance.

To manage the residues in a productive and profitable manner, conservation agriculture (CA) offers a good promise (Kaur and Grover, 2016). With the adoption of conservation agriculture-based technologies these residues can be used for improving soil health, increasing crop productivity, reducing pollution and enhancing sustainability and resilience of agriculture. The resource conserving technologies (RCTs) involving minimum or zero tillage, direct seeding, bed planting and crop

diversification with innovations in residues management are the possible alternatives to the conventional energy and input-intensive agriculture. Permanent crop cover with recycling of crop residues is a pre-requisite and integral part of conservation agriculture. Sowing of a crop in the presence of previous crop residues is a problem. Happy Seeder describes a new approach in solving the problems of direct drilling of seed into heavy crop residues in a single operational pass while retaining the residues as surface mulch (Sandhu *et al.*, 2016).

Description of Happy seeder

Happy seeder combines the stubble mulching and seed drilling functions into the one machine. It consists of a straw managing unit and a sowing unit in one composite machine. The hinged flails mounted on the rotating shaft cuts the standing stubbles and loose straw coming in front of the furrow opener with simultaneous tyne cleaning (for proper seed placement) and places the residue in between the sowing tynes. This PTO operated machine can be operated with 45 hp double clutch tractors and can cover 0.3 – 0.4 ha/hr.

Figure 1. Sowing wheat into rice residues with happy seed drill (Source: Sidhu et al., 2015)

Happy seeder was developed in 2002 in the department of Farm Power and Machinery in collaboration with CSIRO Land and Water Australia under the financial assistance from ACIAR.The final improvement to this concept came in the form of the 9-row Combo Happy Seeder, developed in 2004, in which the straw handling and seeding functions were combined into a much more compact single machine (Sidhu *et al.*, 2007, 2008). A further improvement involved removing some of the straw cutting flails so that only a narrow strip (7.5 cm) of straw in front of the sow-ing tynes was removed. The final version in this series, the Combo+Happy Seeder, also provided the option of strip tillage to improve seed soil contact and thus crop establishment and yield.

Cultivation with Happy Seeder

- Field should be leveled for direct drilling of seed so as to ensure uniformity in soil. It helps in achieving uniform depth of seeding and thus helps to get good crop establishment in residue conditions.
- Ensure that the soil moisture at the time of sowing is optimum so as to have uniform crop establishment.
- To obtain good plant stand, crop residue should be uniformly distributed in the field

- Use recommended quantity of seed and adjust the seeding depth between 3.5 to 5.0 cm.
- Seed should be pretreated to control the pests and diseases
- Use double clutch 45 HP tractor to operate the happy seeder.

Benefits of Happy Seeder Technology

- An ecofriendly technology to check air pollution.
- There is no need of pre-sowing irrigation as the sowing of wheat can be done in residual moisture, i.e. saving of one irrigation.
- Timely sowing of crops can be assured even after harvesting of long duration paddy/basmati varieties.
- Saved labour hours per hectare by eliminating land preparation operation before sowing wheat, which in turn reduced fuel and machinery costs.
- Crop residue as mulch helps in moisture and temperature conservation.
- Less weed population (60-70% less) as compared to conventional practice which reduces the cost of production particularly on the use of herbicides.
- Incorporation/retention of crop residue ensure the availability of micro nutrients because their content varies from 70-80% in the crop residue. These are otherwise lost by burning.
- It is less expensive to use than conventional tillage and do not have a negative impact on profitability.

CONSTRAINTS AND CHALLENGES

- Uniform spreading of straw in the combine harvested fields before using the machine
- Machine weight, load on the tractor (requiring 45 hp tractor for operation) and choking of machine under heavy stubble load
- The machine is more expensive which is a key barrier to adoption for the poorer segment of farmers in India.
- Damage of germinating wheat seedlings by rodents and the difficulty of forming bunds in uncultivated fields in the presence of rice residue.
- Lower seeding capacity compared with conventional seed drills.
- Training of contractors and technical staff is essential for proper operation and maintenance of machine.
- A highly dedicated and committed extension effort along with sincere government support are required to popularize this eco-friendly technology for sustainable agriculture on large areas under RW system
- The high levels of dust generated, and leaving one unsown row adjacent to the field boundary due to the rear position of the ground wheel.

CONCLUSION

Happy Seeder is promising technique to mitigate the agrarian crisis by minimal disturbance of the soil by zero tillage, balanced application of chemical inputs and careful management of residues and wastes and at the same time maintaining or

increasing yield. This reduces land and water pollution and soil erosion, reduces long term dependency on external inputs, enhances environmental management, improves water quality and water use efficiency, and reduces emissions of greenhouse gases through lessened use of fossil fuels with enhanced productivity and profitability of farmers. It also brings many other benefits including retention of organic matter, suppression of weeds and soil evaporation.

REFERENCES

Bisen N and Rahangdale CP (2017). Crop residues management option for sustainable soil health in rice-wheat system: A review. International Journal of Chemical Studies 2017; 5(4): 1038-1042

http://www.iari.res.in/files/Important_Publications-2012-13.pdf

Kaur A and Grover DK. (2016). Adoption of Happy Seeder Technology for Sustainable Agriculture and Alleviation of Agrarian Crisis in Punjab. Indian Journal of Economics and Development 12 (1A): 399-404

MoA. (Ministry of Agriculture). Govt. of India, New Delhi. (2012). www.eands.dacnet.nic.in

Sandhu BS, Dhaliwal, NS and Kumar A. (2016). Happy seeder- an ecofriendly technique to manageme paddy straw. Indian Farming 66(4): 16–18

Sidhu H S, Singh M, Humphreys E, Yadvinder-Singh, Blackwell J and Singh S. (2007). The Happy Seeder enables direct drilling of wheat into rice stubble Australian journal of experimental agriculture 47: 844–854

Sidhu H S, Singh M, Blackwell J, Humphreys E, Bector V, Yadvinder-Singh, Malkeet-Singh and Sarbjit-Singh. (2008). Development of the Happy Seederfor direct drilling into combine harvested rice. In: Humphreys, E., Roth, C.(Eds.), Permanent Beds for Rice–Wheat Cropping Systems and Direct Drillinginto Rice Residues, ACIAR Proceedings No. 127: 159–170.

Sidhu H S, Singh M, Singh Y, Blackwell J, Lohan S K, Humphreys E, Jat M L, Singh V and Singh S. (2015). Development and evaluation of the Turbo Happy Seeder for sowing wheat into heavy rice residues in NW India. Field Crops Research 184: 201–212

Moringa oliefera : A miraculous plant

Richa Thakur[1*], R. Huozha[2] and Vishal Thakur[3]

[1]Research Scholar, Veterinary Pharmacology & Toxicology;[2] Assistant Professor, Veterinary Physiology & Biochemistry, College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture & Technology (GBPUAT), Pantnagar-263145, UK

[3]MVSc, Veterinary Pathology, College of Veterinary and Animal Sciences, Palampur – 176061, HP

**Corresponding Author: richathkr81@gmail.com*

Moringa Oleifera belonging to the family of Moringaceae and popularly known as the miracle plant or the tree of life or drumstick or horseradish tree. It is a plant native to the sub-Himalayan tracts of India. Almost all the parts of this miracle tree have been found to be very useful. Leaves are used as forage, tree trunk for making gums, flower nectar in honey and powdered seeds for water purification. Moringa seed oil (yield 30-40% by weight), also known as Ben oil, is a sweet non-sticking, non-drying oil that resists rancidity. These nutrients are known to scavenge free radicals when combined with a balanced diet and may have immunosuppressive effects. Besides the leaves, the flowers and fruits of *M. Oleifera* have also been found to contain appreciable amounts of carotenoids.

In many developing countries, ruminant production is largely limited by unavailability and high cost of feeds. Low quality feeds are considered to be the major constraints hampering productivity of farm animals. Consequently, these feeds cannot supply the required level of protein and energy leading to poor growth, delayed animal sexual maturity; poor reproductive performance, poor meat quality and low milk yield. Utilization of fodder trees and shrubs could be a potential strategy for increasing the quality and availability of feeds for resource-limited livestock farmers during the dry season. The trees provide a good and cheaper source of protein and micronutrients.

PLANTATION AND SOIL CONDITIONS

M. oleifera can be grown in any tropical and subtropical regions of the world with a temperature around 25–35°C. It requires sandy or loamy soil with a slightly acidic to slightly alkaline pH and a net rainfall of 250–3000 mm. At higher temperature, proteins and enzymes get denatured and this could be the cause for the difference in nutrient content. Soil is an important factor that defines nutrient content and strength of the plant.

NUTRITIVE PROPERTIES

Every part of *M. oleifera* is a storehouse of important nutrients and antinutrients. The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, manganese,

magnesium, iron and copper. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M. oleifera*. *M. Oleifera* leaves are also good sources of phytonutrients such as carotenoids, tocopherols and ascorbic acid. Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar present along with anticancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-octadecanoate. Moringa leaves also have a low calorific value and can be used in the diet of the obese. The pods are fibrous and are valuable to treat digestive problems and colon cancer. The immature pods contain around 46.78% fiber and around 20.66% protein content. Pods have 30% of amino acid content, the leaves have 44% and flowers have 31%. The immature pods and flowers showed similar amounts of palmitic, linolenic and linoleic acids. Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. Moringa powder can be used as a substitute for iron tablets, hence as treatment for anemia. Moringa is rich in phytosterols like stigmasterol, sitosterol and kampesterol which are precursors for hormones. These compounds increase the estrogen production, which in turn stimulates the proliferation of the mammary gland ducts to produce milk.

BENEFITS OF *M. Oleifera*

1. Feed supplement for livestock

Moringa leaves are a valuable source of protein for ruminants but they have a moderate palatability. The use of moringa leaves for feeding poultry, pigs and fish is feasible but only in limited amounts due to the presence of fibre and antinutritional factors. Moringa oil seed cake, the by-product of oil extraction, is not very palatable to livestock and mainly used as green manure or a flocculating agent in water purification. Moringa seeds appear to be toxic to rabbits. Moringa leaves are typically fed fresh to ruminants. However, they have been ensiled alone, or in mixtures with Napier grass or sugarcane, to increase the nutritive value of the silage. Moringa leaves are a valuable source of protein for ruminants. Its protein and organic matter are readily digestible in the rumen and/or in the intestine. Moringa leaves seem to promote rumen microbial protein synthesis due to the substantial contents of readily fermentable nitrogen and energy.

Effect of Moringa fodder on Growth & milk yield of ruminants

Moringa fresh foliage can be included into the dietary roughage component for ruminants. It has shown positive effects on feeding behavior of goat, increased growth rate in sheep and increased milk yield in dual purpose cows but do not change milk composition. Milk from cows fed ensiled moringa leaves do not have off-flavour and aroma, possibly because the ensiling process destroyed most of the glucosinolates, as observed with other forages. MLM (moringa leaf meal) can be included into the diet of fish, laying hens and cross-bred dairy cows. Moringa supplementation resulted in a highest average weight gain of 20.83 g/animal/day in goats feed and protein was efficiently utilized by animals when moringa leaves was used as a fodder supplement.

Moringa diet had the highest efficiency of protein utilization, nutrient digestibility, nitrogen utilization. It improves the milk yield of ruminants as it has a good rumen bypass protein characteristics. cattle feed with the leaves and green stems of moringa can increase milk production by 43-65%, and increase daily weight gain in cattle by up to 32%. In fact, MLM can be used as a substitute for other oil cakes.

2. Medicinal properties

M. oleifera is often referred as a panacea and can be used to cure more than 300 diseases. Moringa has long been used in herbal medicine by Indians and Africans. The presence of phytochemicals makes it a good medicinal agent.

Anti-diabetic

Moringa has been shown to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patients suffer from non-production of insulin, which is a hormone that maintains the blood glucose level at the required normal value. Type 2 diabetes is one associated with insulin resistance. Type 2 diabetes might also be due to Beta cell dysfunction, which fails to sense glucose levels, hence reduces the signaling to insulin, resulting in high blood glucose levels. Diabetes leads to several complications such as retinopathy, nephropathy and atherosclerosis etc. Moringa can be used to prevent such ailments. When there is hyperglycemia, the blood glucose reacts with proteins and causes advanced glycated end products (AGEs). Moringa is also used as an anti-atherosclerotic agent. The anti-atherogenic nature can be accounted for by the antioxidant properties of moringa.

Anticancer

Cancer is a common disease and one in seven deaths is attributed due to improper medication. Several factors like smoking, lack of exercise and radiation exposure can lead to the disease. Cancer treatments like surgery, chemotherapy and radiation are expensive and have side effects. *M. oleifera* can be used as an anticancer agent as it is natural, reliable and safe, at established concentrations. Studies have shown that moringa can be used as an anti-neoproliferative agent, thereby inhibiting the growth of cancer cells. Soluble and solvent extracts of leaves have been proven effective as anticancer agents. The ROS (Reactive Oxygen Species) production by moringa is specific and targets only cancer cells, making it an ideal anticancer agent.

Other diseases

Moringa can be used as a potent neuroprotectant. Cerebral ischemia is caused due to obstruction of blood flow to the brain. This leads to reperfusion and lipid peroxidation, which in turn results in reactive oxygen species. Moringa with its antioxidants can reduce the reactive oxygen specie**s,** thereby protecting the brain. *M. oleifera* is used to treat dementia, as it has been shown to be a promoter of spatial memory. Moringa is suggested to be included in the diet, with the view of boosting the immune system.

3. Agricultural uses

Phytohormones extracted from moringa leaves have been shown to have a growth enhancing effect on various plants, including black gram, peanut, soybean, sugarcane and coffee. Spraying moringa leaf extract on leaves increased plant production by 20-35%.

4. Environmental impact

Water purification

Moringa seed powder has antibacterial properties that make it useful as a natural clarifier for water purification systems and fish ponds. It is considered as a potential natural and inexpensive alternative to toxic alum, but further investigation is required since moringa seed powder may have negative effects when combined with chlorine treatment.

Toxicity and pond management

Moringa seed powder can be toxic to animals and particularly to fish. This toxicity may be used in pond management to control predators of cultured fish. The median lethal concentration (LC_{50}) of moringa seed powder in common carp was 124.0 mg/L after 96 h and the sublethal concentration was 12.4 mg/L.

CONCLUSIONS AND FUTURE PROSPECTIVES

The research on *M. oleifera* is yet to gain importance in India. It is essential that the nutrients of this wonder tree are exploited for a variety of purposes. *M. oleifera* has great anti-diabetic and anti-cancer properties. More studies are needed to corroborate the primary mechanisms of moringa as antidiabetic and anticancer agents. The exact mechanism of this irony is yet to be explored. Also Moringa being rich source of nutrients and metabolizable energy can be considered as alternative fodder for livestock. It can be grown in most of the tropical climatic zones and have low demand of soil nutrients and water. In dairy farming system it can sustain green fodder availability round the year without extra efforts.

Total mixed ration for cattle

Vinu M. Nampoothiri[1] and Rahul Ravi[2]

[1]Veterinary Surgeon, Veterinary Dispensary, Morayur, Malappuram, Kerala
[2]Malabar Rural Development Foundation, Kozhikode, Kerala
Corresponding author: vinumnatl@gmail.com

Dairy cow nutrition is very important for milk production and for maintaining proper health. Dairy cow feed should contain concentrates and forages in correct ratio. Adequate amount of vitamins and minerals also should be there. All the nutrients should be supplied and also should be available to the animal. When the nutrients are balanced then only the animals can properly utilize it for better production and other vital functions of the body. Under these circumstances the concept of a single feed that had correct balance of all nutrients is getting importance. Total mixed ration (TMR) is an efficient and effective concept for feeding dairy animals for more profitable and productive purpose.

A TMR is a completely balanced ration offered to cows in free choice. TMR feeding is a method of feeding successfully adopted for high yielding shed housed dairy cows all around the world. TMR comprises of forages, grains, protein feeds, minerals, vitamins and feed additives formulated to a specified nutrient concentration into a single feed mix.

Two important things that had to be followed during preparation of TMR feed is that regular testing of forages and other feed samples used in TMR for quality assurance and second thing is that the ration formulations had to be regularly updated based on milk quantity and quality parameters, body weight of animal, moisture conditions in forages and feed ingredients, price of feed ingredients etc. Like every feeding systems, TMR feeding method also had its own advantages and disadvantages.

Advantages of TMR

- Feed efficiency improvement is the core advantage of using TMR. Each bite or mouthful of TMR, which the animal consumes, is nutritionally balanced. This provides an adequate environment for the rumen microbes for their efficient functioning. Rumen microbes will be getting regular supply of carbohydrates and proteins for microbial protein production. This finally results in reduced metabolic disorders like acidosis, alkalosis, depressed milk fat, laminitis etc.
- Selective feeding is reduced. Usually if we feed concentrates and forages separately animals had a tendency to eat whatever feed they like. This results in nutritional imbalance and digestive disturbances. In TMR feeding this option of selective feeding got minimized and adds to better feed utilization and efficiency.

- Increase in milk production is noticed upon TMR feeding. Because of better rumen fermentation, absence of metabolic disorders and apt supply of nutrients, milk quality also improves.
- Feeds which are hard to feed separately can be incorporated in TMR feed. So more byproducts and low quality forages can be included which in turn reduces the overall feed cost.
- Labour saving is another important aspect. Feeding concentrates and forages separately will consume more time.
- By knowing the correct amount of daily feed and dry matter intake, feed wastage can be prevented.

Disadvantages of TMR

- TMR system of feeding is mainly for bigger farms because it is highly effective in group feeding instead of individual feeding. Separate TMR can be developed for different groups like fresh cows, early lactation, mid lactation, late lactation cows and dry cows. But certain disadvantages of group feeding are applicable to TMR feeding also. If a cow is having large variation in milk production or body weight from its group average, then this will result in under feeding or over feeding.
- TMR method of feeding is more expensive since mixers/ blenders are needed for TMR preparation.
- Mixing should be proper because both over and under mixing causes problems. Under mixing causes less feed utilization.
- Chopping of hay/straw is needed for proper mixing sometimes.

TMR feeding tips

- Chopping of fodder should be given due importance as fine chopping had to be avoided and also grain particles also should not be so coarse. Silage or haylage should have a particle size of ¾ inch.
- Dry matter intake of TMR should be given utmost importance. Low intake of dry matter should be checked and immediate action should be taken to correct the same. Large changes in the dry matter of forages affect the total dry matter of TMR and also intake by animals.
- Groping of animals based on production not only improve the efficiency of TMR feeding but also reduce the feed cost because feeding of expensive ingredients to lower producing cows causes extensive loss to the farmer
- In a big farm ideal grouping can be done as follows

  Lactating animals - High, medium and low producing
  Dry animals - Early and close to calving
  Heifers - Pre and post breeding
  Calves
- The left off TMR not taken by the animals should be only 5%.

Table 1. Ration composition for TMR

Particulars		Crude Protein (% DM)	Concentrate content (% of TMR)	Dry Matter Intake (%BW)	Total NDF (%DM)	Fat (%DM)	Net Energy (Mcal/lb DM)
Lactating animals	**Early**	17-18	55-60	4	28-32	5-7	0.76-0.8
	Mid	16-17	45-50	3.5	33-35	4-6	0.72-0.76
	Late	15-16	35-40	3	36-38	4-5	0.68-0.72
Dry animals	**Early**	12-13	12-15	2	36	-	0.6-0.64
	Close up	13.5-14.5	22-25	1.8	36	-	0.63-0.67

(Source: Modified from Lammers *et al.,* 2014)

CONCLUSION

Now a day it's the time for organized and big farms which needs feeding of animals precisely. Precise nutrition is possible with the help of TMR feeding concept. Organised farms should be converted to TMR feeding concept for improving the production performance of animals and also for economic rearing. While comparing the advantages and disadvantages of TMR feeding, always advantages are staying high. A carefully designed TMR feeding system in farms really payoff a lot. Good management of the farm should be coupled with TMR feeding for better productivity.

Duck farming- An alternative to poverty alleviation

Dr. Sarin. K. Kunnath and Dr. D. Anil Pavan Kumar

Assistant Professor, Dept. of Animal Genetics & Breeding,
College of Veterinary Science,
P.V.Narsimha Rao Telangana Veterinary University
Korutla,Jagtial-Telangana

Ducks are believed to be have domesticated by Romans in Europe and Malays in Asia few thousands of years ago. As per FAOSTAT, 2014 leading producers of duck meat in the world are China followed by France, Malaysia, Myanmar and Vietnam.Of the total ducks reared in India 90% are indigenous and form the second largest species contributing for egg production. As per, livestock census 2007 in India ducks constituted about 8.52% of total poultry population and counted for about 27.43 million in number.In India, West Bengal, Assam, Kerala, Andhra Pradesh and Tamil Nadu are the leading states in duck population. Ducks are reared for egg, meat and the size of egg is about 4.5% of ducks body weight whereas, that of poultry is 3.3 % of its body weight. Ducks are more prolific compared to chicken and are more adapted to free range system of rearing. Duck rearing in India is concentrated in the hands of small and marginalized sections of society and has not seen the light of industrialization as in case of poultry. The states along the coastal belt of India with inland water resources provide the required natural potential for duck rearing. Considering the hardiness, active foraging ability, adaptability of the ducks to grow in free range system and the less cost input in rearing them, these act as a reliable source of livelihood for many poor rural farmers.

ADVANTAGES OF DUCK REARING:

1. They require less care, attention and lay eggs which are heavier that poultry eggs by about 15-20 gram.
2. Comparatively ducks have more economic egg laying life than poultry
3. They are hardy, more resistant to diseases compared to poultry and can grow in marshy and wet lands which are not adaptable for rearing other domestic animals.
4. They lay eggs at early hours of day, do not require extensive housing system and are free from cannibalism and other vices.
5. Ducks feed on insects, bugs, snails and for this reason integrated farming of duck with fish and duck with paddy cultivation is suggested to be economical.

6. Integrated farming of duck and fish the droppings of ducks serve as feed for fishes, whereas its integration with rice cultivation they loosen up the soil while searching for food, thus helpful in weeding, insect control and also provide manure through its droppings.
7. They act as exterminators of grasshoppers, fleas, snails. They also feed upon larvae, pupae of mosquitoes and can be used in water bodies to check their growth.
8. Ducks are quite intelligent, they can be trained to go to pond/water bodies and come back to sheds on their own.

BREEDS

As discussed earlier duck rearing in India is un-organised and most of the individuals involved in this sector rear indigenous variety recognized breeds like Campbell, Pekin and Muscovy could be found in few states. Central Poultry Development Organisation (CPDO) located at Hessarghetta, Bangalore, Karnataka a Govt. of India funded institute supplies quality ducklings of egg and meat type to farmers at subsidized rates and also are involved in imparting training to farmers and other stakeholders in duck rearing and management. CPDO maintains and supplies stocks of Khaki Campbell (Egg Type) and White Pekin (Vigova Super-M) (Meat Type).

EGG TYPE:

1. **Campbell**: Campbell is a breed of duck with its origin in England, was developed from crossing Mallard, Rouen and Runner ducks. They are reared for their high egg laying capacity. Campbell ducks are available in three colour varieties: khaki, dark and white. The adult weigh about 1.5 to 2.5 Kg. They are active birds with long, neck, bill, head and body. The khaki variety has a green bill, dark brown eyes and rich dark-orange/brown legs and feet.Its head, upper neck, lower back, and tail culverts are brown-bronze while the rest of the plumage is a warm khaki. They are active foragers, start laying eggs from the age of 5-7 months and lay an average of 24-300 eggs per year. Egg size varies from 65 to 75 gm.

Image courtesy: www.purelypoultry.com

2. **Indian Runner:** The origin of these duck is believed to be from islands of Indonesia. They are unique in their posture and stand erect like penguins and run

rather than waddle. The weigh about 1.4 Kg to 2.3 Kg and lay an average of 150-200 eggs per year. The eggs are greenish blue and skin is pink in colour. The colour of these ducks includes those of Fawn & White, White, Penciled, Black, Buff, Chocolate, Cumberland Blue, and Gray. Their height range from 50-76 cm. They have long, wedge shaped head, body is slim but round in appearance and males have a small curl on the tip of their tail.

Image courtesy: https://runnerduck.net

MEAT TYPE:

1. **White Pekin:** Pekin or White Pekin breed of duck reared in America finds its roots from China. They have a solid built body, head is long, rounded, thick neck and their breast is smooth and broad. The plumage is creamy white in colour, the legs and feet are a yellowish orange whereas, the beak is yellow coloured. They are short and almost straight. They are large framed, hardy and adults weight about 4.0-4.5 Kg. Pekin are calm-tempered and are fertile. They are reared principally for meat. They lay about 125 to 225 eggs per year.It attains about 2.2 to 2.5 Kg of body weight in 42 days of age, with a feed conversion ratio of 1:2.3 to 2.7 Kg.

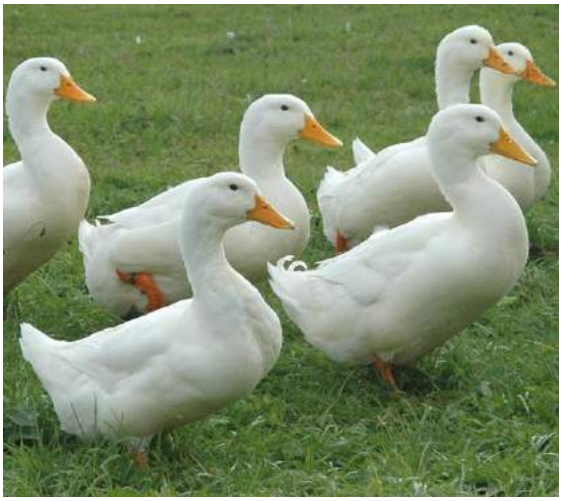


Image courtesy: https://en.wikipedia.org

SYSTEMS OF REARING

Ducks are hardy and are capable of growing with minimum inputs; nevertheless Ducks can be reared in Intensive, Semi-Intensive and Free range systems. Under intensive system of rearing ducks are reared under deep litter system. A confined space of 3-5 Sq.ft per bird, at 16-17 weeks of age is essential. Ration offered should contain 21, 18

and 18 % of protein at starter, growers and layers stage. In semi-intensive system of rearing ducks are reared under deep litter system with a floor space of 2 Sq.ft and an outside run of 8 Sq.ft per bird. In free range system of rearing ducklings are provided with ample space for run and night shelter, under this system around 2000 ducks can be reared per acre of area.

HOUSING

Ducks do no need elaborate housing system; the minimum requirement would be to have a shelter and guarded free run area. The house/shelter should be well ventilated, dry and rat proof.

DIFFERENT TYPES OF HOUSING:

Image Courtesy: A Simple Guide to Duck Raising

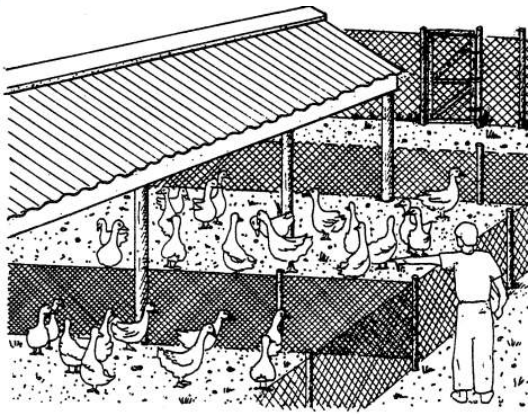


Image Courtesy: Better Farming Series, Raising Ducks 1

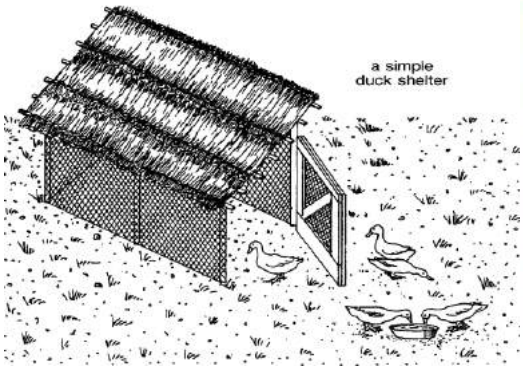
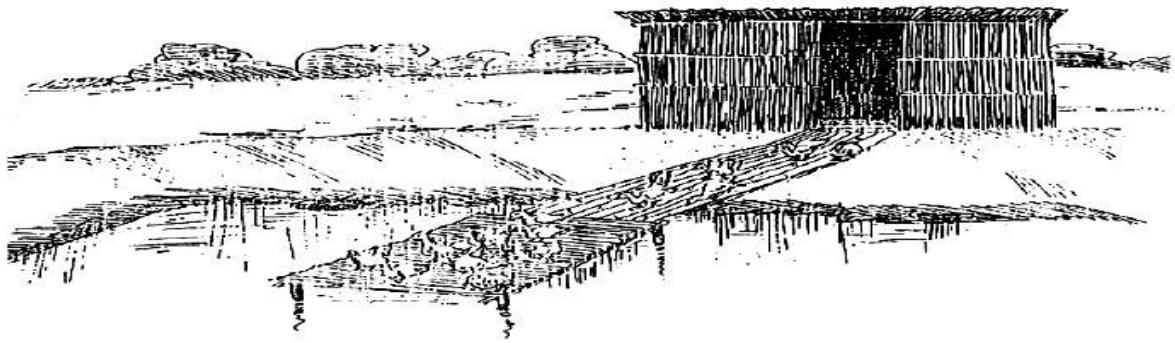


Image Courtesy: Better Farming Series, Raising Ducks 1

Image Courtesy: A Simple Guide to Duck Raising



Duck house on the dyke and feeding platform on the pond water
Image Courtesy: FAO Integrated Fish Farming System in Bangladesh

Image Courtesy *http://www.liveducks.com*

Image Courtesy: *http://shramajeewiki.com*

CARE, MANAGEMENT AND HANDLING:

1. Ducks generally live for ten years, but active egg laying age is up to 4 years. Ducks start laying eggs at an age of 16 weeks. Provide a nest made of wood lined with dry grass or straw, with following measurements for ducks to lay eggs

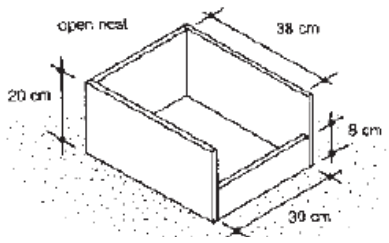


Image Courtesy: Better Farming Series, Raising Ducks 1

2. Ducks reared for meat can be sold at 10 weeks of age, while selling of ducks for meat purpose start with males keeping in mind the flock size, replace two years old ducks with young ones.

3. The sex ratio is 1:5, one drake (male) is kept with 5 females for mating, eggs collected after one month from mating is used for hatching, drakes and ducks should be kept together until the requirement for fertilized egg is over. Replace the growing males with young ones at regular interval by buying it from other farm or replacing it with other farmer.
4. Incubation: Eggs get hatched in 28 days. The optimum temperature is 37.2 to 37 .5°c and the relative humidity is about 65 to 70 per cent. In the incubator eggs are turned at 2 to 4 hours intervals up to 25th day. A fertile egg hatches in to a duck when it is kept warm, under natural conditions a duck sits on them and this is called setting. Provide a wooden nest lined with dry grass or straw for the duck to set for hatching. For hatching select medium sized fertilized eggs and clean it before set for hatching. Large or small sized fertilized eggs may not hatch completely.

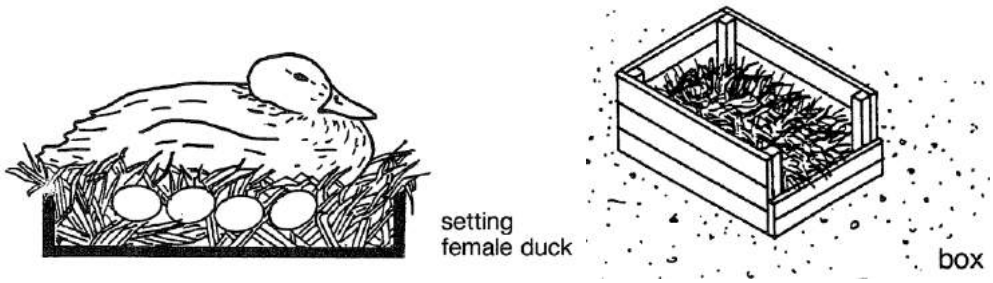


Image Courtesy: Better Farming Series, Raising Ducks 1

When a duck is set for hatching, provide it with fresh water, feed inside the shed itself.

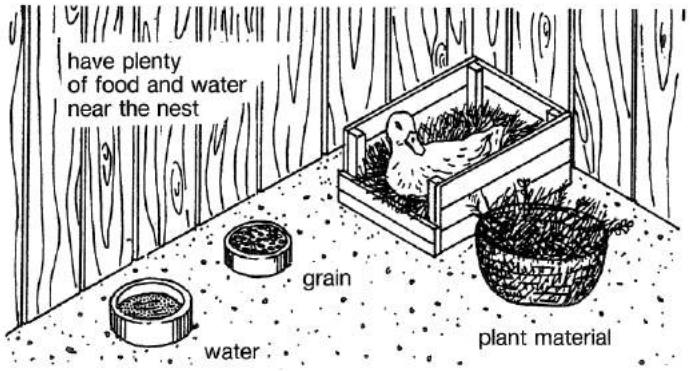


Image Courtesy: Better Farming Series, Raising Ducks 1

5. **Brooding:** One of the essential l management aspect to ensure growth and productive life of hatched duckling is to brood them for minimum a period of 3-4 weeks in case of artificial brooding. The space required per bird for artificial brooding ranges from 0.2-9 Sq.ft. A temperature of 30°C required for first week of brooding and is reduced accordingly every week. Usually a heat lamp of 40-100 watt is used to provide the required heating conditions, and the wattage is altered accordingly how the duck reacts. Feeders and water should be made available all the time and should be accessible to the ducklings. Under natural conditions a broody duck could brood about 10-15 ducklings.

Image Courtesy: A Simple Guide to Duck Raising

6. Selecting duck/drake while purchasing to start a farm should be done with utmost care, the selected bird should bright eyes, well shaped feet, legs, head and shiny feathers.

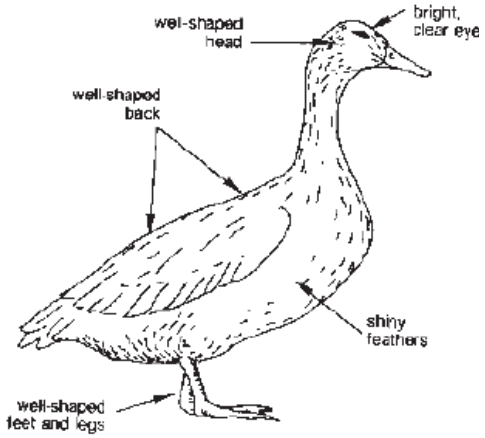


Image Courtesy: Better Farming Series, Raising Ducks 1

7. Ducks should not be grabbed/held on to by wings or legs, the best method is to catch them hold off by base of the neck, firmly and gently.

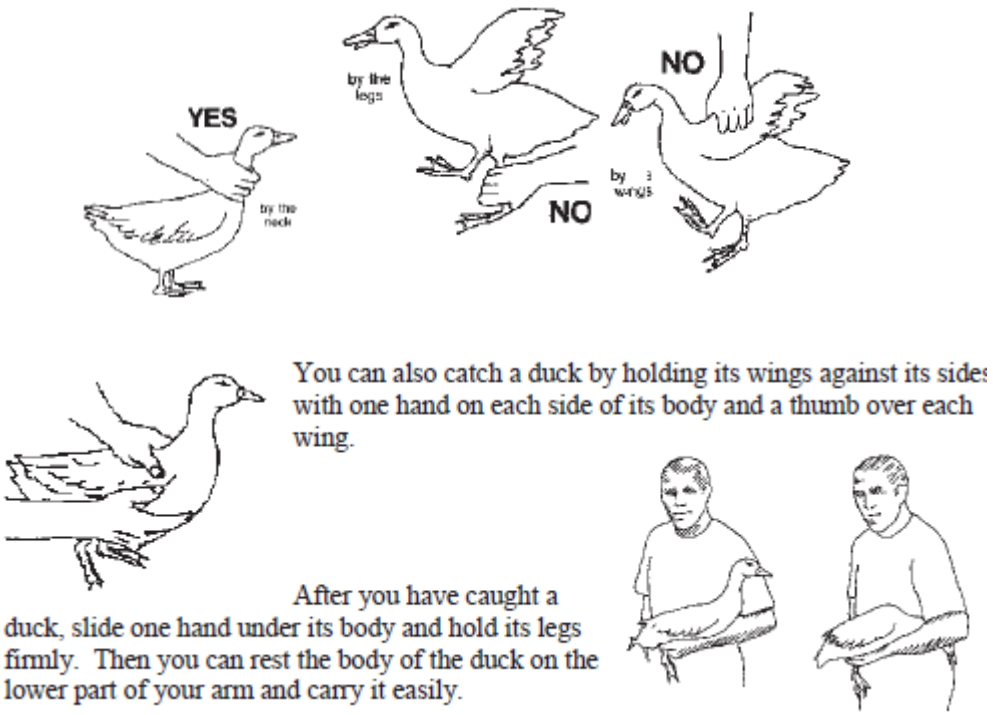


Image Courtesy: Better Farming Series, Raising Ducks 1

8. Duck is a water bird and swimming is not essential for its existence, but they need water for cleaning eyes, bills and head at times and for this the water provided should be deep enough only to dip its head.

Image Courtesy: A Simple Guide to Raising Duck Raising

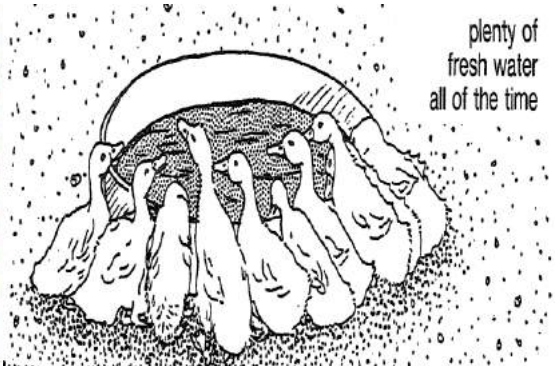


Image Courtesy: Better Farming Series, Ducks 1

9. Ducks are usually alert with a level carriage; they can be seen normally waddling around and pecking as they inspect their surroundings. They emit characteristic honking or quacking noises when their territories are entered.

FEEDING:

Ducks are capable of converting grains, insects, snails, plant materials, leftover food particles and pond materials in to egg and meat efficiently. Commercial duck feeds are available according to age group as pellets and crumbs. Starters for up to 0-2 week,

grower for 3-8 week old and for adults 9 to 20 weeks, then layers and breeders. Duck should always be provided with access to water, they prefer having wet feed. Feeding of ducklings under brooding should be taken care of until they get adapted, they should be provided with coarse milled cereals moistened with water initially before moving on to mash feed. No more feed that can be eaten in about 10 minutes should be fed at any time. Grit or sand and water should be available. Ducklings normally consume 12.5 kg of feed in 20 weeks.

Table: Feed formulae Followed at CPDO, Bengaluru, Karnataka

INGREDIENTS (%)	KHAKI CAMPBELL			WHITE BROILER DUCKS		
	Starter	Grower	Layer	Starter	Grower	Layer
Wheat	45	48	42	60	40	40
Yellow Maize	-	-	10	-	29	20
De-oiled rice bran	14	25.5	6.5	-	10	-
Soyabean meal	25	15	20	25	10	20
Fish meal	10	6	10	10	6	10
Lucern leaf Meal	2	2	2	2	2	2
Mineral Mixture	2.5	2.5	2.5	2.5	2.5	2.5
Shell Grit	-	-	5.5	-	-	5
D.C.P	1.0	0.5	1.0	-	-	-
Vitamin Mixture	0.5	0.5	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Vitamin Mix. In gm.						
Vitamin AB2D3K	25	25	30	25	25	30
Vitamin B+E	25	25	30	25	25	30
Niacinamide	5	5	5	5	5	5
Choline Chloride	50	50	50	50	50	50
Antibiotic	50	50	50	50	50	50
A.P.F. – 100	20	20	20	20	20	20
U.T.T.P.	20	20	20	20	20	20
Total	195	195	205	195	195	205

Filler material (ground wheat/ maize); Maize should be free from aflatoxin.

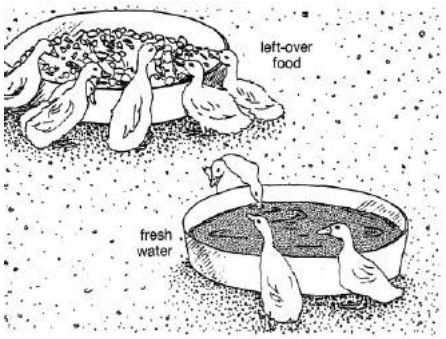


Image Courtesy: Better Farming Series, Raising Ducks 1

Image Courtesy: https://ylxm.en.alibaba.com

Image Courtesy: https://www.tyrantfarms.com

Image Courtesy: A Simple Guide to Raising Duck

A generalized formula for different categories of duck feed is given below accordingly changes may be made based on the availability of feed ingredients.

HEALTH COVER

Ducks are in general resistant to diseases and avian parasites; the infestation of internal parasites is common among ducks and with accesses to stagnant ponds. The internal parasites include flukes and tape worms. The external parasites like ticks and mites and their infestation causes annoyance, irritation, stress and results in decreased egg production. A healthy bird will have clear and bright eyes, good posture, plumage, clean and healthy skin, well formed shanks and feet. Vigorous movements if disturbed, with effective walking and preening, active feeding and drinking. Whereas early symptoms of disease could be: head pulled in to the body, huddling appearing chilled, lack of preening and general inactivity, in-coordination, drooping eyelids and puffy head.

Preening: An act of Grooming. *Image Courtesy: http://www.natures-desktop.com*

Waddling: walk with short steps and a clumsy swaying motion. *Image Courtesy: https://www.shutterstock.com*

COMMON DISEASES

Ducks in general are resistant to diseases. They could be susceptible to viral diseases like Duck Plague and Duck Viral Hepatitis and vaccination is the most suitable option to prevent the disease from affecting the flock. Duck Cholera caused by *Pasteuralla* could be treated using Sulpha drugs. Botulism or food poisoning due to ingestion of bacterium

from decaying plants can affect young ducks and could be treated by adding, Epsom salt which acts as purgative. Aflatoxicosis which arises due to fungal infestation in feed can results in mortality over a period of time. With drawl of infected feed could result in recovery of birds.

VACCINATION SCHEDULE:

S.No	Name Of The Vaccine	Route	Dose	Age Of Ducks
1	DUCK CHOLERA	Subcutaneous	Duckling 1 ml.	3-4 weeks
			Adult 2 ml.	After 1 month of previous vaccination
2	DUCK PLAGUE		Adult 1 ml.	8-12 weeks

VACCINE CAN BE OBTAINED FROM

1. Director, Institute of veterinary Preventive Medicine, Ranipet, Vellore District, Tamil Nadu State (Duck Plague).
2. Director, Institute of Animal Health & Veterinary Biologicals, Palode, Placha, Thiruvananthapuram, Kerala- 695562

CONCLUSION

Ducks in general are hardy, disease resistant, active forager, with better adaptability and can be reared with low and minimum inputs. They don't require elaborate housing sheds; can survive by feeding on insects, grass, snails and left over food. Yet, they produce on an average of 180-200 eggs per year with minimum inputs and are good source of animal protein. Duck rearing can be successfully used as tool to alleviate poverty and meet the protein requirement, by encouraging the marginalized section to be involved in it.

REFERENCE

https://livestockconservancy.org/index.php/heritage/internal/campbell
https://en.wikipedia.org/wiki/Indian_Runner_duck
A Simple Guide to Duck Raising, Turtle Village Trust Agricultural Training Programmes, by Dr. Allan Bachan
FAO, Better Farming Series, Raising Ducks 1
Indegenous Technical Knowledge in Duck Production in Tamil Nadu, by K.Gajendran and SMK Karthickeyan, Indian Journal of Tradituional Knowledge, Vol.(10), April 2011,pp,307-310.
Duck Farming, Fascinating Option in India, by Dharmendra Singh Rajput, Shiv Pratap Singh, Sudipta Ghosh and Nema RP, Rajput et al., J Veterinar Sci Technolo 2014
Duck Management Guide, Central Poultry Development Organisation,Bangalore.
Duck Rearing an Introduction, Dr. K.T. Chandy, Agricultural & Environmental Education.

Health Care and Management of Neonates and young calf

Rajat Verma[1], Manish Kumar Verma[2*], Richa Thakur[2] and Pankaj Patel[1]

[1]MVSc Scholar, Poultry Science; Research Scholar[2], Veterinary Pharmacology & Toxicology
College of Veterinary and Animal Sciences,
G. B. Pant University of Agriculture & Technology (GBPUAT),
Pantnagar-263145, UK
**Corresponding Author: manishverma307@gmail.com.*

Neonates and young calves are the back bone of dairy farms. Calves form the future dairy herd. Routinely replacement of 20 to 30% cows with freshly calved heifer- cows is highly essential to maintain production efficiency. Raising calves is most difficult operation in a dairy farm which require a great deal of management skill, proper attention and hard work dairy animal produce milk by converting the crop residue and by products from the crop which otherwise would be wasted (Donna *et al*., 2006). India has vast resources of livestock which play a vital role in improving the socio economic condition of rural masses. The future of any herd depends on how calves are raised. When this proper feeding, health, breeding, should not be taken care then the calf will not attain the maximum production. If proper hygienic condition maintain during the neonatal rearing then the calf will free from managemental and contaminated disease. Growth of dairy will occur very rapidly when young calves and neonates have given balanced feeding and hygienic management. The first 72 hours is critical for newborn calf.

CARE OF NEW BORN CALF JUST AFTER CALVING

When calf is born there are a few critical tasks that must take place. First, assess the vital signs of the calf to ensure it is alive. Check its breathing, heart rate and movement. This movement does not have to be much, but enough to show that the calf is functioning. Normally cow will lick and dry the calf immediately after parturition which may stimulate circulation and respiration. If the cow fails to do so, it can be stimulated to lick by sprinkling handful of bran or salt over the body of calf. The mucus from the nostril of the newborn calf should be wiped and cleaned with a dry towel. Sometimes respiratory passage may be block with mucus and interfere with calf respiration. Under such condition the calf should be lifted by holding the hock in such a way that the head is down, so that the mucus may flow off. Care should be taken while lifting the calf, it may slip off. A hand full of straw can be used to have a grip while lifting. The calf can also make to sneeze by tickling a twig of hay or grass inside nostril. If the above method

is failing, little time is left to lose. The attending person should apply his mouth to the nostrils of the animal and suck out of the mucus. After that he should blow in his expired air through the calf nostril closing its mouth. Carbon dioxide in the expired air which has been blown in the lungs of the calf will act as respiratory stimulant to initiate respiration (Donna *et al*., 2006). This should be followed with intermittent pressing and releasing of pressure on the chest wall of the calf to give artificial respiration. Navel or umbilical cord should be ligature with a sterile thread one inch from the body (under field condition the thread can be soaked with tincture iodine) severed 1 to 2 cm distal to the ligature and tincture iodine or povidone should be painted liberally. This is very important because infection can gain easily through navel and cause serious illness like navel ill, navel abscess and joint ill. Neonatal ascariasis is common in buffalo calves and deworming should be made as early as possible, preferably in the 1 week of life. A single oral dose of 10 gm piperazine is recommended for calves. New born calf should void meconium in 4 to 6 hours of first colostrum feeding and first feces is tarry in color and consistency.

Figure: Isolated shed for newborn calves in a dairy farm

COLOSTRUM FEEDING MANAGEMENT IN NEONATE

Colostrum is the thick, creamy, yellow secretion of the first milking collected from the udder after calving. Colostrum is the first milk secreted after parturition. It provides antibody which are absorbed intact in the first few days of the calf life. It contains immunoglobulins-IgM, IgG, IgA which are essential for new born calves and can pass through the intestinal membranes freely during the first 12 hours of its life. There are three main classes of immunoglobulin present in colostrum. "IgG, IgA and IgM accounting for approximately 85% to 90%, 5%, and 7%, respectively (Nagalakshmi, 2009). It is also rich in vitamins –A, D, E and minerals –Ca, Mg, Fe and P. It also has a laxative effect in removing of muconium. The colostrum should be fed at the rate of one tenth of body weight of calves. It contains large amount of gamma globulins. The gamma globulins must be absorbed as such across the intestinal wall into blood stream without being broken down into amino acids. The intestinal wall of the calf will allow the

globulin to pass from inside the intestine to the blood stream for only a short period of time after calf is born. This permeability is rapidly lost after first few hours of life (1 to 2 hours). It will be highly useful to feed colostrum in the first 15 to 30 min. There absorption is highest within 12 hours after birth. The absorptive cell lining of the small intestine are immature at birth. So in this stage they indiscriminately take up large molecules like immunoglobins. As the calf grows older hour by hour, there is a transition of epithelial cells of small intestine from immature type to mature type which cannot allow large protein molecules. The amount of proteins in colostrum is about five times higher than that in milk, particularly due to a high content of immunoglobulin. Colostrum act as a laxative agent. after birth of calf gamma globulin level in blood serum of neonatal calves is only 0.97 mg /ml. it increases to 16.5 mg/ml level after first colostrum feeding at 12hr. when colostrum feeding is given on second day its value become 28.18 mg/ml. quantity of colostrum should be given @1/10th of the body weight. Excess colostrums feeding should be avoided because it causes scours. In most parameters the highest values were found in colostrum from the first milking, the most pronounced decrease being observed for the first three days after parturition. Only the pH and lactose values were found to be lowest in colostrum from the first milking. Colostrum is characterized by a lower pH value than milk. Slightly acid reaction of colostrum and milk is caused by the presence of proteins, dihydrogen phosphates, citrates and carbon dioxide. Titratable acidity of colostrum is roughly 2-2.5 times higher than that of milk.

CARE OF YOUNG CALF AFTER COLOSTRUM FEEDING

Reticulo-rumen is non functional in calves and hence feeding of calves should be treated as non-ruminant and they are not equipped to utilize cellulose. Calves cannot utilize roughages containing higher amount of cellulose. In such condition, calves should be fed with good quality leguminous hay and other roughages**.** Milk feeding should be 3 or 4 times in a day during 1 week and can be reduced to 2 times in a day up to 90 days. The calf is best maintained in an individual pen for first few weeks and after 8 weeks calf will handled in group. After that different practice should be done in calf group like tattooing of calf for identification. At 15 days of age dehorning will be done. Vaccination should also be follow against contagious disease. Also provide fresh and clean water time to time. Calf pen should be closed to cow herd. Pen should be clean and providing proper sunlight, good ventilation and floor should not be slippery. Group feeding should be avoided to minimize over feeding or under feeding. After 6 to 8 weeks, calves may be grouped according to age and sex. Calves should be fed twice or more times in a day. One time feeding may cause indigestion and diarrhea results in dehydration. Making the calf independent of its mother is known as weaning. In weaning, calves are not allowed to suckle milk from their dam. Weaning calf should be trained to drink milk from pail such that feeding management easier. Mostly crossbred calves learn quickly to drink milk from pail. As compare to crossbred, buffalo calves are lazy and slow in learning to drink milk or milk replacer from the bucket. The calf should not be forced to drink milk by immersing the head into the bucket. But dairy attendant should learn them to drink

milk. After cleaning their hands, they dip fingers into the milk jar and allow calf to suckle the fingers by taking calf mouth close to fingers. The process of dehorning in dairy cattle has been used for years to reduce the risk of injuries to both humans and other animals. Different methods have been used to prevent horn growth in a young calf such that prevents injuries. Dehorning should be done by different method like heat and chemical cauterization within first eight weeks of age.

ARTIFICIAL COLOSTRUMS

If dam colostrum is not available, then artificial or alternate colostrum should be given. Artificial colostrum serves as a rich source of nutrients for the newborn calf as it has high amount of energy and protein (Nagalakshmi, 2009). With these proportions for making artificial colostrum, you are able to feed for the needed four to five days of colostrum feeding at the recommended rate of 10 per cent of calf body weight.

- One egg- protein source
- Half liter fresh warm water + half liter whole milk-source of lactose and milk protein
- 1 teaspoonful castor oil – energy
- 1teaspoonful of cod liver oil –energy

Colostrum is given to calf as soon as possible. From 2 weeks to 1 month, calf should be fed milk at approx.10% of their body weight and should be fed at body temperature (Vanessa *et al.,* 2014). Calves have little capacity to utilize non-protein nitrogenous compound and therefore substance like urea should not be included in ration. Weaning of calves within 4 days of birth is important. After weaning, calf is trained to drink milk from a pail. The calf must receive sufficient milk during the first three months.

COMPOSITION OF MILK REPLACER

Components	Parts
Wheat	10
Fish meal.	12
Linseed meal.	40
Milk.	23
Coconut oil.	10
Butyric acid.	0.3
Citric acid.	1.5
Mineral mixture.	3.0
Antibiotic.	0.2

MILK REPLACERS

Milk replacer is fed to calves as early as at 10 days of age to replace milk from economic point of view. Milk replacer should resemble milk more or less on broad chemical composition especially in terms of protein quantity and quality, amino acid quantity and

quality, fatty acids, minerals and vitamins (Vanessa *et al.,* 2014). It should have a biological value equivalent to that of milk. Good quality milk replacer should have minimum 50% spray dried skim milk powder. It should not contain starch, fiber. It contains 22 to 25% good quality protein and also readily dispersible in water.

CALF STARTER

Calf starter are the first day concentrate mixture fed to calves. Calf starts eating small amount of dry starter from the 2 week of life. A calf starter should be highly palatable. It should have high energy i.e. 75% TDN and 14-16 % DCP. Calf starter may be fed on free choice basis until the calf starts consuming about 1-1.5 Kg of the starter mix a day after which the amount may be restricted. It is a mixture of ground farm grain, protein feed, minerals, vitamins, and antibiotics. When calf attain the age of 2 weeks the amount of whole milk given to it may be cut down.

COMPOSITION OF CALF STARTER

Ingredient	Parts
Maize	42
GNC	35
Wheat bran	10
Fish meal	10
Mineral mixture	2.0
Salt	1.0

COMMON AILMENTS

1. **Calf diarrhea**

Diarrhea is the most common cause of death in young calves (Ingrid *et al.,* 2011). The highest risk period for calf diarrhea is within the first month after birth. Cause by- E.coli.
Clinical sign and Treatment:

- Thin and watery feces, sunken eye, dry mucus membrane, rough hair. Extremities become cold to touch, loss of appetite, difficulty getting up, unable to rise, loss of consciousness.

Treatment : Fluid therapy should be given. Anti diarrheal powder should be given.

2. Pneumonia

Calf pneumonia is a major problem in dairy. It is a multifactorial disease. The most common postmortem diagnosis occurs in calves between 1 to 5 month of age**.**
Infectious agent- Bacteria, Mycoplasma, Virus.
Symptoms and treatment

- Dull and depressed, high temperature, raised breathing due to lung damage, nasal discharge and coughing, reduced food intake.
- Antibiotics and anti inflammatory should be given.

3. Navel-ill and joint-ill

This is caused by bacteria infecting the umbilical cord soon after birth particularly where the calving area is contaminated. It can lead to severe inflammation. Animals with joint ill are reluctant to walk and stand only for brief period (Dusty *et al.,* 2008). Infection is carried in the blood stream to all parts of the body.

Symptoms and treatment:

- Reduced appetite, diarrhea and pneumonia.
- Navel in all newborn calves should be swabbed with diluted iodine 7 percent as a precautionary measure. Calving pen should be kept cleaned.

4. Colibacillosis

It is an infectious disease of new born animals caused by E.coli.

Symptoms and treatment:

- Enteritis, swelling of lymph node, pneumonia, fever, diarrhea, dehydration, nasal discharge and navel-ill.
- Antibiotic, antipyretic and fluid therapy should be given.

VACCINATION

Due to the complexity and immaturity of the calf's immune and management systems developing an effective vaccination program is essential. Calves are born with a functional yet very immature immune system that responds to antigens as long as maternal antibodies are not present. If maternal antibodies are present it is difficult for the calf to properly respond to the vaccinations The most common infectious ailments of neonatal are calf diarrhea, navel-ill, pneumonia against which there are no vaccine available. These diseases are prevented through optimal hygienic measure especially up to first three month of age. Common infectious diseases like FMD, HS and BQ need vaccination (Dusty *et al.,* 2008).

1. FMD- 3 weeks and above (primary vaccination) and then twice a year vaccine (Raksha FMD 3 ml deep IM).

2. HS- 3 month and above and annually before monsoon vaccine (Raksha HS 2 ml IM).

3. BQ- 3 month and above and annually before monsoon vaccine (Raksha BQ 2 ml). But mainly Raksha triovac (HS+BQ+FMD) 3 ml deep IM.

REFERENCES

Donna M, Patty B, John T, and Sharon F. Feeding and Managing Baby Calves from Birth to 3 Months of Age. University of Kentucky College of Agriculture, Lexington.

Dusty WN. 2008. Resuscitation and Critical Care of Neonatal Calves. Veterinary Clinics of North America: Food Animal Practice, *2*5(1); 1-11.

Ingrid L, John FM, Bernadette E and Simon JM. 2011. Calf health from birth to weaning. I. General aspects of disease prevention. Irish Veterinary Journal, 64; 10.

Nagalakshmi D.2009. Colostrum Management and Feeding in Neonatal Calves. Intas Polivet, 2; 142-152.

Vanessa M, Geert H and Geert O. 2014. Advances in prevention and therapy of neonatal dairy calf diarrhoea: a systematical review with emphasis on colostrum management and fluid therapy. Acta Vet Scand, 56(1): 75.

Livestock transportation

Nazir Ahmad Mir[1*], Shahid Ahmad Shergojry[2] and Sarver Ahmed Rather[3]

[1]Subject matter specialist (Animal Science) KVK Leh-Ladhak, J&K India
[2]Subject matter specialist (Animal Science) KVK Kulgam, J&K India
[3]Scientific officer,NRL, BARC Mumbai, India
***Corresponding Author: mir643@gmail.com*

Domestication of animals paralleled with human civilization itself, thus domestic animals became indivisible part of human civilization. Domestic animals are kept for various purposes e.g. as food animals, companions, drought power, for animal products and by products depending upon type of animal. As human beings use different transportation means for going from one place to another, the choice of which depends on duration of travel, comfort level, economy etc. In the same way livestock is being transported through different means but the most common mode utilized is road transportation in the world including India. Transportation of animals include rounding up, catching the animals, loading them on to vehicle, then actual transit and finally unloading of animals at destination.

Domestic animals are transported for various reasons or purposes e.g. for slaughter at slaughter houses which are mostly located away from animal farms, for treatment of various ailments, vaccination, for artificial insemination (A. I.) at A.I. centers, for participation in exhibitions, fairs, melas, sports competitions or seasonal tourism, for shifting animals to pastures. Thus the transportation becomes inevitable practice in livestock rearing and production system and at the same time transportation imposes severe stress on animals. The effect of various stressors (factors) on animals during transportation, how animal's respond to these stressors and finally impact on animals has been represented diagrammatically (Fig.1).

Various studies have been carried out to assess the effect of transportation stress and it has been found that transportation has negative impact on normal physiology and behavior of animals, thereby making animals susceptible to diseases and finally decreasing the animal productivity and compromising animal welfare. The environment condition especially high or low ambient temperature and relative humidity (RH) add to the transportation stress of animals. The literature has revealed that transportation of animals has dramatic effect on the animal welfare and production, besides this various attempts had been made by different workers to find out the strategies for mitigating the adverse effects of transportation stress. Modification of animal transportation vehicles based on type of animal i.e large animals e.g cattle and buffalo; small animal e.g sheep and goat., in terms of design of transportation vehicle can reduce the transportation stress. Supplementation of various substances e.g. vitamin C, jaggery,

vitamin E, Propofol and a range of other substances has been shown to reduce the transportation stress when fed individually or in combination with one another. Providing rest periods and water during long transportation besides restriction of continuous transportation to certain duration of time also helps to reduce transportation stress.

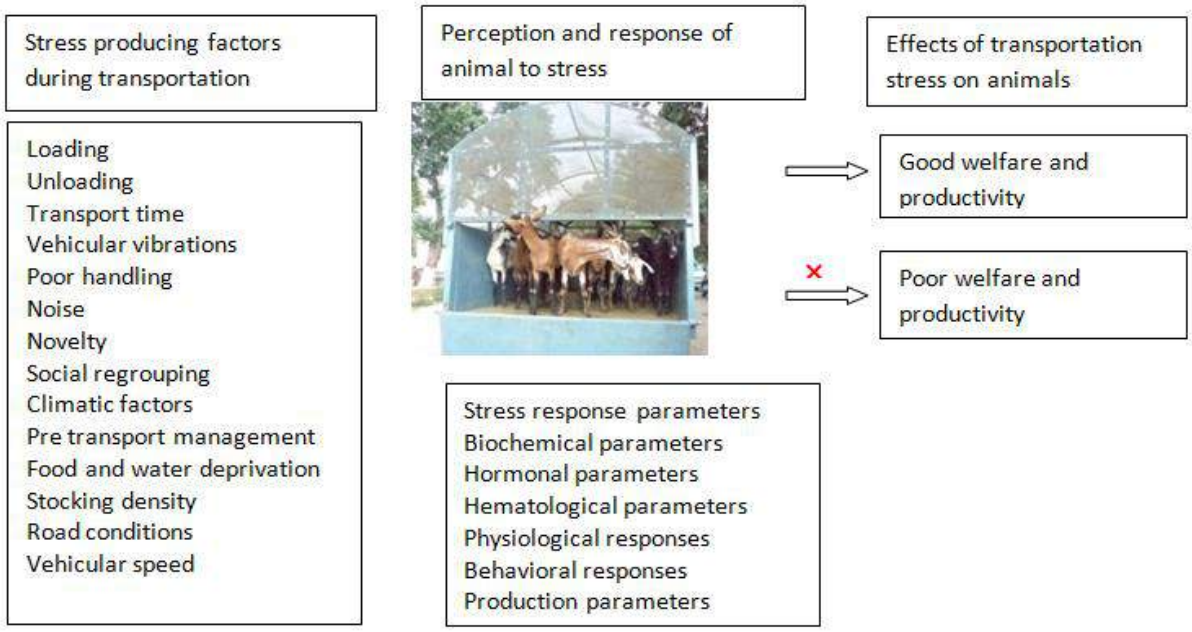


Figure 1: Factors inducing transportation stress and animals response to these factors

In developed countries livestock transportation is carried out in specially designed vehicles for animal transportation but still the animals do suffer from transportation insult. In many developing countries including India no such vehicles are available. The animal transportation in India is done by trucks, tractor trailers, auto rickshaw or any other vehicle available within vicinity of farmers. Small animals including sheep, goat and poultry are sometimes transported in the same vehicle carrying human passengers. Although European Union has laid down certain rules and regulations regarding animal transportation to ensure human handling of animals during transportation but in developing countries these regulations are flexible. In recent past animal welfare activists have raised hue and cry regarding animal welfare during transportation but to what extend this is going to have its fruits we have to wait and watch. Besides this scientific communities are also trying their best to find out ways for mitigating the adverse effects of transportation stress on animals.

Biofortication of agricultural crops towards food secuirity

S. Alagappan

Ph.D Research Scholar,
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003. Tamil Nadu, India.
Corresponding Author: Email: alga.s@rediffmail.com, Tel.: +91-944-251-0069.

Abstract

Worldwide almost 1 billion people are undernourished and more than a quarter of all children under 5 years of age are underweight (UNICEF, 2010). Malnutrition in children can impair their physical, cognitive, and psychological growth and leads to increased child morbidity and mortality. Among adults, effects include lethargy and poor health, reduced productivity, decreased cognitive function and a loss of learning potential. In addition to undernourishment, approximately 2 billion people worldwide suffer from micronutrient deficiencies, also called the "hidden hunger" (FAO, 2010). These micronutrient deficiencies, particularly iron, iodine, zinc and vitamin A, are commonly associated with inadequate dietary intake, poor utilization, affect mainly women and children. Biofortification is the one of the potential weapon in reducing micronutrient deficiency. Biofortification refers to a process of breeding staple food crops that are rich in bio-available micronutrients. The enhancement of essential nutrient content in staple crops can be achieved through conventional plant breeding or, in situations of limited genetic range for nutrient content through transgenic means and fertilizer management (West and Thompson, 2010). Biofortification of cereal grains through using fertilizers (also called agronomic biofortification) enhances the production of micronutrient dense seeds and contributes to the overall yield. Increasing evidence has indicated that micronutrient fertilizers greatly contribute to micronutrient concentrations in cereals, and hence application of micronutrient fertilizers seems to be an important complementary approach to enhancing micronutrients through plant breeding (Cakmak, 2008). Among the different micronutrient, Zn play and vital role in human health. Hence several research works on Zn biofortified crops have been conducted. For example Zn fertilization in cereals and oilseed crops. Among the different management options, the applications of Zn in soil and foliar method increases the grain Zn, Fe and vitamin A concentrations.

Key words: Malnutrition, hidden hunger, biofortified crops, transgenic crops

INTRODUCTION

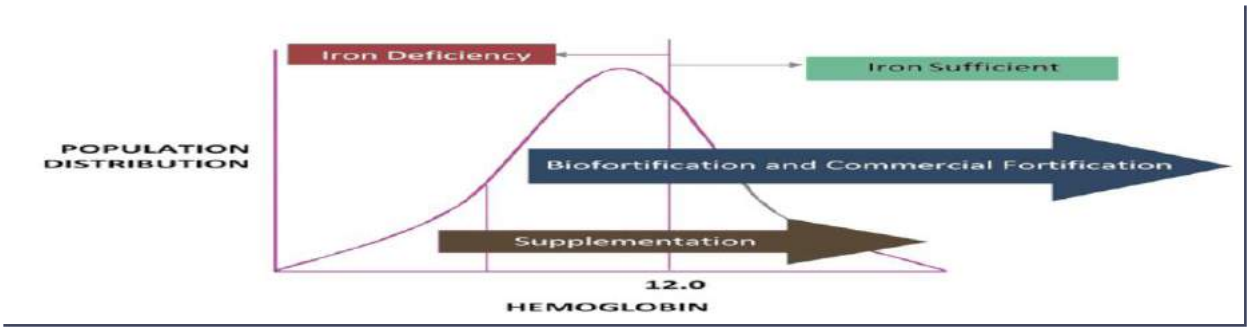
Human being requires diverse and well balanced diet, containing complex mixture of both macro and micro nutrients in order to maintain optimum health. In general,17 minerals and 13 vitamins are essential micronutrients in the human diet are required at minimum levels to alleviate nutritional disorders. The current status on malnutrition in the world is around 3.4 billion suffers micronutrient deficiency - iron, vitamin, iodine &

zinc, 3.1 million school age children suffer vitamin A deficiency, 2 billion people severe deficient in iron (Anemic), and 50% of pregnant women and 40 % of non pregnant women in developing countries are anemic. In India about 57 % of school children are with Vitamin A deficiency and 79 % of kids between 6 & 35 months of age are with anemic followed with 56 % of women between 15 & 49 years are anemic which shows the ill health of Indian active public and 85 % of Indian public are with the deficiency in iodine.

The new approaches to fight against the deficiencies

Supplementation, Agronomic biofortification, Food fortification and Biofortification.Fortification: Fortification may be defined as the addition of nutrients to foods for the purpose of preventing nutrient deficiencies in populations. Fortification world wide: U. S. Fortification began in 1920 with iodine fortified salt and during 1930, vitamin D fortified milk was developed. India was pioneer in food fortification process for developing vitamin A fortified ghee during 1962. India had developed the technology to fortify tea with vitamin A during 1996. In 1997, National Federation of cooperative sugar factories Ltd., fortified sugars with 12-15 mg/ kg of vitamin A. Advantages: Providing certain nutrients simultaneously in the same food improves the utilization of certain vitamins and minerals, e.g. vitamin C enhances the absorption of iron. Providing nutrients through the regular food supply and distribution system reduces. Disadvantages: The shelf life of fortified milled cereals is reduced compared to unfortified unmilled cereals. Regular quality control is essential. When fortified food is cooked too long, vitamin C loss can be as much as 90% (study undertaken by the Refugee Health Unit on CSB, Somalia, 1989). A fortified commodity is more expensive than an unfortified one.

BIOFORTIFICATION IMPROVES STATUS FOR THOSE LESS DEFICIENT



PRIMARY ISSUES HAVE BEEN IDENTIFIED - BIOFORTIFICATION SUCCESSFUL

A biofortified crop must be high yielding and profitable to the farmer, The biofortified crop must be shown to be efficacious and effective at reducing micronutrient malnutrition in humans be acceptable to both farmers and consumers

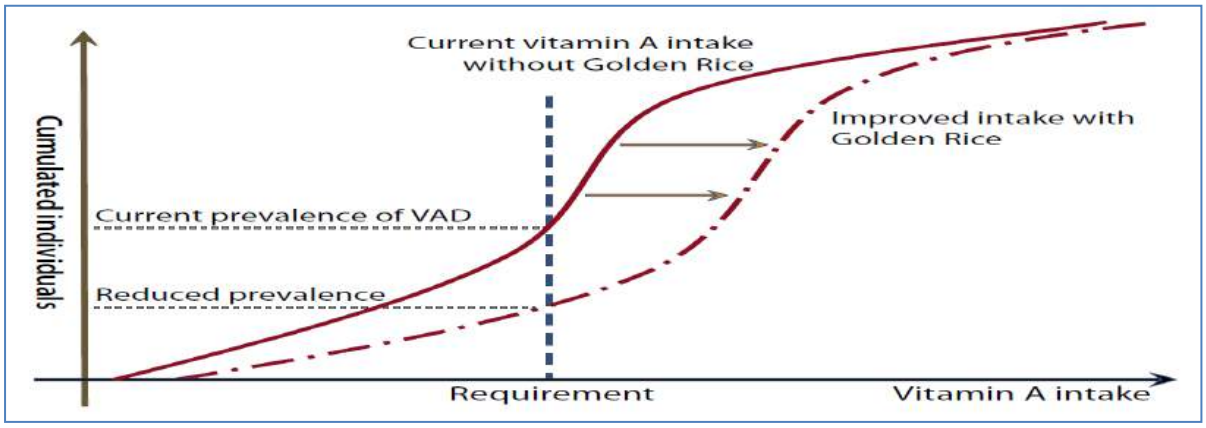
Approaches for biofortification of staple food grains: Biofortification of cereals with zinc & iron through fertilization. Cereal crops are inherently very low in grain Zn and Fe concentrations (Cakmaket al. 2010). Thus, biofortification of cereal crops with Zn

and Fe is a high-priority global issue. Application of Zn- and Fe-containing fertilizers is a short-term solution. **Biofortification of wheat with zinc through zinc fertilization.** Wheat field experiments - one or two continuous cropping years at 23 experimental site years in seven countries *viz.,* China, India, Kazakhstan, Mexico, Pakistan, Turkeyand Zambia. Location, Zn treatments, Nil Zn (control), Soil Zn application - (50 kg $ZnSO_4$ ha^{-1} as basal), Foliar Zn application (two times of $ZnSO_4$ application @ 0.5% at the heading and milk stages), Soil + foliar Zn application, Zinc reduces phosphorus uptake by roots and accumulation of phytate in grains, This agronomic side effect of Zn fertilization may result in better bioavailability of Zn in the human digestive system, Seedlings from seeds containing high Zn have better ability to withstand adverse environmental conditions.

Agronomics and human nutritional benefits of micronutrients enriched seeds: Seed enriched with micronutrients, Improving human nutrition, Improving seed viability and seedling vigour, Improving abiotic stress, Decreasing seedling rate, Higher yield under deficiency and increasing the disease resistant.

GOLDEN RICE: Golden rice" that produces vitamin A for reducing blindness and dwarfism that result from a vitamin-A deficient diet. Golden rice was designed to produce beta-carotene, a precursor of Vitamin A, in the part of rice that people eat, the **endosperm**. The rice plant can naturally produce beta-carotene is a carotenoid pigment that occurs in the leaves and is involved in photosynthesis. Plant does not normally produce the pigment in the endosperm since photosynthesis does not occur in the endosperm. **Creation of golden rice:** Golden rice was created by **Ingo Potrykus** working with **Peter Beyer**. Project started in 1992. Golden rice was created by transforming rice with two beta-carotene biosynthesis genes, ***psy*** (phytoene synthase) from **daffodil** (*Narcissus pseudonarcissus*), ***crt1*** from the soil bacterium ***Erwiniauredovora,*** The original Golden rice it produced 1.6 µg/g of carotenoids under Greenhouse, Golden rice has been bred with local rice cultivars in the Philippines, Taiwan and with the American rice variety Cocodrie. The first field trials of these golden rice cultivars were conducted by Louisiana State University Agricultural Center in 2004. 2005, biotechnology company **Syngenta** produced a variety of golden rice called "Golden Rice 2". Golden rice 2 produces 23 times more carotenoids than golden rice (up to 37 µg/g).

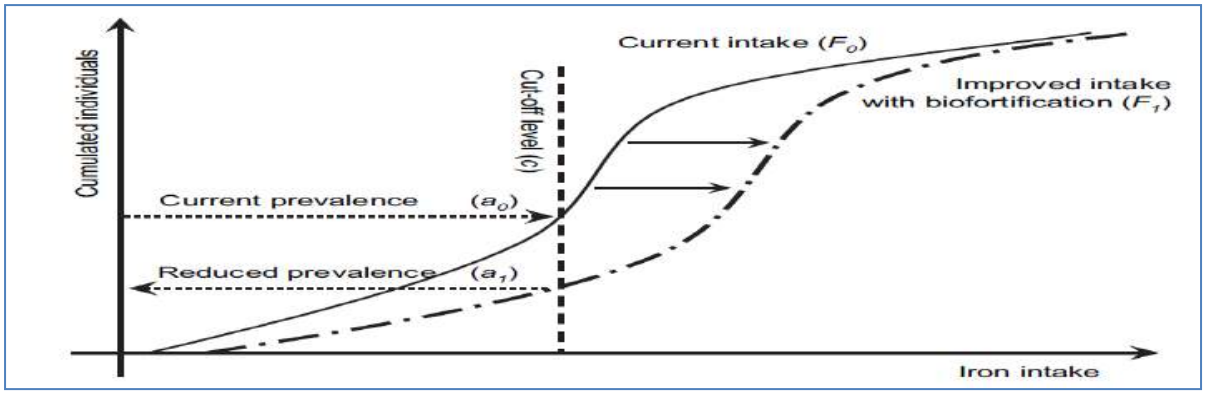
IMPROVEMENT IN VITAMIN A INTAKE WITH GOLDEN RICE



GOLDEN MUSTARD

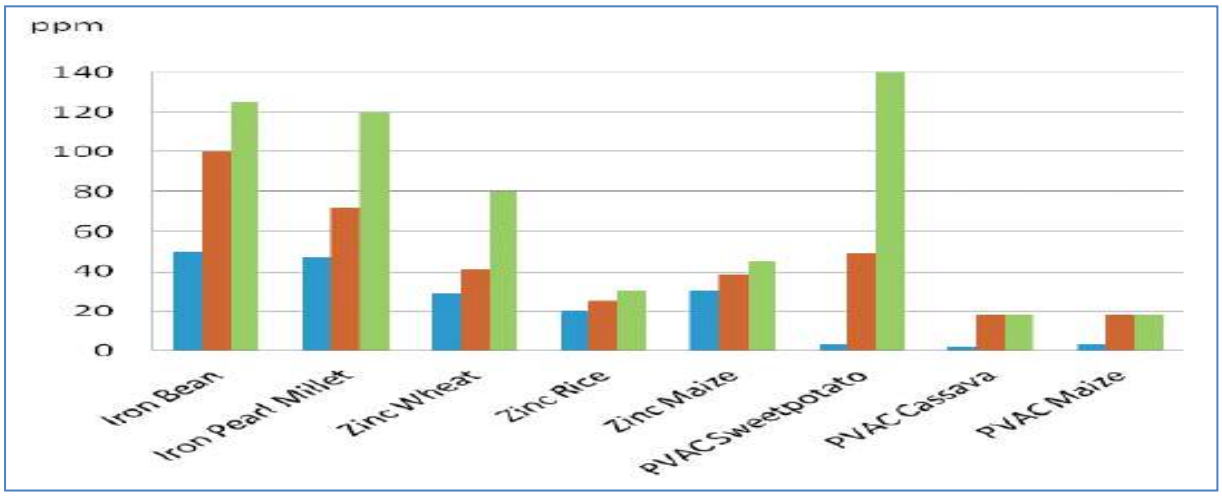
The Energy and Resources Institute, with technical support from **Monsanto company** and Michigan state University. The development of transgenic line of Indian mustard with enhanced levels of beta-caronete expressed in seed mesocarp. When processed into mustard oil, the fat soluble carotenoids in the mesocarp are retained in the oil.

GENE: High beta-carotene oil mustard varieties were developped by **Calgene** in the 90's (Calgene was acquired by Monsanto in 1996). It used genes from ***Erwiniauredovora***, a bacteria that also provides one of the genes involved in the golden rice. **Content of Beta-carotene:** Biofortified mustard oil, has the potential to alleviate VAD -Provitamin A. 50 – fold increase in carotenoid in mature seed of (*Brassica napus*). Beta-carotene biofortified mustard – 185 µg/g. **Potential:** Effective conc. of vitamin A – 92.5 µg to 300 µg per gram of oil. While cooking @ high temperature doesn't reduce Beta carotene. Child need approximately 1-4 g of oil per day to meet the full requirement of 400 µg/day with no other sources of vitamin A.



β-carotene in pigeon pea:

Ole: psy1 gene transfer, T1 seeds from 40 transgenic events collected for further analysis. ICRISAT – Pigeonpea-(β-carotene and methionine).



MICRONUTRIENT LEVELS ACROSS VARIETIES

Consortium to develop Biofortified crops: Iron-rich pearl millet, Beta carotene-rich ragi-IDRC, Beta carotene-rice, Iron-rich rice (IRRI), IRRI - to transfer the golden trait **IR64** and ICRISAT – Golden rice field trial.

Table: Product release for Biofortified products

Crops	Nutrients	Countries of first release	Agronomic trait	Release Year
Rice	Pro vitamin A	Uganda and Mozambique	High Yielding and Drought tolerance	2012-2013
Wheat	Zn, Fe	Rwanda, Democratic Republic of Cango and India	Pests, diseases resistance, and drought tolerance	2012-2013
Maize	Zn, Fe	Nigeria, Democratic Republic of Cango and Zambia	High Yielding and Drought tolerance	2011-2012

Pearl Millet	Fe, Zn	Bangladesh, India	Drought tolerance	2011

CONCLUSION

Development of micronutrient rich crops through biofortification, Technology popularizations in rural areas and Alleviation of micronutrient malnutrition through biofortified crops, Development of suitable agronomic management in micronutrient deficiency area, Exploring possibilities of biofortified in millets and Regional specific biofortification products research is required for further implementation.

REFERENCES

Cakmak, I. (2008). Enrichment of cereal grains with zinc: Agronomic or genetic biofortification. *Plant Soil*, **302**: 1-17.

FAO, (2010). Food Based Approaches for Improving Diets and Raising Levels of Nutrition. International Symposium on Food and Nutrition Security, Rome on 7-9 December.

UNICEF, (2010). Progress for Children: Achieving the MDGs with Equity. Report No. 9. New York: UNICEF.

West, K.P and A.L. Thompson. (2010). Biofortification as a Complementary Approach to Controlling Micronutrient Deficiencies in the Developing World, paper presented at first global conference on biofortification, Washington, D.C (9-11 November).

www.faostat.org

www.who.org

www.unicef.org

Current scenario of organic farming in India

S. Alagappan

Ph.D Research Scholar,
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003. Tamil Nadu, India.
Corresponding Author: Email: alga.s@rediffmail.com

ABSTRACT

India produces a large variety of food crops including cereals, pulses and oilseeds. Diversified agriculture is the priority of the Central Government, and technical and financial support is being extended to farmers to encourage diversification especially in the areas of horticulture, floriculture, medicinal and aromatic plants, apiculture (Bee-keeping) and sericulture. The government is continuously working towards the development of the agribusiness sector through considerable emphasis on infrastructure and food processing. However, there is still a scope for further development and up-gradation of technology and agri-infrastructure to attain world-class standards. The main emphasis is on quality enhancement, infrastructure development and the use of modern technology. Organic farming was practiced in India since thousands of years. The great Indian civilization thrived on organic farming and was one of the most prosperous countries in the world, till the British ruled it. Increasing pesticide residues in food materials, eutrophication of surface and ground-waters and increasing nitrous oxide emissions which are detrimental to the ozone layer of the atmosphere, drew attention towards the harmful effects of modern agriculture and environmentalists pressed hard for a more sustainable agriculture. The role of organic farming in India rural economy can be leveraged to mitigate the ever-increasing problem of food security in India. With rapid industrialization of rural states of India, there has been a crunch for farmland. Further, with the exponential population growth of India, the need for food sufficiency has become the need of the hour. Furthermore, the overuse of plant growth inhibitor, pesticides and fertilizers for faster growth of agricultural produce is detrimental to human health and the environment as a whole. An attempt is made to analyze the importance of organic farming, principle of organic farming, Organic farming in rural economy, consumption pattern and export of organically produced products in India.

Key words: Organic farming, organic food, Indian economy

INTRODUCTION

With 67% of our population and 55% of the total work force depending on agriculture and other allied activities, agriculture meets the basic needs of India's growing population. It has been estimated that for India to achieve a double digit GDP growth rate, agricultural growth of around 4% is required. Agriculture is the backbone of the Indian economy. Despite this, it is facing various constraints such as fragmentation of landholding, low productivity and conversion of agricultural land to non agricultural uses. Still there are increasing investment opportunities in the sector due to the rising

need for quality and value-added products. The Definition of the word "Organic", an ecological management production system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on the minimal use of off-farm inputs and on management practices that restore, maintain and enhance "ecological harmony" (National Standards Board of the US Department of Agriculture (USDA)).It may be emphasized here that in the production and marketing of organically produced agricultural products, the check is on the process of its production rather than the product per se, although quality standards, which are quite strict, have to be adhered to.

The steering committee, under the Chairmanship of Dr. M. S. Swaminathan, appointed by the task force on organic farming of the ministry of agriculture and cooperation, advocated giving boost to organic farming in rain fed areas and in north eastern states, where there was limited use of fertilizers and other agricultural chemicals. Madhya Pradesh, Uttaranchal and Sikkim have already declared themselves as organic states. But such areas are organic by default. At Maharashtra alone has a sizeable of about 0.5 million ha. Under organic farming will not help. For marketing the organic produce at a premium price, proper certification is a must (Rajendra, 2007).

Main principle of organic farming

The main principles of organic farming are the followings:
To work as much as possible within a closed system, and draw upon local resources. To maintain the long-term fertility of soils. To avoid all forms of pollution that may result from agricultural techniques. To produce foodstuffs of high nutritional quality and sufficient quantity. To reduce the use of fossil energy in agricultural practice to a minimum. To give livestock conditions of life that confirm to their physiological need. To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human being.

The four pillars of organic farming are:

1) Organic standards.
2) Certification / Regulatory mechanism.
3) Technology packages.
4) Market network.

Organic farming in India

Organic farming was practiced in India since thousands of years. The great Indian civilization thrived on organic farming and was one of the most prosperous countries in the world, till the British ruled it. In traditional India, the entire agriculture was practiced using organic techniques, where the fertilizers, pesticides, etc., were obtained from plant and animal products. Organic farming was the backbone of the Indian economy and cow was worshipped (and is still done so) as a god. The cow, not only provided milk, but also provided bullocks for farming and dung which was used as fertilizers.

The Indian states involved in organic farming in India are as follows: Gujarat, Kerala, Karnataka, Uttarachal, Sikkim, Rajasthan, Maharashtra, Tamil Nadu, Madhya Pradesh and Himachal Pradesh

Main organic agricultural products of India

Bajra-mustard-wheat, Dungarpur Pulses-cereals, Chilly, Bajra, Cereals-cereals, Mustard, Cereals-pulses, Til, Kholar, Wheat, Maize, Nagour Guar-cumin, Ginger, Guar-wheat, Soybean, Moong, Large cardamom, Mustard, Passion fruit, Ganganagar Cotton, Bhilwara Urd, Jaisalmer Bajra, Bharatpur Bajra and wheat, Jhunjhunu Pulses and wheat, Alwar Wheat and bajra, Banswara Maize, Cotton-grass, and Jaipur Guar.

High premium: Organic food is normally priced 20 - 30% higher than conventional food. This premium is very important for a small farmer whose income is just sufficient to feed his/her family with one meal. **Low investment:** Organic farming normally does not involve capital investment as high as that required in chemical farming. Further, since organic fertilizers and pesticides can be produced locally, the yearly costs incurred by the farmer are also low. Agriculture greatly depends on external factors such as climate, pests, disease. Furthermore, most of the small farmers are dependent on natural rain for water. Therefore in cases of natural calamity, pest or disease attack, and irregular rainfall, when there is a crop failure, small farmers practicing organic farming have to suffer less as their investments are low. (It should be noted that while shifting from chemical farming to organic farming, the transition might be costly). **Less dependence on money lenders:** Many small farmers worldwide commit suicide due to increasing debt. Since chemical inputs, which are very costly, are not required in organic farming, small farmers are not dependent on money lenders. Crop failure, therefore, does not leave an organic farmer into enormous debt, and does not force him to take an extreme step. **Synergy with life forms:** Organic farming involves synergy with various plant and animal life forms. Small farmers are able to understand this synergy easily and hence find it easy to implement them. **Traditional knowledge:** Small farmers have abundance of traditional knowledge with them and within their community. Most of this traditional knowledge cannot be used for chemical farming. However, when it comes to organic farming, the farmers can make use of the traditional knowledge. Further, in case of organic farming, small farmers are not dependent on those who provide chemical know-how.

Organic food consumption in India is on the rise

Some people believe that organic food is only a “concept” popular in the developed countries. They think that when it comes to organic food, India only exports organic food and very little is consumed. However, this is not true. Though 50% of the organic food production in India is targeted towards exports, there are many who look towards organic food for domestic consumption. The most important reason for buying organic food was the concern for the health of children, with over 66% parents preferring organic food to non organic food. Though organic food is priced over 25% more than conventional food in India, many parents are willing to pay this higher premium due to

the perceived health benefits of organic food. The increase in organic food consumption in India is evident from the fact that many organic food stores are spurring up in India. Today every supermarket has an organic food store and every large city in India has numerous organic food stores and restaurants. This is a huge change considering that the first organic food store in Mumbai was started in 1997.What do Indian organic food consumers prefer? The pattern of organic food consumption in India is much different than in the developed countries. In India, consumers prefer organic marmalade, organic strawberry, organic tea, organic honey, organic cashew butter and various organic flours. However, the Indian organic food consumer needs education.

Organic food exports from India

Organic food exports from India are increasing with more farmers shifting to organic farming. With the domestic consumption being low, the prime market for Indian organic food industry lies in the US and Europe. India has now become a leading supplier of organic herbs, organic spices, organic basmati rice, etc. The exports amount to 53% of the organic food produced in India. This is considerably high when compared to percentage of agricultural products exported. In 2003, only 6 - 7% of the total agricultural produce in India was exported (Food Processing Market in India, 2005).

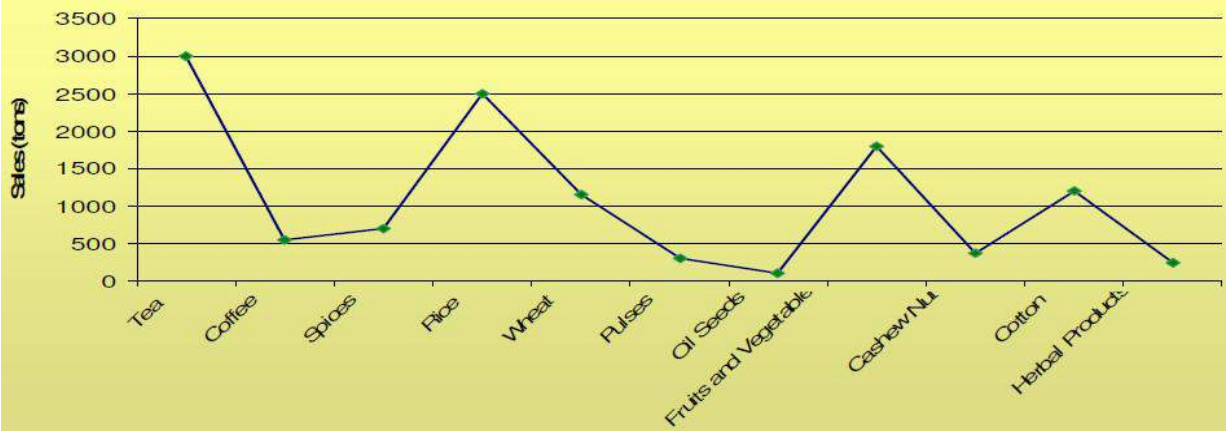
Exports is driving organic food production in India

The increasing demand for organic food products in the developed countries and the extensive support by the Indian government coupled with its focus on agri-exports are the drivers for the Indian organic food industry. Organic food products in India are priced about 20 - 30% higher than non-organic food products. This is a very high premium for most of the Indian population where the per capita income is merely USD 800. Though the salaries in India are increasing rapidly, the domestic market is not sufficient to consume the entire organic food produced in the country. As a result, exports of organic food are the prime aim of organic farmers as well as the government. The Indian government is committed towards encouraging organic food production. It allocated Rs.100 crore or USD 22.2 million during the Tenth Five Year Plan for promoting sustainable agriculture in India. APEDA (Agricultural and Processed Food Export Development Authority) coordinates the export of organic food (and other food products) in India. The National Programme for Organic Production in India was initiated by the ministry of commerce. The programme provides standard for the organic food industry in the country. Since these standards have been developed taking into consideration international organic production standards such as CODEX and IFOAM, Indian organic food products are being accepted in the US and European markets. APEDA also provides a list of organic food exporters in India.

Export performance of organic food products from India

solution to the increasing costs involved in chemical farming. Currently most of the organic farmers in India are still in the transition phase and hence their costs are still high. As these farmers continue with organic farming, the production costs are expected

to reduce, making India as one of the most important producers of organic food (Figure 1). Source: APEDA.



Organic food products exported from India include the following

Organic Cereals: Wheat, rice, maize or corn, Organic Pulses: Red gram, black gram, Organic Fruits**:** Banana, mango, orange, pineapple, passion fruit, cashew nut, walnut, Organic Oil Seeds and Oils: Soybean, sunflower, mustard, cotton seed, groundnut, castor, Organic Vegetables: Brinjal, garlic, potato, tomato, onion, Organic Herbs and Spices: Chilli, peppermint, cardamom, turmeric, black pepper, white pepper, amla, tamarind, ginger, vanilla, clove, cinnamon, nutmeg, mace, Others: Jaggery, sugar, tea, coffee, cotton, and textiles.

CONCLUSION

Organic food production costs are higher in the developed countries as organic farming is labour intensive and labour is costly in these countries. However, in a country like India, where labour is abundant and is relatively cheap, organic farming is seen as a good cost effective solution to the increasing costs involved in chemical farming. The increasing demand for organic food products in the developed countries and the extensive support by the Indian government coupled with its focus on agri-exports are the drivers for the Indian organic food industry.

REFERENCES

Rejendra P (2007) Organic Farming: A Fresh Thrust Needed, the Analyst Special Issue, The Icfai University Press pp. 47-48.

Ultraviolet Processing- A Novel Technology for Food Preservation

Shivashankar Sanganamoni[1]*, Srinivasa Rao Pavuluri[2]

Agriculture and Food Engineering Department, Indian Institute of Technology, Kharagpur, West Bengal – 721 302 (India).

**Corresponding Author: shiva14cae@gmail.com*

Deterioration of foods by pathogenic and spoilage microorganisms can be minimized by food processing and preservation techniques. Frequent outbreaks of foodborne pathogens are associated with fresh produce, milk and fruit juices. Currently, produce industry uses chemicals and fumigants to control pathogens in packing and handling industries. The liquid foods and dairy industry uses thermal pasteurization methods to disinfect food pathogens and extend the shelf-life of products. Though thermal methods are effective in inactivating microorganisms, thermal processing negatively affects foods through losses in vitamins; and changes in sensory properties, such as color, flavor and wholesomeness. Moreover, thermal processing is not practical in fresh produce industry. Thermal pasteurization also affects enzyme inactivation, lipid oxidation, protein denaturation and non-enzymatic browning. Therefore non-thermal processing methods are being studies as alternative food processing techniques.

Non-Thermal Alternative Methods of Food Preservation.

Currently several non-thermal technologies are under research. Some of these technologies are ultrasound (US), high-pressure processing (HPP), pulsed electric fields (PEF), pulsed light treatment (PL), ultraviolet light (UV), and non-thermal atmospheric pressure plasma (NTAP). These novel non-thermal methods may be useful in inactivating foodborne pathogens and spoilage microorganisms from a range of solid and liquid foods. UV irradiation is considered one of the effective means of disinfection, which excludes the necessity of heat to get rid of microorganisms.

Ultraviolet (UV) Technology

UV light is the part of electromagnetic spectrum with wave lengths ranging from 100-400 nm. UV light is traditionally sub divided into the following categories: UV-A range from 315-400 nm and this range is responsible for Changes in human skin. UV-B range from 280 to 315 nm and can cause skin burning and has the potential to cause skin cancer. UV-C ranges from 200 to 280 nm and is very well known for its antimicrobial effect. It used for the decontamination of medical equipment, water treatments, drinking water, water for swimming pools, and surface disinfection of different fruits and other processing equipment. Application of UV light on various

liquid foods like apple cider, orange juice, grape juice, milk and honey have been reported recently.

Principle of UV Technology

Germicidal properties UV-C is due to the absorption of the UV light by DNA, which causes formation of thymine dimer in the same DNA strand (Miller *et al*., 1999). Due to this, the DNA transcription and replication is blocked, which compromises cellular functions and leads to cell death. It has broad microbial action with effective inactivation of viruses, vegetative bacteria, bacterial spores, yeasts and parasites. UV-C irradiation is a physical rather than a chemical process, which makes it ideal for to ease of maintenance, low operating cost, operator safety and lack of residues post treatment. UV-C is a non-ionizing radiation. However precautions must be taken such that there is no human exposure and ozone if generated due to the presence of vacuum, must be evacuated.

Factors Effecting the Performance of UV Technology in Liquid Foods

The efficacy of the system depends on the absorbance of the medium, moisture content, amount of solid particles and suspended materials, flow rate of the fluid, fluid thickness, reactor design, UV intensity which is related to the age of lamps used, exposure time, type of microorganisms and growth phase of the organism, and initial microbial density (Sanganamoni *et al*. 2017).

APPLICATIONS OF UV TECHNOLOGY IN FOOD PROCESSING

The first application of UV radiation for drinking water disinfection was carried out in 1910 in Marseille. At that time its use was limited by its high cost, the low reliability of the equipment and the advent of chlorination, which was a cheaper, more reliable method and with the ability to measure the residual disinfectant. Since then, UV irradiation has been gaining interest and since the 80s, in Europe, it has been widely used to disinfect drinking water, reaching in some cases to replace chlorination.

UV irradiation has also been applied successfully in the pasteurization of liquid foods such as milk and fruit juices (Matak *et al*., 2005). Although the treatment of opaque liquid foods by UV irradiation is an additional problem, in the dairy industry this method has been used for different applications. Thus, for example, brines used in the production of Mozzarella cheese have been irradiated. Many studies were succeeded in reducing the total colony count between 50 and 60%, and coliforms in 80–90% in goat milk using UV-C radiation. Matak *et al*. (2005) also demonstrated that UV radiation could be used to reduce the population of Listeria monocytogenes in goat milk.

UV irradiation has also been applied successfully for inactivation of enzymes in coconut water. Sanganamoni et al., 2017 studied the effect of ultraviolet (UV-C) and thermal treatment of tender coconut water (*Cocos nucifera*) on physicochemical properties (viz. pH, total soluble solids (TSS), titrable acidity, total color difference, turbidity), bioactive component (viz. ascorbic acid, total phenolic content, antioxidant activity) and inactivation of phenol oxidizing enzymes such as polyphenol oxidase (PPO) and peroxidase (POD). The process conditions for ultraviolet treatment were

sample thickness (1, 2, 3 mm), treatment time (30, 60, 90 min) and distance of sample from lamp source (8.6, 13.7, 18.6 cm). Whereas, for thermal treatment the process parameters were temperature (80, 85, 90, 95 ^{o}C) and treatment time (2.5, 5, 7.5, 10 min). The results obtained from this study showed that the ultraviolet treatment (UV) doesn't have any significant effect on pH, TSS, titrable acidity of tender coconut water (TCW). However, the UV treatment conditions had significant effect on total color difference (ΔE*), turbidity, ascorbic acid, total phenolic content, antioxidant capacity, PPO and POD of TCW. Further, the thermal treatment showed negligible effect on pH, TSS, titrable acidity of TCW but significantly (p < 0.0001) affected the total color difference, turbidity, ascorbic acid content, total phenolic content, antioxidant capacity, PPO and POD of TCW. The maximum inactivation of PPO was achieved to be 51.5% in ultraviolet treatment, whereas in thermal treatment the maximum inactivation of PPO was found to be 99%, which was higher than the former one. The maximum inactivation of POD in ultraviolet treatment and thermal treatments were 65.7% and 100%, respectively. The complete inactivation of POD was achieved after thermal treatment at 90 ^{o}C for 5 min. However, the treatment was continued further in order to inactivate PPO completely. PPO was found to be most resistant enzyme in both thermal and UV treatment. The results also indicates that the maximum inactivation of PPO and POD was achieved in thermal treatment than the ultraviolet treatment. In contrast, the deterioration of nutritional properties in thermal treatment was high as compared to ultraviolet treatment. The obtained results suggested that, although the thermal treatment was better processing option pertaining to enzyme inactivation, but ultraviolet treatment was found superior based on retention of nutritional attributes.

CONCLUSION

Promising opportunity exists for adopting ultraviolet processing in a small or large scale food and dairy processing industry. With the approval of FDA, several new applications of UV processing are being tested and validated by the dairy and food industries in the United States of America. With potential for offering superior organoleptic qualities of food products at lower initial investment and operating costs, the authors foresee a great success for adoption of UV processing technology by the food processing industry.

REFERENCES

Matak, K. E., Churey, J. J., Worobo, R. W., Sumner, S. S., Hovingh, E., & Hackney, C. R. (2005). Efficacy of UV light for the reduction of Listeria monocytogenes in goat's milk. *Journal of Food Protection, 68*, 2212–2216.

Shivashankar Sanganamoni., Soumya Purohit and P Srinivasa Rao. (2017). Effect of Ultraviolet-C Treatment on Some Physico-Chemical Properties of Tender Coconut Water. *International Journal of Current Microbiology and Applied Sciences, 6(5)*, 2893-2904.

Climate change and Indian Agriculture

L. K. Das, R.K. Rout S. Behera and N. Ranasingh

College of Agriculture, O.U.A.T, Bhawanipatna, Odisha-766001
**Corresponding Author: lkdas.ouat@gmail.com*

In the backdrop of a burgeoning population where food and nutritional security is a constant challenge, agriculture has emerged as a key component for the growth of the Indian economy. With a contribution of approximately 17.3% to India's GDP during 2016-17 at 2011-12 prices and 10. % to the total exports in 2016 -17 as suggested by the latest reports and the fact that it provides employment to 58.2% of the population, a consistent growth of this sector is vital to meet other challenges as well. In India, agriculture is substantially dependent on the south-west monsoon. This is evident from the fact that the net irrigated area of the country is 60.9 million hectares from a total net sown area of 140.3 million hectares. Thus, a large part of the net sown area is rain-fed, thereby making the agriculture sector in India very sensitive to any changes in the pattern of rainfall. For instance, the impact of overall deficit of 23% in rainfall during the south-west monsoon in 2009-10, which adversely affected *Kharif* production, is reflected in the agriculture GDP growth rate which shows a decline of 0.2 per cent as against the previous year's growth rate of 1.6 per cent. Climate change has a serious impact on the availability of various resources on the earth especially water, which sustains life on this planet. Changes in the biosphere, biodiversity and natural resources are adversely affecting human health and quality of life. Throughout the 21st century, India is projected to experience warming above global level. India will also begin to experience more seasonal variation in temperature with more warming in the winters than summers. Longevity of heat waves across India has extended in recent years with warmer night temperatures and hotter days, and this trend is expected to continue. The average temperature change is predicted to be 2.33°C-4.78°C with a doubling in CO2 concentrations. These heat waves will lead to increased variability in summer monsoon precipitation, which will result in drastic effects on the agriculture sector. In India Research Institute (IARI) indicate the possibility of loss of 4-5 million tonnes in wheat production with every rise of 1º C temperature throughout the growing period even after considering carbon fertilization but no other adaptation benefits. The modelling based estimates are in line with the field observations. For example, in March 2004, temperatures were higher in the Indo–Gangetic plains by 3-6ºC, which is equivalent to almost 1ºC/ day over the whole crop season. As a result, wheat crop

matured earlier by 10-20 days and wheat production dropped by more than 4 million tonnes in the country. Other crops such as mustard, tomato, onion, garlic and other vegetable and fruit crops also suffered losses (*Aggarwal, 2008*). An analysis of the historical trends in yields of rice (*Oryza sativa L.*) and wheat (*Triticum aestivum L.* emend Fiori & Paol.) crops in the Indo–Gangetic plains using regional statistics, long term fertility experiments, other conventional field experiments and the crop simulation models has shown that rice yields during the last three decades are showing a declining trend and this may be partly related to the gradual change in weather conditions in the last two decades (*As cited in Aggarwal, 2008*).

GENERAL TREND OF CLIMATE CHANGE

The changes in climate parameters are being felt globally in the form of changes in temperature and rainfall pattern. The global atmospheric concentration of carbon dioxide, a greenhouse gas (GHG) largely responsible for global warming, has increased from a pre-industrial value of about 280 ppm to 387 ppm in 2010. Similarly, the global atmospheric concentration of methane and nitrous oxides, other important GHGs, has also increased considerably resulting in the warming of the climate system by 0.74°C between 1906 and 2005 (*IPCC, 2007 b*). Of the last 12 years (1995–2006), 11 years have been recorded as the warmest in the instrumental record of global surface temperature (since 1850). The global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003. This rate was faster over 1993 to 2003, about 3.1 mm per year (*IPCC, 2007 a*). There is also a global trend of an increased frequency of droughts as well as heavy precipitation events over many regions. Cold days, cold nights and frost events have become less frequent, while hot days, hot nights and heat waves have become more frequent. It is also likely that future tropical cyclones will become more intense with larger peak wind speeds and heavier precipitation. The IPCC (2007) projected that temperature increase by the end of this century is expected to be in the range 1.8 to 4.0°C. For the Indian region (South Asia), the IPCC projected 0.5 to 1.2°C rise in temperature by 2020, 0.88 to 3.16°C by 2050 and 1.56 to 5.44°C by 2080, depending on the future development scenario (*IPCC 2007 b*). Overall, the temperature rise is likely to be much higher during the winter (*Rabi*) rather than in the rainy season (*Kharif*). It is projected that by the end of the 21st century, rainfall over India will increase by 10-12% and the mean annual temperature by 3-5°C. These environmental changes are likely to increase the pressure on Indian agriculture, in addition to the on-going stresses of yield stagnation, land-use, competition for land, water and other resources and globalization. It is estimated that by 2020, food grain requirement would be almost 30-50% more than the current demand (*Paroda and Kumar, 2000*). This will have to be produced from the same or even the shrinking land resource due to increasing competition for land and other resources by the non-agricultural sector.

IMPACT OF CLIMATE CHANGE ON AGRICULTURE

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change scenarios include higher temperatures, changes in

precipitation, and higher atmospheric CO_2 concentrations which may affect on yield (both quality and quantity), growth rates, photosynthesis and transpiration rates, moisture availability, through changes of water use (irrigation) and changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. Environmental effects such as frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, land availability, reduction of crop diversity may also affect agricultural productivity.

For every 75 ppm increase in CO_2 concentration rice yields will increase by 0.5 t/ha, but yield will decrease by 0.6 t/ha for every 1 °C increase in temperature (Sheehy et al., 2005). CO_2 enrichment have generally shown significant increases in rice biomass (25-40%) and yields (15-39%) at ambient temperature. Increase in CO_2 to 550 ppm increases yields of rice, wheat, legumes and oilseeds by 10-20%.Global warming could lead to an increase in pest insect populations, harming yields of staple crops like wheat, soybeans, and corn. While warmer temperatures create longer growing seasons, and faster growth rates for plants, it also increases the metabolic rate and number of breeding cycles of insect populations. Insects that previously had only two breeding cycles per year could gain an additional cycle if warm growing seasons extend, causing a population boom. Temperate places and higher latitudes are more likely to experience a dramatic change in insect populations.

A 1^oC increase in temperature may reduce yields of wheat, soybean, mustard, groundnut, and potato by 3-7%.Much higher losses at higher temperatures. Productivity of most crops to decrease only marginally by 2020 but by 10-40% by 2100 due to increases in temperature, rainfall variability, and decreases in irrigation water. The major impacts of climate change will be on rain fed or un-irrigated crops, which is cultivated in nearly 60% of cropland. A temperature rise by 0.5^oC in winter temperature is projected to reduce rain fed wheat yield by 0.45 tonnes per hectare in India (Lal et al., 1998). Possibly some improvement in yields of chickpea, rabi maize, sorghum and millets; and coconut in west coast. Less loss in potato, mustard and vegetables in north-western India due to reduced frost damage. Increased droughts and floods are likely to increase production variability Recent studies done at the Indian Agricultural Research Institute indicate the possibility of loss of 4 – 5 million tons in wheat production in future with every rise of 1oC temperature.

POLICY MEASURES

Assist farmers in coping with current climatic risks by providing value-added weather services to farmers. Farmers can adapt to climate changes to some degree by shifting planting dates, choosing varieties with different growth duration, or changing crop rotations.. An Early warning system should be put in place to monitor changes in pest and disease outbreaks. The overall pest control strategy should be based on integrated pest management because it takes care of multiple pests in a given climatic scenario. Participatory and formal plant breeding to develop climate-resilient crop varieties that can tolerate higher temperatures, drought and salinity. Developing short-duration crop

varieties that can mature before the peak heat phase set in. Selecting genotype in crops that have a higher per day yield potential to counter yield loss from heat-induced reduction in growing periods. Preventive measures for drought that include on-farm reservoirs in medium lands, growing of pulses and oilseeds instead of rice in uplands, ridges and furrow system in cotton crops, growing of intercrops in place of pure crops in uplands, land grading and leveling, stabilization of field bunds by stone and grasses, graded line bunds, contour trenching for runoff collection, conservation furrows, mulching and more application of Farm yard manure (FYM).Efficient water use such as frequent but shallow irrigation, drip and sprinkler irrigation for high value crops, irrigation at critical stages. Efficient fertilizer use such as optimum fertilizer dose, split application of nitrogenous and potassium fertilizers, deep placement, use of *neem, karanja* products and other such nitrification inhibitors, liming of acid soils, use of micronutrients such as zinc and boron, use of sulphur in oilseed crops, integrated nutrient management. Seasonal weather forecasts could be used as a supportive measure to optimize planting and irrigation patterns. Provide greater coverage of weather linked agriculture insurance. Intensify the food production system by improving the technology and input delivery system. Adopt resource conservation technologies such as no tillage, laser land leveling, direct seeding of rice and crop diversification which will help in reducing in the global warming potential. Crop diversification can be done by growing non-paddy crops in rain fed uplands to perform better under prolonged soil moisture stress in kharif. Develop a long-term land use plan for ensuring food security and climatic resilience. National grid grain storages at the household/ community level to the district level must be established to ensure local food security and stabilize prices. Provide incentives to farmers for resource conservation and efficiency by providing credit to the farmers for transition to adaptation technologies. Provide technical, institutional and financial support for establishment of community banks of food, forage and seed. Provide more funds to strengthen research for enhancing adaptation and mitigation capacity of agriculture

CONCLUSION

Climate change, the outcome of the “Global Warming” has now started showing its impacts worldwide. Climate is the primary determinant of agricultural productivity which directly impact on food production across the globe. Agriculture sector is the most sensitive sector to the climate changes because the climate of a region/country determines the nature and characteristics of vegetation and crops. World agriculture faces a serious decline within this century due to global warming. Overall, agricultural productivity for the entire world is projected to decline between 3 and 16 % by 2080. Developing countries, many of which have a average temperatures that are already near or above crop tolerance levels, are predicted to suffer an average 10 to 25% decline in agricultural productivity the 2080s. Rich countries, which have typically lower average temperatures, will experience a much milder or even positive average effect, ranging from a 8% increase in productivity to a 6% decline. Individual developing countries face even larger declines. India, for example, could see a drop of 30 to 40%.

Impact of GST on Agriculture Sector

R.K. Rout*, S. Behera and N. Ransingh

College of Agriculture, O.U.A.T, Bhawanipatna, Odisha-766001
**Corresponding Author: rajrout76@gmail.com*

Agriculture is one of the most critical sectors of the Indian economy. Growth and development of agriculture and allied sector directly affects well-being of people at large, rural prosperity and employment and forms an important resource base for a number of agro-based industries and agro-services. The agriculture sector in India has undergone significant structural changes in the form of decrease in share of GDP from 30 per cent in 1990-91 to 17.4 in 2015-16 (Annual Report, 2015-16 MoA & FW) indicating a shift from the traditional agrarian economy towards a service dominated one. However, this decrease in agriculture's contribution to GDP has not been accompanied by a matching reduction in the share of agriculture in employment. About 52 per cent of the total workforce is still employed by the farm sector which makes more than half of the Indian population dependent on agriculture for sustenance (NSS 66th Round). Value addition in agriculture, thus, holds huge potential for enhancing the living standard of majority of the people. Improved agriculture marketing offers a major opportunity to achieve this objective. Goods and service tax will have both negative and positive impact on agriculture. The price of agricultural commodities will go down, as previously the agricultural commodities are charged with different prices within the state, inter-state and in overall country. GST would lead to efficient allocation of resources. Terms of trade move in the favour of Agriculture as compared to manufacturing sector. This will increase prices of some commodities like milk, tea, etc. thus, boon the millions of farmers in India. In nut shell we can say that it will effect directly and indirectly to agriculture sector. Agriculture is principal source of livelihood and 20% contributor of total gross domestic product with flagging of 10% on account of total exports. In current tax regime, agriculture has enjoyed a various exemptions from indirect tax. Sale of agriculture commodities is exempt from VAT. Concessional rates have been imposed on agricultural accessories and supporting machineries. As the GST is being introduced with the unbiased objective of having a unified tax structure for goods and services, this is likely to facilitate and strengthen the Scheme on National Agricultural Market (NAM) aimed at an integrated system of market of agriculture produce at the national level, allowing free flow of agricultural commodities across states. Now check more details “Impact of GST on Agriculture Sector,

HOW AGRICULTURE IS PLACED UNDER GST

As per the Model GST law “agriculture” with all its grammatical variations and cognate expressions, includes floriculture, horticulture, sericulture, the raising of crops, grass or

garden produce and also grazing, but does not include dairy farming, poultry farming, stock breeding, the mere cutting of wood or grass, gathering of fruit, raising of man-made forest or rearing of seedlings or plants. This definition of agriculture under the Model GST Law is similar to the definition under the Maharashtra Value Added Tax Act (i.e. MVAT Act). However, under the Service Tax law, agriculture has been defined as ”agriculture” means the cultivation of plants and rearing of all life-forms of animals, except the rearing of horses, for food, fiber, fuel, raw material or other similar products’. The new definitions of agriculture and agriculturist are provided by GST in section 2(7) and 2(8) respectively

Table: **GST Rates on Agriculture Sector**

Goods	Old rate (%)	GST rate (%)	Difference (%)
Cheaper			
Seed, Organic compost without brand	0	0	0
Head pump and its parts	12.5	5.0	+7.5
Tractor	12.5	12.0	+0.5
chemical fertilizer	12.0	5.0	+7.0
Expensive			
Tractor Tire & Rim	12.5	18.0	-5.5
Other tractor parts	12.5	18.0	-5.5
Harvester, Earth, Grader, Parts	0	12.0	-12.0
Insecticide	5.5	18.0	-12.5
Drip and sprinkler irrigation equipment	5.0	18.0	-13
Pesticide sprayers	6.0	18.0	-12.0
Electric motors	7.0	12.0	-11.0

The application of GST to food items will have a significant impact on those who are small and marginal farmers because they fallow less mechanization & more organic. But at the same time, a complete exemption for food items would drastically shrink the tax base. Food includes grains and cereals, meat, fish and poultry, milk and dairy products, fruits and vegetables, candy and prepared meals for home consumption, restaurant meals and beverages, even if the food is within the scope of GST, such sales would largely remain exempt due to small business registration threshold. Given the exemption of food from CENVAT and 4% VAT on food item, the GST under a single rate would lead to a doubling of tax burden on food

MERITS OF GST IN AGRICULTURAL SECTOR

1. GST implementation will play favourable role for National Agricultural Market on merging all the different taxations on agricultural products. Once transportation facilitated, it will improve the marketing efficiency and create access to virtual world.

2. GST is vital to enhance the performance of supply chain mechanism in terms of transparency, reliability and timeliness, which in turn will ensure reduction in waste and cost of agricultural produce.
3. Agricultural sector has been kept outside from undertaking GST compliances.
4. Will reduce the time taken for inter-state transportation.
5. Service tax will also be exempted in various services related to agricultural produce.
6. An agriculturist would come under non-taxable person.
7. All basic agriculture goods (not processed) which are not chargeable under current VAT Laws would not be charged to tax in GST.
8. As the exemption under VAT is limited to unprocessed food, the main impact that GST in agriculture would bring is the inflation with currently 4% VAT being increased to 8% on many food items including cereals and grains.

DEMERITS OF GST IN AGRICULTURAL SECTOR

1. Because custom duty will not subsume GST, it will continue to impose on agricultural imports.
2. GST is all set to increase the prices of most agricultural inputs like seeds, pesticides and farm equipments resulting into increase in cost of production for farmers.
3. Also as GST being single source of tax across nation will not allow farmers any more to take advantage of inter-state price variations. Similarly they will find difficult to get cheaper inputs due to constant pricing across states unlike in previous states laws.
4. Fertilizers like Urea, DAT, Potash, will bear a spike tax rate in GST.
5. Drip and sprinkler irrigation equipment, which currently attracts a VAT rate of 5%, will be taxed at 18% under GST. Similarly, the tax rate on pesticide sprayers has gone up from 6% to 18% and electric motors from 7% to 12%. Tractors will be taxed at a rate of either 12% or 28%, up from the current 5%. GST is expected to reduce incidence of suppressed sales since billing and payment of tax would be necessary for availing setoff of taxes at each stage. The same standard would apply to transactions between traders in agricultural commodities where there is significant amount of suppressed sale the present system often, makes it difficult to implement tax support provided by the centre for an agro-commodity due to diverse policies adopted by the different states. The implementation of GST is predicted to bring uniformity across states and centre which would make tax support policy of a particular commodity effective. The ease of availing tax credit under GST regime is expected to lift inter-state trade leading to achieving the objectives of National Agricultural Market

CONCLUSION

It can be said from the above that GST is expected to have both positive and negative impact on the farm sector. An increase in the cost of few agricultural products is anticipated due to the rise in inflation index for lesser period. Though, implementation of GST is going to benefit a lot, the farmers/distributors in the long run as there will a single unified national agriculture market. GST would certify that farmers in India, who contribute the most to GDP, will be able to sell their produce for the best available price.

Role of natural enemies in horticultural ecosystem in Himachal Pradesh

Suman Sanjta

PhD Research Scholar, Department of Entomology, CSKHPKV, Palampur
**Corresponding Author: sumansanjta@gmail.com*

The parasitoids, predators and pathogenic microorganisms associated naturally with a population of plants or animals and causing mortality or debility to the individuals are called as natural enemies. The term natural enemy is often used in a general sense for all parasitoids, predators and pathogens. Natural enemies are of different types- Predators, Parasitoids, Pathogens. Predators: An animal which feeds upon other animals that is usually weaker and smaller than itself, frequently devouring them completely and rapidly. These are bigger than their prey and require more than one prey to complete its life cycle. Eg. Coccinellid beetles, Syrphid flies, predatory mites etc. Parasitoids: An insect parasite of an arthropod: parasitic only in its immature stages, destroying its host in the process of its development and free living as an adult. These are usually smaller in size than their host and require one prey to complete its life cycle. Eg. *Aphidius* wasps, *Trichogramma* sp. etc. Pathogens: Pathogens are diseases causing agents that attack pest insects. Pathogens of agricultural pests are usually bacterial, fungal or viral.

Horticulture is the science, technology, and business involved in intensive plant cultivation for human use. It is practiced from the individual level in a garden up to the activities of a multinational corporation. It is very diverse in its activities, incorporating plants for food (fruits, vegetables, mushrooms, culinary herbs) and non-food crops (flowers, trees and shrubs, turf-grass, hops, medicinal herbs). It also includes related services in plant conservation, landscape restoration, landscape and garden design/construction/maintenance, arboriculture, horticultural therapy, and much more. This range of food, medicinal, environmental, and social products and services are all fundamental to developing and maintaining human health and well-being.

An ecosystem is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows. The energy that flows through ecosystems is obtained primarily from the sun. It generally enters the system through photosynthesis, a process that also captures carbon from the atmosphere. By feeding on plants and on one another, animals play an important role in the movement of matter and energy through the system. In horticulture ecosystem the producers are like tomato plant, peach tree or rose plant and

primary consumers will be fruit borer, peach aphid or bud worm respectively and secondary consumers will include all the natural enemies like Cotesia or Coccinellid beetles which feed on these primary consumers and regulate their population.

In today's era we need to develop such program in which natural enemies can be best utilised along with the other practices of IPM because if we rely completely on the use of chemicals then problems like Resistance, Resurgence, Residue and secondary pest outbreak may result. Use of natural enemies in IPM system provide permanent control of the pest and they safe to the non target species and are economical and easy to apply.

Use of natural enemies in horticulture ecosystem is an age old practice. In 324BC the Chinese citrus growers used wild ants *Oecophylla smaragdina* to control the population of citrus caterpillar. In the history of classical biological control there are many successful examples of pest control by the use of natural enemies like control of locust by Indian Mynah bird in Mauritius in1762, control of cottony cushion scale by Vedalia beetle which laid a milestone in the history of biological control.

Pest management in Horticultural crops by Natural Enemies in HP:

There have been a number of case studies in Himachal Pradesh in controlling the pest populations in different horticultural ecosystems, most of which has shown very good results which are as follows:

San Jose Scale (*Quadraspidiotus perniciosus)*:

In 1958-60 three strains (Russian, Californian, Chinese) of *Encarsia perniciosi* were introduced along with *Aphytis diaspidis* in the Shimla area out of which the Russian strain gave 89% parasitism. *Encarsia perniciosi* and *Aphytis diaspidis* gave 86.5% parasitism in combination.

Woolly apple aphid:

Aphelinus mali was released in Kullu and Shimla in 1940. It established well and was quite effective. Recolonisation was done in Shimla, Solan, Kullu and Sirmaur. Parasitism in colonised areas increased by over 50%.

Apple borer:

Root borer

When entomopathogenic nematodes viz. *Steinernema* sp. and *Heterorhbditis* sp. were applied to the apple root borer they showed 66.7-100% mortality in root borer and *Metarhizium anisopliae* (Entomopathogenic fungi) have given about 88% control under field conditions and about 100% control under laboratory conditions.

Stem borer

When apple tree branches were treated with *Metarhizium anisopliae* (Entomopathogenic fungus) the branches had 66.7 % closed holes in the next season.

Phytophagous mites:

7 releases of *Neoseiulus longispinosus* (Predator: prey = 1:30) has been as effective as 3 sprays of Profenofos(0.15%) for the control of phytophagous mites in apple.

Leaf miner

Serpentine leaf miner

In Solan region six parasitoids were found to be associated with serpentine leaf miner out of which *Neochrisocharis formosa* was dominant species. Parasitization of serpentine leaf miner (April- October) ranged from 4.2 to 33.9 % .

Pea leaf miner

In the Solan region three parasitoids were found to be associated with pea leaf miner out of which *Diglyphus* sp. was the dominant species. Parasitization of Pea leaf miner (Jan-Mar) ranged from 22.9 to 40.3%.

Helicoverpa armigera:

Natural egg-parasitization of the *Helicoverpa armigera* with *T. chilonis* on tomato was high by late crop season. Early 4 releases of *T. chilonis* at 50000 Corcyra parasitized eggs/ha at 7-10 day interval in April-May were found effective.

When 2 sprays of HaNPV at $1.5x10^{12}$ PIB/ha were done after second and fourth release of the parasitoid it provided as satisfactory control of the pest as did the insecticidal control.

Greenhouse Whitefly:

Encarsia sophia, *E. Enaron, Eretmocerus delhiensis* were recorded in the Palampur region.Former two were dominant from Jul-Nov and Jul-Aug respectively. When *V. lecanii* was applied in combination with *Encarsia sophia* caused 78.33% mortality.

Cole crops:

Release of *Chrysoperla zatrowi sillemi (5 larvae/infested plants), Trichogramma brassicae(*100 thousand/ha) and spray of Bt (1Kg/ha) was effective in managing *Brevicoryne brassicae* and *Pieris brassicae.*

Biological Control is not always applicable:

An IPM practitioner needs to be aware that as great as biocontrol is, it cannot be applied in certain production systems. For example, in situations in which the consumer has low tolerance for damage as it is the case in ornamental flower production. Biological control is not effective if pest population's numbers are already way too high. That is, bio-control nature is preventive. When the objective is to eradicate a particular pest then "bio-control only" is not the right way to go. There are some examples in which biocontrol alone has been enough to eliminate a pest problem but they are not the majority of cases. It is more common to find bio-control as one of the components of an IPM program.

CONCLUSION

Natural enemies have proved important in controlling the pest population. These are considered as important tool in IPM. They are mostly used against the indirect pests and crops in which economic injury level is high. They can be best utilised in the permanent ecosystem. Stress on the conservation of natural enemies should be given.It paves new ways to the researchers to develop such strains which are resistant to abiotic stresses and chemicals.

BIOFORTIFICATION – An Earmarking strategy to address malnutrition

Jasti Srivarsha

[1]*Ph.D Scholar, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra*.
**Corresponding Author*: jastisrivarsha@gmail.com

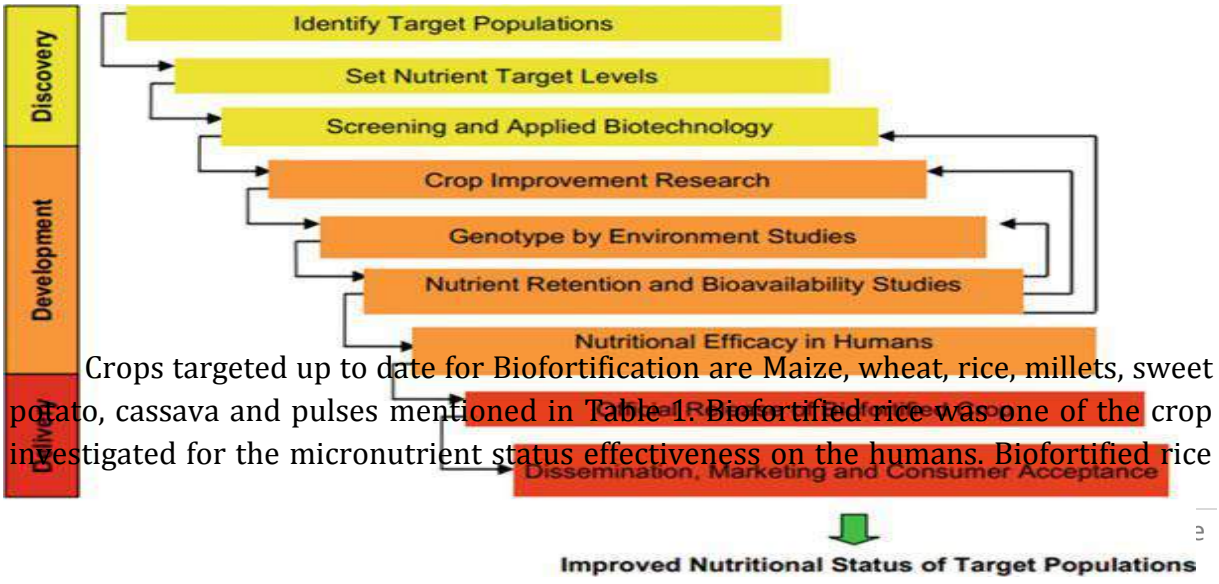
Human beings are dependent on plants and animals for their diet. Most of the essential nutrients and minerals are contributed by the plants. Unfortunately, agricultural systems have never been explicitly designed to promote human health and instead, mostly focus on increased profitability for farmers and agricultural industries. Modern agriculture has been successful in solving the challenge of agriculture production through 'Green revolution'. Now, its focus is on not only producing more food but also on producing quality food.

Biofortification may be defined as the process of increasing the bioavailable concentrations of essential elements in edible portions of crop plants through agronomic intervention or genetic selection (Singh et al. 2015). Mostly Iron, Zinc and Vitamin A concentrations are targeted in this strategy of Biofortification so far.

STEPS INVOLVED FOR THE SUCCESSFUL BIOFORTIFICATION IN CROPS:

a) Deciding the crops to be targeted for biofortification.
b) Set the target of which all nutrient quantities are to be enhanced.
c) Decision of the approach to be involved (conventional / molecular).
d) Target the mechanisms which enhance the nutrient uptake from soil.
e) Target the mechanisms which increase the micronutrient transfer to the grains.
f) Study of G × E interaction on these traits.
g) Conducting the studies on nutrient retention and their bioavailability.

Figure 1: HarvestPlus pathway (Bouis et al. 2011)



Crops targeted up to date for Biofortification are Maize, wheat, rice, millets, sweet potato, cassava and pulses mentioned in Table 1. Biofortified rice was one of the crop investigated for the micronutrient status effectiveness on the humans. Biofortified rice

was produced by traditional breeding. In rice, most of the work has been done for the enrichment of β-carotene, to develop the so called —Golden rice (Paine et al., 2005). In wheat, vitamin A, Zinc and Iron concentrations are targeted. Coming to maize, the breeding strategy has been highly focussed to increase the vitamin-A content. Biofortification in millets is an emerging process. High Fe pearlmillet has been developed by Harvest Plus, (2009). Biofortification in sweet potato has been done for the pro vitamin-A content. Varieties with orange fleshed high provitamin- A content has been developed.

Table -1: Schedule of product release

Crop	Nutrient	Countries of first release	Agronomic trait	Release year[a]
Sweetpotato	Provitamin-A	Uganda, Mozambique	Disease resistance, Drought tolerance and acid soil tolerance	2007
Beans	Iron, Zinc	Rwanda, DR Congo	Virus resistance, Heat and Drought tolerance	2010
Pearlmillet	Iron, Zinc	India	Mildew resistance and drought tolerance	2011
Cassava	Provitamin-A	Nigeria, DR Congo	Disease resistance	2011-12
Maize	Provitamin-A	Zambia	Disease resistance and Drought tolerance	2011-12
Rice	Zinc, Iron	Bangladesh, India	Disease and pest resistance, Cold and Submergence tolerance	2012-13
Wheat	Zinc, Iron	India, Pakistan	Disease resistance, Lodging	2012-13

a Approved for release by National Governments after intensive multi-location testing for agronomic and micronutrient performance. **Source**: Bouis, et al. (2011)

Advantages of Biofortification:

- These crops are cost effective supplying sources of micronutrients to the rural people which in turn contributes in reducing the malnutrition.
- The benefit to the society is far more than the cost involved in breeding these biofortified varieties.
- Biofortification improves status of micronutrients for those less or deficient and maintains status for all at low cost.

Problems faced in commercializing these biofortified varieties:

- The yellow or orange product colour of high pro-vitamin-A crops, rather than the whiter colour of comparable non biofortified varieties (Bouis, 2016).
- As a result, the area under cultivation of bifortified crops is limited.

- False perception of the consumers that biofortified crops are genetically modified. The reason behind this is the varieties released till date from national seed systems were produced through conventional breeding techniques.

How to overcome the drawbacks in commercialization?

- The consumers have to be informed the reason behind the colour change of white to yellow or orange by the government programmes which even helps in changing the perception of the consumers.
- The government should provide the facilities for availing the subsidies even for the cultivation of biofortified crops to the farmers.

CONCLUSION

As a whole, biofortification is the novel genetical approach to address the serious challenges of global concern. Apart from being sustainable, biofortification is cost-effective tool to mitigate hiddenhunger. To transfer the technology of cultivating biofortified crops into rural livelihood globally, extensive marketing policies, subsidies have to be introduced. Further research in this line of developing and marketing biofortified varieties by using the emerging approaches would pave the way for the nutritionally secured biomes.

REFERENCES

Bouis H (2016) Panel 6.3: Biofortification: How to scale up? Global Nutrition Report, 2016. International Food Policy Research Institute. pp: 69.

Bouis HE, Hotz C, McClafferty B, Meenakshi JV, Pfeiffer WH (2011) Biofortification: a new tool to reduce micronutrient malnutrition. *Food Nutr Bull* 32: 31–40.

HarvestPlus (2009) Breeding Crops for Better Nutrition: General Brochure. Washington, DC: HarvestPlus.

Paine JA, Shipton CA, Howells RM, Kennedy MJ, Vernon G (2005) Improving the nutritional value of Golden Rice through increased pro-vitamin A content. *Nat Biotechnol* 23: 482-487.

Singh U, Praharaj CS, Chaturvedi SK, Abhishek B (2015) Biofortification: Introduction, Approaches, Limitations, and Challenges. Biofortification of Food Crops. Springer New Delhi Heidelberg New York Dordrecht London. pp: 3-18.

Contract Farming: Prospects and problems in India

Ajay Chourasiya* and K.R. Naik

Department of Agronomy,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur- 482004 (M.P.)
**Corresponding Author: ajaychourasiya09@gmail.com*

The Indian agri-food system is undergoing rapid transformation and there is growing evidence that contract farming will have an important role in this transformation. An important concern in Indian agriculture is that while "front end" activities – including wholesaling, processing, logistics, and retailing – are rapidly expanding and consolidating, the "back end" activities of production agriculture have been continuously fragmenting (Gulati, 2008). The challenge lies in linking the two ends and ensuring viable business opportunities for both farmers and agri-businesses. The challenge lies in linking the two ends and ensuring viable business opportunities for both farmers and agri-businesses. In India, contract farming occupies an area of 0.43 Mha out of 19.1Mha of total cropped area (Anonymous, 2007). ITC introduced cultivation of Virginia tobacco in Coastal Andhra Pradesh in the 1920's incorporating most elements of a fair contract farming system and met with good farmer response. The PepsiCo introduced tomato cultivation in Punjab in the 1990's under the farming to obtain inputs for its paste-manufacturing facility established as a pre-condition to its entry in to India.

Establishing farm-firm linkages is not only about providing assured markets, reducing risk, and ensuring 'remunerative' prices, but also providing critical services such as credit, insurance, grading and inspection, technology extension, and market information. These institutional services can help elevate the scale at which small holders can operate, raise their productivity and income, and mitigate the risks involved in participating in markets for high value horticultural, livestock, and fishery products.

The recent growth and diversification of consumer demand and the expansion of organized agricultural processing and marketing ventures in India has the potential to boost the market opportunities, productivity, and incomes of farmers, including small holders. However, achieving these goals will likely require creation of new institutions and innovations to develop supply chains and facilitate linkages between farmers, wholesalers, processors, and retailers. Among these institutions and innovations are various models of contract farming, including those led by cooperatives, by farmer groups, and by various types of private sector resource intermediation that develop backward linkages to growers.

WHAT IS CONTRACT FARMING?

Contract Farming can be defined as an agreement between farmers and processing or marketing firms for the production and supply of agricultural products under forward agreements, frequently at predetermined prices.

Contract farming is agricultural production carried out according to an agreement between a buyer and farmers, which establishes conditions for the production and marketing of a farm product or products. Typically, the farmer agrees to provide established quantities of a specific agricultural product, meeting the quality standards and delivery schedule set by the purchaser. In turn, the buyer commits to purchase the product, often at a pre-determined price. In some cases the buyer also commits to support production through, for example, supplying farm inputs, land preparation, providing technical advice and arranging transport of produce to the buyer's premises. Another term often used to refer to contract farming operations is 'out-grower schemes", whereby farmers are linked with a large farm or processing plant which supports production planning, input supply, extension advice and transport. Contract farming is used for a wide variety of agricultural products.

THE RATIONALE FOR CONTRACT FARMING

Contract farming is one of the different governance mechanisms for transactions in agri food chains. The use of contracts (either formal or informal) has become attractive to many agricultural producers worldwide because of benefits such as the assured market and access to support services. It is also a system of interest to buyers who are looking for assured supplies of produce for sale or for processing. Processors are among the most important users of contracts, as they wish to assure full utilization of their plant processing capacity. A key feature of contract farming is that it facilitates backward and forward market linkages that are the cornerstone of market-led, commercial agriculture. Well-managed contract farming is considered as an effective approach to help solve many of the market linkage and access problems for small farmers.

HISTORY OF CONTRACT FARMING:

1. Commodity co-operatives, which emerged in the 1950's, provided most services envisaged under ideal contract farming to their members.
2. ITC introduced cultivation of Virginia tobacco in Coastal Andhra Pradesh in the 1920's incorporating most elements of a fair contract farming system and met with good farmer response. This was replaced by auctions in 1984.
3. Organized public and private seed companies, which emerged in the 1960's
4. Contract Farming was the strategy of choice for almost all food processing projects contemplated in the 1980's and 1990's.
5. The Pepsico introduced tomato cultivation in Punjab in the 1990's under farming to obtain inputs for its paste-manufacturing facility established as a pre-condition to its entry in to India.
6. This was sold to Hindustan Lever in 2000, which had earlier acquired the kisan Karnataka.

Contract Farming is again vogue, and even tried for bulk production of subsistence crops, such as paddy rice, maize and wheat.

Table: State-wise Total Cropped Area and Area under Contract Farming in India

States	Total Cropped Area (In '000 hectare)	Area under Contract Farming (In Hectare)
Assam	3962	160
Bihar	7882	20
Goa	169	1924
Gujarat	11311	2000
Haryana	6388	1416
Mizoram	98	2447
Orissa	8637	5900
Punjab	7931	121457
Tamil Nadu	5316	236610
India	190641	425834
		Source: indiastat.com (2007)

OBJECTIVES OF CONTRACT FARMING:

1. To reduce the load on the central and state level procurement system.
2. To increase private sector investment in agriculture.
3. To bring about a market focus in terms of crop selection by Indian farmers.
4. To generate a steady source of income at the individual farmer level.
5. To promote processing and value addition.
6. To generate gainful employment in rural communities, particularly for landless agricultural labour.
7. To flatten as far as possible, any seasonality associated with such employment.
8. To reduce migration from rural to urban areas.
9. To promote rural self-reliance in general by pooling locally available resources and expertise to meet new challenges.

The traditional model:

Moving from food security to market demand

Farmer	Mandi	Buyer /Processor	Manufactures/ Brand Marketers	Distributors	Retailer	Consumers

Control zone

The Contract farming model:

Moving to a value delivery sequence

Choose the values → **Provide the Value** → **Communicate the values**

R&D activity	Seed Selection	Variety Evaluation	Contract Farming	Processing	Manufactures/ Marketers	Distributors/ Retailer	Consumer

Span of involvement

Types of Contract Farming:

These are a few of the models of contract farming that are accepted globally:

1. **Centralized model:** The contracting company provides support to the production of the crop by smallholder farmers, purchases the crop from the farmers, and then processes, packages and markets the product, thereby tightly controlling its quality. This can be used for crops such as tobacco, cotton, paprika, sugar cane, banana, coffee, tea, cocoa and rubber. This may involve tens of thousands of farmers. The level of involvement of the contracting company in supporting production may vary. Example: - PepsiCo (Potato, Chillies, Peanut), Unilever (Tomato, Tea, Milk), ITC (Tobacco, Oilseeds)
2. **Nucleus Estate model:** This is a variation of the centralized model. The promoter also owns and manages an estate plantation (usually close to a processing plant) and the estate is often fairly large in order to provide some guarantee of throughput for the plant. It is mainly used for tree crops, but can also be for, e.g., fresh vegetables and fruits for export.
3. **Multipartite model:** The multipartite model usually involves the government, statutory bodies and private companies jointly participating with the local farmers. The model may have separate organizations responsible for credit provision, production, management, processing and marketing of the produce.

Example:-Mahindra Subhlabh Service Ltd.

4. **Informal model:** This model is basically run by individual entrepreneurs or small companies who make simple, informal production contracts with farmers on a seasonal basis. The crops usually require only a minimal amount of processing or packaging for resale to the retail trade or local markets, as with vegetables, watermelons, and fruits. Financial investment is usually minimal. This is perhaps the most speculative of all contract-farming models, with a risk of default by both promoter and farmer.
5. **Intermediary model:** This model has formal subcontracting by companies to intermediaries (collectors, farmer groups, NGOs) and the intermediaries have their own (informal) arrangements with farmers. The main disadvantage in this model is it disconnects the link between company and farmer.

PROSPECTS OF CONTRACT FARMING:

A) Prospects of contract farming for the farmer:-

1. Provision of inputs and production services:

Many contractual arrangements involve considerable production support in addition to the supply of basic inputs such as seed and fertilizer. Sponsors may also provide land preparation, field cultivation and harvesting as well as free training and extension. This is primarily to ensure that proper crop husbandry practices are followed in order to achieve projected yields and required qualities. There is, however, a danger that such arrangements may lead to the farmer being little more than a laborer on his or her own land. It is often difficult for small-scale farmers outside the contract-farming context to gain access to inputs. In Africa, in particular, fertilizer distribution arrangements have been disrupted by structural adjustment measures, with the private sector having yet to fill adequately the void created by the closure of parasitical agencies. In many countries a vicious circle has developed whereby the low demand for inputs provides no incentive for the development of commercial distribution networks and this, in turn, further adversely affects input availability and use. Contract farming can help to overcome many of these problems through bulk ordering by management.

2. Access to credit:

The majority of smallholder producers experience difficulties in obtaining credit for production inputs. With the collapse or restructuring of many agricultural development banks and the closure of many export crop marketing boards (particularly in Africa), which in the past supplied farmers with inputs on credit, difficulties have increased rather than decreased. Contract farming usually allows farmers access to some form of credit to finance production inputs. In most cases it is the sponsors who advance credit through their managers. However, arrangements can be made with commercial banks or government agencies through crop liens that are guaranteed by the sponsor, i.e. the contract serves as collateral. When substantial investments are required of farmers, such as packing or grading sheds, tobacco barns or heavy machinery, banks will not normally advance credit without guarantees from the sponsor.

The tendency of certain farmers to abuse credit arrangements by selling crops to buyers other than the sponsor (extra-contractual marketing), or by diverting inputs supplied by management to other purposes, has caused some sponsors to reconsider supplying most inputs, opting instead to provide only seeds and essential agrochemicals. The policies and conditions that control advances are normally described in attachments to contract.

3. Introduction of appropriate technology:

New techniques are often required to upgrade agricultural commodities for markets that demand high quality standards. New production techniques are often necessary to increase productivity as well as to ensure that the commodity meets market demands. However, smallscale farmers are frequently reluctant to adopt new technologies because of the possible risks and costs involved. They are more likely to accept new practices when they can rely on external resources for material and technological inputs. Nevertheless, the introduction of new technology will not be successful unless it is initiated within a well managed and structured farming operation. Private agribusiness will usually offer technology more diligently than government agricultural extension services because it has a direct economic interest in improving farmers'

production. Most of the larger sponsors prefer to provide their own extension rather than rely on government services.

4. Skill transfer:

The skills the farmer learns through contract farming may include record keeping, the efficient use of farm resources, improved methods of applying chemicals and fertilizers, knowledge of the importance of quality and the characteristics and demands of export markets. Farmers can gain experience in carrying out field activities following a strict timetable imposed by the extension service. In addition, spillover effects from contract farming activities could lead to investment in market infrastructure and human capital, thus improving the productivity of other farm activities. Farmers often apply techniques introduced by management (ridging, fertilizing, transplanting, pest control, etc.) to other cash and subsistence crops.

5. Guaranteed and fixed pricing structures:

The returns farmers receive for their crops on the open market depend on the prevailing market prices as well as on their ability to negotiate with buyers. This can create considerable uncertainty which, to a certain extent, contract farming can overcome. Frequently, sponsors indicate in advance the price(s) to be paid and these are specified in the agreement. On the other hand, some contracts are not based on fixed prices but are related to the market prices at the time of delivery.

6. Access to reliable markets:

Small-scale farmers are often constrained in what they can produce by limited marketing opportunities, which often makes diversification into new crops very difficult. Farmers will not cultivate unless they know they can sell their crop, and traders or processors will not invest in ventures unless they are assured that the required commodities can be consistently produced. Contract farming offers a potential solution to this situation by providing market guarantees to the farmers and assuring supply to the purchasers. Even where there are existing outlets for the same crops, contract farming can offer significant advantages to farmers. They do not have to search for and negotiate with local and international buyers, and project sponsors usually organize transport for their crops, normally from the farm gate.

B) Prospects of contract farming for the sponsors:

1. Political acceptability;
2. Overcoming land constraints;
3. Production reliability and shared risk;
4. Quality consistency; and
5. Promotion of farm inputs

1. Political acceptability:

It can be more politically expedient for a sponsor to involve smallholder farmers in production rather than to operate plantations. Many governments are reluctant to have large plantations and some are actively involved in closing down such estates and

redistributing their land. Contract farming, particularly when the farmer is not a tenant of the sponsor, is less likely to be subject to political criticism. As a result of the restructuring of their economies, many African governments have promoted contract farming as an alternative to private, corporate and state owned plantations. In recent years many countries have seen a move away from the plantation system of production to one where smaller-scale farmers grow crops under contract for processing and/or marketing. The decision to choose contract farming does not make a company totally immune from criticism. For example, the considerable opposition to the role of multinational corporations in India in the late 1990s had a negative effect on investment in contract farming by foreign agribusiness corporations.

2. Overcoming land constraints:

Most of the world's plantations were established in the colonial era when land was relatively plentiful and the colonial powers had few scruples about either simply annexing it or paying landowners minimal compensation. That is, fortunately, no longer the situation. Most large tracts of suitable land are now either traditionally owned, costly to purchase or unavailable for commercial development. Moreover, even if it were possible for companies to purchase land at an affordable price, it would rarely be possible to purchase large enough parcels of land to offer the necessary economies of scale achieved by estate agriculture. Contract farming, therefore, offers access to crop production from land that would not otherwise be available to a company, with the additional advantage that it does not have to purchase it.

3. Production reliability and shared risk:

The failure to supply agreed contracts could seriously jeopardize future sales. Plantation agriculture and contract farming both offer reasonable supply reliability. Sponsors of contract farming, even with the best management, always run the risk that farmers will fail to honor agreements. On the other hand, plantation agriculture always runs the risk of labour disputes. In the case of horticultural production some companies do prefer estate rather than contracted production. In Gambia and Ghana, for example, a number of crops are grown under the estate model, as are strawberries and flowers in Kenya. Working with contracted farmers enables sponsors to share the risk of production failure due to poor weather, disease, etc. The farmer takes the risk of loss of production while the company absorbs losses associated with reduced or nonexistent throughput for the processing facility. Where production problems are widespread and no fault of the farmers, sponsors will often defer repayment of production advances to the following season. Both estate and contract farming methods of obtaining raw materials are considerably more reliable than making purchases on the open market. The open market is rarely an acceptable option for organizations that have significant assets tied up in processing facilities and need to have guaranteed quantities of raw material to justify their investment. For example, it is hardly ever an acceptable option for companies who make regular shipments of horticultural produce to supermarkets and for export. Companies must ensure that crops are harvested and sold on a carefully

scheduled and consistent basis: a factor that is normally assured under a well-directed contract farming scheme.

4. Quality consistency:

Markets for fresh and processed agricultural produce require consistent quality standards. Moreover, these markets are moving increasingly to a situation where the supplier must also conform to regulatory controls regarding production techniques, particularly the use of pesticides.

For fresh produce there is an growing requirement for "traceability", i.e. suppliers to major markets increasingly need to be confident of identifying the source of production if problems related to food safety arise. Both estate and contracted crop production require close supervision to control and maintain product quality, especially when farmers are unfamiliar with new harvesting and grading methods. Often, large numbers of crops within a single project have to be transplanted, harvested and purchased in a uniform manner so as to achieve product consistency. Agribusinesses producing for markets demanding high quality standards, such as fruits and vegetables for export, often find that small-scale farmers and their families are more likely to produce high-quality products than farmers who must supervise hired labour.8 Also contract farming makes quarantine controls more manageable. It is easier for quarantine authorities to inspect a limited number of exporters of a single commodity, who closely supervise farmers, than to inspect hundreds, or sometimes thousands, of individual producers selling through open markets. Much of the production of "organic" foods is being done on contract, as an integrated operation facilitates a clear crop identity from farmer to retailer. In some highly sophisticated operations, containers are now being loaded on the farm for direct delivery to the supermarket.

5. Promotion of farm inputs:

An example of an unusual but, nevertheless, interesting benefit for sponsors comes from the Philippines. A feed milling company experienced difficulties in marketing its feed, which was more expensive than that produced by competing companies. To solve this problem it developed rearing schemes for pigs and poultry under contract in order to provide a market outlet for its feeds and to demonstrate their performance to other farmers living near the contracted farmers.

PROBLEMS OF CONTRACT FARMING

A) Contract farming problems faced by farmers:

1. Increased risk:

Farmers entering new contract farming ventures should be prepared to balance the prospect of higher returns with the possibility of greater risk. Such risk is more likely when the agribusiness venture is introducing a new crop to the area. There may be production risks, particularly where prior field tests are inadequate, resulting in lower-than-expected yields for the farmers. Market risks may occur when the company's forecasts of market size or price levels are not accurate. Considerable problems can result if farmers perceive that the company is unwilling to share any of the risk, even if

partly responsible for the losses. In Thailand, for example, a company that contracted farmers to rear chickens charged a levy on farmers' incomes in order to offset the possibility of a high chicken mortality rate. This was much resented by the farmers, as they believed that the poor quality of the day-old chicks supplied by the company was one reason for the problem.

2. Unsuitable technology and crop incompatibility:

The introduction of a new crop to be grown under conditions rigorously controlled by the sponsor can cause disruption to the existing farming system. For example, the managers may identify land traditionally reserved for food crops as the most suitable for the contracted crop. Harvesting of the contracted crop may fall at the same time as the harvesting of food crops, thus causing competition for scarce labour resources. Particular problems may be experienced when contract farming is related to resettlement programmers. In Papua New Guinea, for example, people from the Highlands were resettled in coastal areas to grow oil palm and rubber. This required the farmers, who were traditionally sweet potato eaters, to learn cultivation techniques for new food crops and to adapt their dietary practices accordingly. Two factors should be considered before innovations are introduced to any agricultural environment. The first is the possible adverse effect on the social life of the community. When tobacco growers in Fiji were encouraged to cure tobacco themselves rather than sell it in the fresh green form, it was found that they were unable to handle the highly technical curing operation with any degree of continuity. This was attributed to intermittent social commitments and customary obligations that overrode contractual responsibilities and eventually resulted in the cancellation of their contracts. The second factor is the practicality of introducing innovations or adaptations. The introduction of sophisticated machines (e.g. for transplanting) may result in a loss of local employment and overcapitalization of the contracted farmer. Furthermore, in field activities such as transplanting and weed control, mechanical methods often produce less effective results than do traditional cultivation methods. Field extension services must always ensure that the contracted crop fits in with the farmer's total cropping regime, particularly in the areas of pest control and field rotation practices.

3. Manipulation of quotas and quality specifications:

Inefficient management can lead to production exceeding original targets. For example, failures of field staff to measure fields following transplanting can result in gross over planting. Sponsors may have unrealistic expectations of the market for their product or the market may collapse unexpectedly owing to transport problems, civil unrest, change in government policy or the arrival of a competitor. Such occurrences can lead managers to reduce farmers' quotas. Few contracts specify penalties in such circumstances. In some situations management may be tempted to manipulate quality standards in order to reduce purchases while appearing to honor the contract. Such practices will cause sponsor-farmer confrontation, especially if farmers have no method to dispute grading irregularities. All contract farming ventures should have forums where farmers can raise concerns and grievances relating to such issues.

4. Corruption:

Problems occur when staffs responsible for issuing contracts and buying crops exploit their position. Such practices result in a collapse of trust and communication between the contracted parties and soon undermine any contract. Management needs to ensure that corruption in any form does not occur. On a larger scale, the sponsors can themselves be dishonest or corrupt. Governments have sometimes fallen victim to dubious or "fly-by-night" companies who have seen the opportunity for a quick profit. Techniques could include charging excessive fees to manage a government-owned venture or persuading the government and other investors to set up a new contract farming company and then sell that company overpriced and poor quality processing equipment. In such cases farmers who make investments in production and primary processing facilities run the risk of losing everything.

5. Domination by monopolies:

The monopoly of a single crop by a sponsor can have a negative effect. Allowing only one purchaser encourages monopolistic tendencies, particularly where farmers are locked into a fairly sizeable investment, such as with tree crops, and cannot easily change to other crops. On the other hand, large-scale investments, such as for nucleus estates, often require a monopoly in order to be viable. In order to protect farmers when there is only a single buyer for one commodity, the government should have some role in determining the prices paid. Drucker suggests that privately managed monopolies under public regulation are preferable to non-regulated private or public monopolies. The greatest abuses do tend to occur when there are public monopolies, where buying prices are set by the government, or where farmers have made long-term investments in perennial crops. In 1999 the Kenya Tea Development Authority experienced serious unrest amongst its growers, reportedly because of the Authority's inefficient extension services and alleged "manipulation" of farmers. There was also discontent in Kenya among sugar farmers because the price set by the government did not change between 1997 and 1999.

Indebtedness and over reliance on advances were high, as they thought contract farming did not pay. One of the major attractions of contract farming for farmers is the availability of credit provided either directly by the company or through a third party. However, farmers can face considerable indebtedness if they are confronted with production problems, if the company provides poor technical advice, if there are significant changes in market conditions, or if the company fails to honour the contract. This is of particular concern with long-term investments, either for tree crops or for on-farm processing facilities. If advances are uncontrolled, the indebtedness of farmers can increase to uneconomic levels. In one venture "compassionate" advances for school fees, weddings and even alimony resulted in many farmers receiving no payments at the end of the season. Dropout rates for farmers in that particular project.

B) Contract farming problems faced by sponsors:

1. Land availability constraints:

Farmers must have suitable land on which to cultivate their contracted crops. Problems can arise when farmers have minimal or no security of tenure as there is a danger of the sponsor's investment being wasted as a result of farmer landlord disputes.

Difficulties are also common when sponsors lease land to farmers. Such arrangements normally have eviction clauses included as part of the conditions. Some contract farming ventures are dominated by customary land usage arrangements negotiated by landless farmers with traditional landowners. While such a situation allows the poorest cultivator to take part in contract farming ventures, discrete management measures need to be applied to ensure that landless farmers are not exploited by their landlords. Before entering into contracts, the sponsor must ensure that access to land is secured, at least for the term of the agreement.

2. Social and cultural constraints:

Problems can arise when management chooses farmers who are unable to comply with strict timetables and regulations because of social obligations. Promoting agriculture through contracts is also a cultural issue. In communities where custom and tradition play an important role, difficulties may arise when farming innovations are introduced. Before introducing new cropping schedules, sponsors must consider the social attitudes and the traditional farming practices of the community and assess how a new crop could be introduced. Customary beliefs and religious issues are also important factors. For example, Easter for some Christians is an inappropriate time for sowing vegetable crops. Harvesting activities should not be programmed to take place during festivals, and failure to accommodate such traditions will result in negative farmer reaction. It must also be recognized that farmers require time to adjust to new practices.

3. Farmer discontent:

A number of situations can lead to farmer dissatisfaction. Discriminatory buying, late payments, inefficient extension services, poor agronomic advice, unreliable transportation for crops, a mid-season change in pricing or management's rudeness to farmers will all normally generate dissent. If not readily addressed, such circumstances will cause hostility towards the sponsors that may result in farmers withdrawing from projects.

4. Extra-contractual marketing:

The sale of produce by farmers to a third party, outside the conditions of a contract, can be a major problem. Extra-contractual sales are always possible and are not easily controlled when an alternative market exists. For example, a farmer cooperative in Croatia bought cucumbers, red peppers and aborigines on contract. The cooperative's advances to the farmers included all necessary production inputs. Unfortunately members often sold their vegetables to traders at higher prices than the cooperative had contracted. The outside buyers offered cash to farmers as opposed to the prolonged and difficult collection of payments negotiated through the cooperative. Sponsors themselves can sometimes be a cause of extra-contractual practices. There are several companies working with the same crop (e.g. cotton in some southern African countries), they could collaborate by establishing a register of contracted farmers. Managers must be aware of produce being sold outside the project and also be aware of produce from outside being channeled into the buying system. This occurs when non-contracted farmers take advantage of higher prices paid by an established sponsor. Non-contracted crops are filtered into the buying system by outside farmers through friends and family

who have crop contracts. Such practices make it difficult for the sponsor to regulate production targets, chemical residues and other quality aspects.

5. Input diversion:

A frequent problem is that farmers are tempted to use inputs supplied under contract for purposes other than those for which they were intended. They may choose to use the inputs on their other cash and subsistence crops or even to sell them. Clearly this is not acceptable to the sponsor, as the contracted crop's yields will be reduced and the quality affected. Steps to overcome such problems include improved monitoring by extension staff, farmer training and the issuing of realistic quantities of inputs. However, the knowledge that a contract has the advantages of technical inputs, cash advances and a guaranteed market usually makes the majority of farmers conform to the agreement. Unless a project is very poorly managed, input diversion is usually an annoyance rather a serious problem.

SUGGESTIONS TO PROMOTE CONTRACT FARMING

1. Government Policy Support Technology

- ✓ Leverage the ICAR, university system to provide region specific crop solutions - make them part of public information domain.
- ✓ Facilitate import of varieties / hybrids for contract farmers. Growth will be led by productivity enhancement and market focus.
- ✓ Research system synergy with both farmers and private sector

2. Government Policies and Regulations

- ✓ Make purchase interference by a third party in a contract farming program, a cognizable offence Required - a quasi-judicial system of contract enforcement
- ✓ Single tier regulation for contract farming at the state level
- ✓ Contract farming organizations be allowed to take out realistic and deregulated crop insurance policies

3. Government Fiscal Support

- ✓ Collect no taxes from food processors involved in contract farming. Compel them to invest in lieu in rural infrastructure and farmer upliftment to the extent of tax saved
- ✓ Offer 150% deduction on investments made in the creation of extension services for participating farmers linked to procurement of output
- ✓ Legislation needs to be clarified in order to determine whether or not it is permissible to procure agricultural produce directly from the farmers.
- ✓ No taxes or duties on import of agri equipment to be used in a registered contract farming program
- ✓ Abolish all fees, taxes, cess, duties, levies on procurement effected by a registered contract farming program

RESEARCH FINDINGS ON CONTRACT FARMING:

Table 1: Contract farming of dairy, poultry and vegetables in India

S. No.	Item	Gross margin (Rs./t)	
		Contract	Non-contract
1.	Milk production	3700	1800
2.	Broilers production	2300	2000
3.	Vegetable production	1800	1000

Source: Pratap et al., 2005, International Food Policy Research Institute, Washington, DC

Table 2: Potato production in Punjab, India

Item	Contract	Non- Contract	Percentage
Price (Rs/q)	546	316	73%
Yield (q/acre)	69	82	-16%
Gross Returns (Rs/acre)	37,883	25,961	46%
Total variable cost (Rs/acre)	21,288	15,689	36%
Net Returns (Rs/acre)	16,595	10,272	62%

Source: International Food Policy Research Institute, Washington, DC

Table 3: Costs and returns per acre of contract and non-contract crop

Factor Inputs	Rice Seed (CC)	Rice (NC)
Cost of Animal and Machine Power	4902 (27.60)	4926 (36.36)
Seeds	353 (1.99)	342 (2.52)
Cost of Human Labor	4878 (27.46)	1430 (10.56)
Cost of Chemicals and Manure	3859 (21.72)	2654 (19.59)
Total Variable Costs	13992 (78.77)	9352 (69.03)
Total Other Costs*	722 (4.06)	710 (5.24)
Total Cultivation Cost	14714 (82.83)	10062 (74.27)
Rental Value of Land	3050 (17.17)	2962 (21.86)
Transaction Costs **	0.0	524 (3.87)
Total Costs	17764 (100)	13548 (100)
Production in (Qtl)	18.52	20.81
Gross Return(Rs./ha)	33519	14932
Net Return (Rs./ha)	15755	1384
Note: Figure in parentheses indicates percentage to total costs. * Total other costs is comprise land revenue, depreciation on farm inputs (12.5 per cent) ** Total Transaction costs include cost of transportation and market commission.		
Source: Swain (2005) Productivity and Farmer's Efficiency under Contract Farming: a Case		

Study of Rice Seed Cultivation in Southern India. Centre for Development Studies, Trivandrum, Kerala

Table 4. Economics of contract spinach production

Items	Contract	Independent	% difference
Yield (t/ha)	8.6	8.3	4.0
Production cost (Rs/t)	1485	1630	-8.9
Transaction and marketing cost (Rs/t)	35	437	-90
Total cost (Rs/t)	1520	2067	-26.5
Price (Rs/t)	3311	3074	7.7
Net revenue (Rs/t)	1791	1007	77.9
Source: Birthal et al. (2005) , National Centre for Agricultural Economics and Policy Research , New Delhi			

Table 5. Economics of Contract Milk Production

Items	Contract	Independent	% difference
Milk yield (kg)	11.9	11.4	4.4
Production cost (Rs/t)	5586	5782	-2.5
Transaction cost and marketing (Rs/t)	100	1442	-93.1
Total cost (Rs/t)	5686	7170	-20.7
Price (Rs/t)	9337	8991	3.8
Net revenue (Rs/t)	3651	1821	100.5
Source: Birthal et al. (2005) , National Centre for Agricultural Economics and Policy Research , New Delhi			

Table 6. Economics of Suguna food Poultry farming

Item	Contract	Non Contract
Output: No. of birds sold	7757.52	6209.52
Mortality: No. of birds	747.57	740.95
Avg. total weight of birds sold (Kgs)	12917.16	13224.76
Revenues from bird sales(Rs.)	644566.2	377014.3
Avg. Revenues/Kg of bird sold	82.2	61.64
Source: Murthy and Madhuri (2013).		

Table 7. Companies/Firms involved in Contract farming and Agro commodity

S.No.	Name	Agro commodity
1.	Pepsi	Potato, green chilly and citrus fruits in Punjab
2.	Green Agro Pack	gherkins in Karnataka

3.	Desai cold storage	Banana, Mango, Okra
4.	Tata Chemicals	Jatropha
5.	IKF Technologies Ltd.	Jatropha
6.	Godrej Agrovat	Palm oil
7.	Gujarat Agro Industries	Onion
8.	Reliance Agrotech	cashew, mango, bambo and teak in M.P.
9.	A.V. Thomas Group Kochi	Marigold in A.P. and T.N.
10.	HLL	Chicory in Gujarat; basmati rice in Punjab; and dairy in U.P.
11.	Coimbatore Cots and Coatings Ltd	Cotton in T.N.
12.	Ion Exchange Enviro Farm Ltd	organic mango, banana, pineapple, pulses and vegetables in Maharashtra
13.	Mittal Farm	Medicinal plants and herb in Gujarat
14.	Semi Labs and Natural Remedies	Medicinal plants in Karnataka
15.	C&M Group	Maize and Soybean in Maharashtra
16.	Rallis India/Tata Chemicals	Wheat in MP; basmati rice and hyola in Punjab
17.	Soguna Broilers	Broiler in T.N.
18.	Global Ostrich (India)Pvt. Ltd & Chamundi Hatcheries	Ostrich farming in Karnataka
19.	Shri Bhumi Farms Pvt. Ltd	Red bananas in Karnataka
20.	Appachi Cotton Company	Cotton in T.N.
21.	Agrocell corporation	Organic cotton
22.	Mc Coin India Ltd.	Potato
23.	Desai cold storage	Banana, Mango, Okra
24.	Tata Chemicals	Jatropha
25.	IKF Technologies Ltd.	Jatropha
26.	Godrej Agrovat	Palm oil
27.	Gujarat Agro Industries	Onion

Source: Parmod Kumar (2007), National council of applied economics research

CONCLUSION

It is could be concluded from the foregoing discussion that through contract farming an early access to credit, input, information and technology and product markets for small-scale farming structure and increased profit of small farmers a whole as compared to traditional farming.

BIBLIOGRAPHY

Anonymous. 2007. India statistics, http://www.indiastat.com

Charles Eaton and Andrew W. Shepherd.2001.Contract Farming: Partnerships for growth.FAO Agricultural Services Bulletin, Rome. pp. 8-56.

Gulati, Ashok. 2008. Fragmenting Bottom and Consolidating Top: India's Changing Food System and Implications for Small Holders, in India: Some aspects of Economic and Social development (eds.).

Murthy MRK and Bindu Madhuri S. 2013. A case study on suguna poultry production through contract farming in Andhra Pradesh. Asia Pacific Journal of Marketing & Management Review 2 (5) 58-68.

Pratap Birthal. Power point presentation on Conditions for success of contract farming, National Centre for Agricultural Economics and Policy Research, New Delhi.

Swain Braja Bandhu.2005. Productivity and Farmer's Efficiency under Contract Farming: a Case Study of Rice Seed Cultivation in Southern India. Centre for Development Studies, Trivandrum, Kerala.

Shoja Rani, BN. Globalization and Contract Farming in India-Advantages and Problems. Conference on Global Competition & Competitiveness of Indian Corporate.pp.637-647

Will Margret.2013.Contract farming handbook. A practical guide for linking small-scale producers and buyers through business model innovation, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Crop simulation modeling in Agriculture

S. Alagappan* and Dr. R. Venkitaswamy**

**Ph.D Research Scholar, **Professor and Head*
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003. Tamil Nadu, India.
Corresponding Author: alga.s@rediffmail.com

Abstract

Crop Simulation Models (CSM) integrate current scientific knowledge from many different disciplines, including crop physiology, plant breeding, agronomy, agro meteorology, soil physics, soil chemistry, pathology and entomology. CSM used in Crop Management, Water Balance, Climate change and impacts, Cropping Systems, Intercropping and spacing interactions, Land use studies, Soil impacts(erosion, acidity, organic matter, leaching), Crop adaptations and breeding. CSM is widely used in different countries on various applications in agriculture. Precision farming and organic farming crop yield prediction, yield monitoring, farming system design and implementation, weather data collection, validation and utilization are being systematically used in crop modelling.

INTRODUCTION

Definition: Crop Simulation Models: Crop simulation models in general Crop Simulation Models (CSM) are the "dynamic simulation of crop growth by numerical integration of crop growth by numerical integration of constituent process with the aid of computers". **Calculate or predict *crop yield as a* function of** : a. Weather conditions, b. Soil conditions c. Crop management scenarios.

Data Sets Required for Model:

Daily weather data: Rainfall, max and min temperatures, solar radiation or sunshine hours. Soil profile characterization data (one time activity—data to be collected from soil survey reports): Soil texture by horizon, bulk density, fraction stones, organic carbon, soil pH (water), horizon thickness and depth, root growth distribution, surface characteristics such as soil colour, slope, permeability, drainage class, soil series name.
Management data : Crop, cultivar, planting date, seedling rate, plant spacing, row spacing, planting depth, irrigation (dates, amounts, type and method of irrigation), fertilizer applied dates, amounts, type of material, method of application), chemical application (date, amount, type, method of application), tillage/inter culture operations (dates, depth, equipment used), organic fertilizer (date, amount, type and method of application), thinning and weeding (date and method).

Bio physical and Plant characters on crop model development

Physiological effects on crops, pastures, forests and livestock (quantity and quality), Changes in land, soil and water resources (quantity and quality), Altered hydrological cycle and precipitation variance, Changes in length of growing period (LGP), Land degradation and desertification-increase in soil Salinity, Increased weed and pest challenges, Reduced crop yields . All these have implications for food production and livelihoods Crop development— various growth phases, Crop growth-photosynthesis, respiration and expansion processes, Partitioning to plant parts—Pod and seed growth etc, Nitrogen fixation - growth of nodules and N fixation, Root growth - depth and proliferation, Soil processes - nutrient transformations and balances, Hydrological processes - water balance, Direct and indirect effects-temp. and water stresses, Pests and diseases-growth and development.

DSSAT Applications: Diagnose problems (Yield Gap Analysis),Precision agriculture, Diagnose factors causing yield variations, Prescribe spatially variable management, Water and irrigation management, Soil fertility management, Plant breeding and Genotype*Environment interactions , Yield prediction for crop management, Adaptive management using climate forecasts, Climate variability and Climate change, Soil carbon sequestration, Land use change analysis, Targeting aid (Early Warning) - policy decisions, Bio fuel production, Risk insurance (rainfall).

Info Crop: National Agricultural Technology Project (NATP) - ICAR mainly deals with the main features of Crop growth, water deficit, nitrogen management, temperature, crop-pest interactions, soil water and nitrogen balance & (soil) OC dynamics, GHG, Aerobic and anaerobic conditions

Climatic change could contain either of the two values: 1. Same Change Everyday 2. Variable Changes Overtime. No further development – lack of support. **WOFOST 7.1.3 :**Semi-deterministic crop simulation model of physiological processes, Simulation runs from sowing to maturity and is based on response of crop to weather (all Prod levels) and soil moisture conditions (Wat-lim). WOFOST Control Center version 1.8 (WCC). **WOFOST is designed to fit available regional data sets as input data:** Crop, Soil, site Weather Farm management factors limited to crop cultivar choice and average sowing date.

Model output: Crop growth curves: crop stage, biomass, LAI and harvestable part under potential, and water-limited conditions, Soil moisture evolution, Monitoring based on tracking differences with normal conditions, Model output can be used as yield predictors, **Crop (choice from 8 field crops), Standard crop file,** 46 crop parameters including, 34 single parameters, 12 multiple parameter tables (crop age or temperature) , **Variety (regional cultivars), Crop calendar,** start of season and end of season.

CropSyst Crop simulation model : Cropping Systems Simulation Model, Multi-year multi-crop daily time step simulation model ,RS / GIS, C++, Washington State. University. **CropSyst : Management options:** cultivar selection, crop rotation (including fallow years), irrigation, nitrogen fertilization, tillage operations (over 80

options), and residue management. Simulates… soil water budget, soil-plant nitrogen budget, crop canopy and root growth, dry matter production, yield, residue production and erosion.

Aquacrop: FAO Model : Aqua Crop v3.1 – 2011,Specially -water limiting factors, planning purposesforuseofeconomists,wateradministratorsandFarmmanagers.http://www.fao.org/nr/water/aquacrop.html.

ORYZA2000 : Version 2.13 (2009), 1990 - Simulation and Systems Analysis for Rice Production (SARP), ORYZA1- potential production, ORYZAW - water limitations and ORYZAN - nitrogen limitations .To study the impact of climate change rice yields and to explore adaptive management options (fertilizer, cultivar, irrigation strategy, sowing date, etc***.).*** This crop simulation model is only for rice and not dealing any other crops.

APSIM 7.3 February 2011TEAM: Commonwealth Scientific and Industrial Research Organization (CSIRO), The University of Queensland (UQ), Department of Employment, Economic Development and Innovation (DEEDI). APSIM: Fallow Water Balance , Effect of residue cover on soil water storage during fallow, Nitrogen cycling, Single season crop simulations, Cropping sequence simulations (rotations), Evaluating a cropping system, Climate change projections***, APSIM South Asia manual 2011.*** **APSIM application:** Crop Management, Water Balance, Climate change and impacts, Cropping Systems, Intercropping and spacing interactions, Land use studies, Soil impacts(erosion, acidity, organic matter, leaching), Crop adaptations and breeding***.***

CERES CSM: CERES Rice and Maize to determine potential crop yields with and without constraints including water, nitrogen, capital, labour, farmers income and options to maximize food production and farmers and regional incomes for the state of Haryana, India***.*** CERES models provides very little details on genetic coefficients and the values used in genetic coefficient data are not readily available. CERES Rice model used in tropical and sub tropical Asian environment where as CERES Wheat is used in temperate environment. MACROS, CERES Rice and RICESYS are used to study climate change impact on rice growing areas in Asia.(MACROS for temperature, CERES for CO2 ,and RICESYS for green house experiment data), MERES model is used to predict methane emissions in Rice, CERES Wheat application in India, relates to planting dates, planting methods, CERES Rice application in India, covers dry seeded rice (DSR)and transplanted rice(TPR) to improve rice production. CERES Rice and CERES Wheat models in India covers the crop parameters such as temperature, solar radiation, rain fall, wind, CO2 concentration, pest and diseases, irrigation water.

Successful agro meteorological models: A few successful models in Agro meteorology: The de Wit school models: the first model to attempt photosynthetic rates of crop canopies. Crop growth simulation (ELCROS) by de Wit et al 1970. (BACROS) To improve the simulation of transpiration and involve into the Basic Crop growth simulator (BACROS. IBSNAT and DSSAT Models: to sustain the yield levels, Production of decision support systems, Minimum amount of data required for running simulations, Site specific yield simulations.

CSM Benefits to students: Reduced time for experimentation, Provision of safe learning environment, Facilitates distance education, Increased control over environmental variability and Integration of different but associated topic areas.

CSM Limitations to students: Loss of field and laboratory skills, Separation from field of study, Frustrating and boring, Experimental and observation outside model range, and Development of belief that CSM are reality**.**

Crop model prediction challenges:

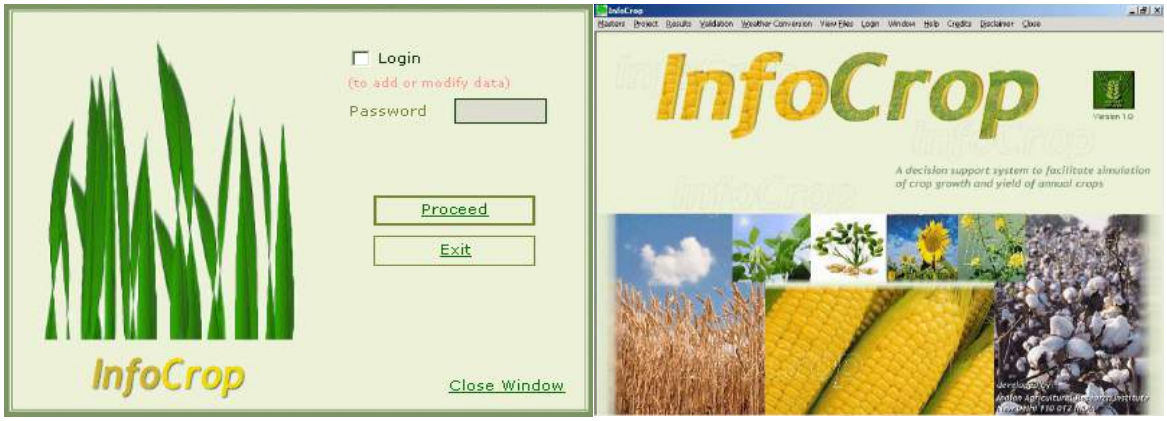
1.Build on existing research to identify or develop, and implement practical tools for downscaling climate forecasts tailored to needs of crop model users.2. Design and seek funding for the type of comparative study of potential and existing downscaling methods developments.3. Develop a mechanism for facilitating communication among researchers interested in pursuing this area further.4. Clarify and communicate a positive global policy for sharing climate model output with researchers working on downscaling and agricultural applications.5.inadequate quantitative information about the skill and reliability of model-based. 6.forecasts difficulty in obtaining climate model hind casts ,the mismatch of spatial and temporal scale between climate model output and crop model requirements.

CONCLUSION

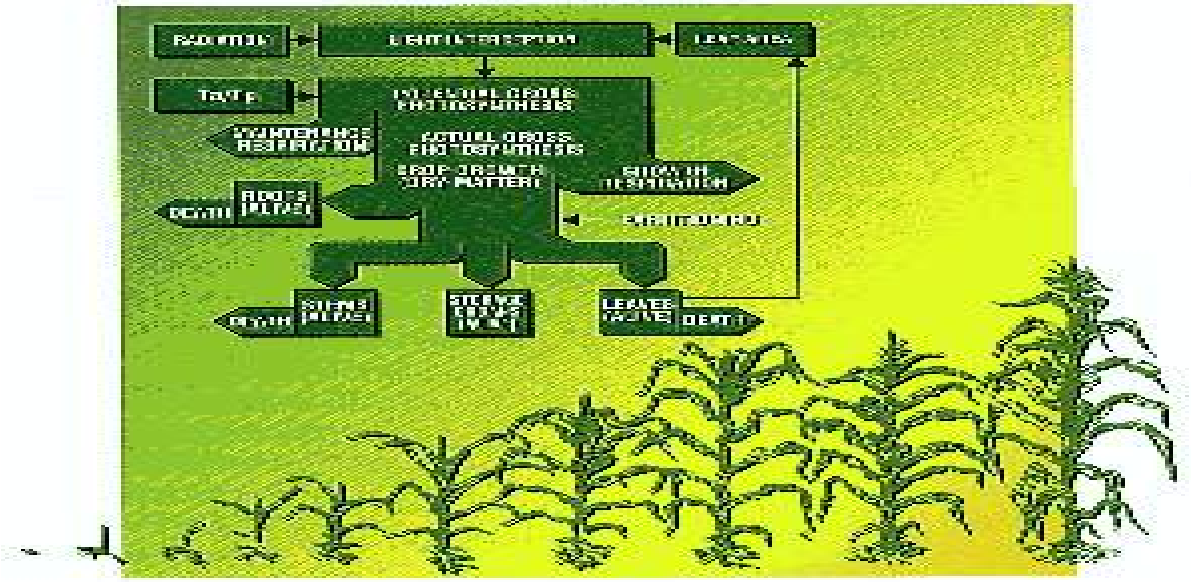
Crop specific ICASA/IBSANT crop specific models included in the DSSAT software (including all CERES and GRO models listed under each crop), Generic WOFOST provides a family of generic models with specific parameters, for maize, wheat, sugar beet, and more (not listed under each crop since, are not crop specific), General model EPIC, Water irrigation requirements for all crops, CROPWAT, Alfalfa ALSIM, ALFALFA, Barley CERES-Barley, Cotton GOSSYM, COTCROP, COTTAM, Dry beans BEANGRO, Maize CERES-Maize, CORNF, SIMAIZ, CORNMOD, VT-Maize, GAPS, CUPID, Peanuts PNUTGRO, Pearl millet CERES-Millet, RESCAP Potatoes SUBSTOR, Rice CERES-Rice, RICEMOD,Sorghum CERES-Sorghum, SORGF, SORKAM, RESCAP,Soybeans SOYGRO, GLYCIM, REALSOY, SOYMOD, Sugarcane CANEMOD, Wheat CERES-Wheat, TAMW, SIMTAG, AFRCWHEAT, NWHEAT, SIRIUS ,SOILN -Wheat. CSM application in agriculture has got wider scope for future developments, climate change studies and to meet the global food security in future.

IMOPRTANT CROP SIMULATION MODELS

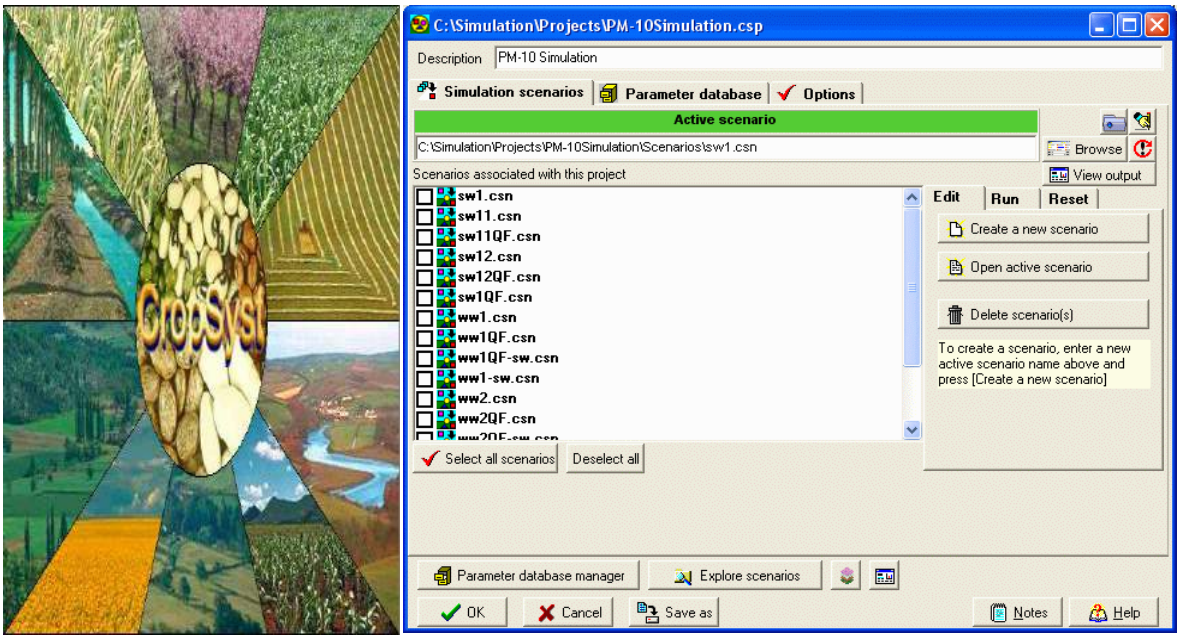
DSSAT CROP SIMULATION MODEL



INFOCROP CROP SIMULATION MODEL

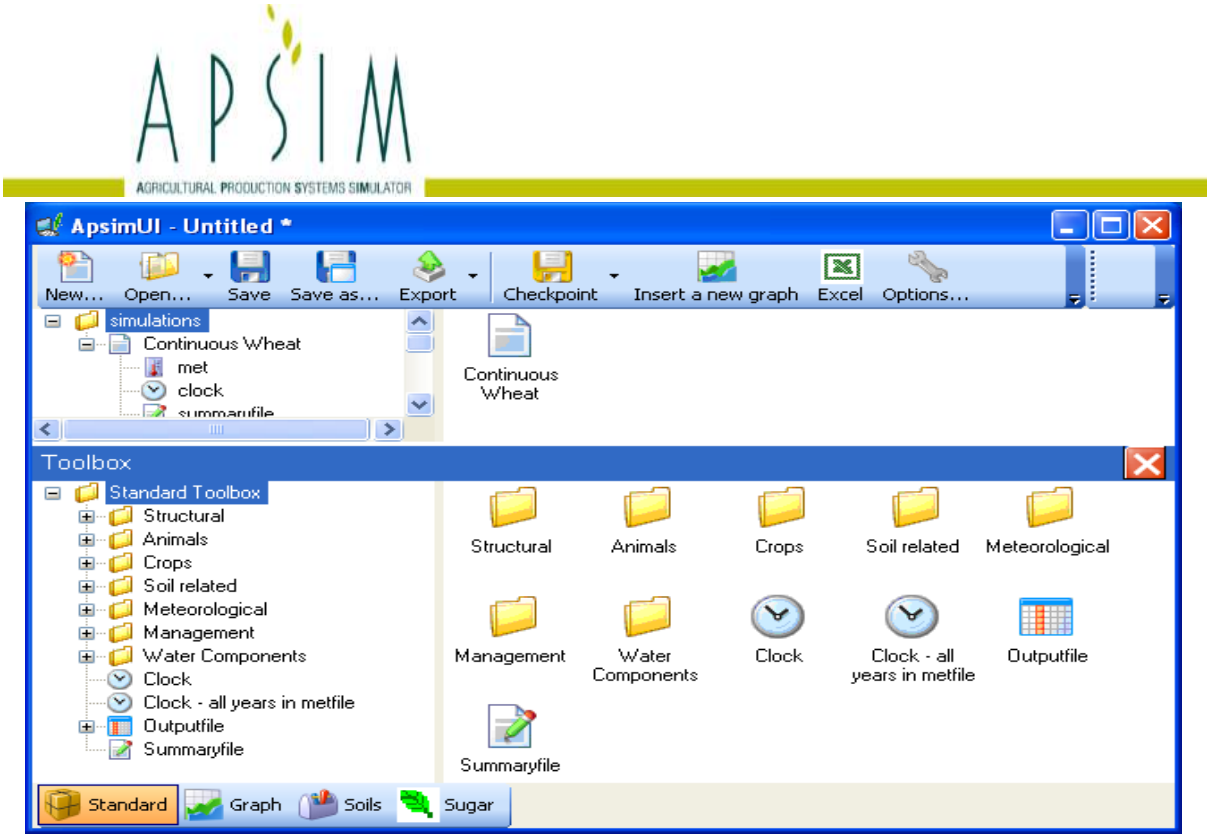


WOFOST CROP SIMULATION MODEL



CROP SYST CROP SIMULATION MODEL

AQUA CROP FAO MODEL



APSIM CROP SIMULATION MODEL

ORYZA 2000 IRRI CROP SIMULATION MODEL

Fat cow syndrome (FCS): Metabolic disease of ruminants

Nadeem Shah[1]*, Uma Kant Verma[2], Hanuman Prasad yadav[3], Jitendra Kumar[4], Ajeet Singh[1] and Shabir Ahmad Lone[3]

[1]Senior Research Fellow (SRF), ABRC, ICAR-NDRI, Karnal (Haryana)
[2]PhD Scholar (AGB), ICAR-NDRI, Karnal (Haryana)
[3]PhD Scholar (ARGO), ICAR-NDRI, Karnal (Haryana)
[4]MVSc (Vet Gyn & Obs), NDUAT, Faizabad (UP)
** Corresponding Author: drnadeem.ndri@hmail.com*

It is a clinical syndrome associated with higher incidence of metabolic, digestive, infectious, and reproductive disorders such as milk fever, ketosis and retained placenta, which arises due to the accumulation of excessive fat in the liver and develops primarily due to faulty feed management leading to excessive consumption of feed. The clinical signs include depression, anorexia, ketonuria, marked decrease in production, progressive debilitation, weakness, nervous signs, and elevation in temperature.

Synonyms of Fat Cow Syndrome in different ruminants

Dairy cows	Beef cows	Ewes & Does
Hepatic Lipidosis Fat Liver Syndrome	Pregnancy toxemia	Ovine ketosis Twin lamb disease Pregnancy disease

INTRODUCTION

The dairy cows do not normally store fat in their liver, so fatty liver or FCS does not occur regularly in ruminants, but when body condition of cow increases, fatty liver occurs as a result of breaking down too much fat. Thus, the liver becomes fatty when the cow is losing body condition, the more loss in the condition the more fat accumulates in the liver.

Endocrine changes associated with parturition and lactogenesis contribute to the development of fatty liver.

Cows that are over conditioned at calving are most likely to develop fatty liver and cows that develop fatty liver at calving are most susceptible to ketosis.

Fatty liver syndrome (> 20% fat) reduces liver function, depresses appetite and milk yield.

The syndrome is frequently a herd problem characterized by a high morbidity (around 50% to 90 %) and mortality (around 25%).

RISK FACTORS

Host Factor

Non lactating dairy cows: The disease can occur in non lactating dairy cows by the imposition of a partial starvation diet in late pregnancy to attempt to reduce the body weight of cows which are considered to be too fat.

Dairy cattle: Fatty liver occurs primarily in the first 4 weeks after calving when up to 50% of all cows have some accumulation of triacylglycerol in the liver.

Beef cattle: Changing the diet of pregnant beef cows from silage to straw in an attempt to reduce their body weight and incidence of dystocia has resulted in outbreaks of disease.

In beef cattle, the severe form of the disease, pregnancy toxemia is seen most commonly in the last 6 weeks of pregnancy in cows which are fat and pregnant with twins.

Morbidity is about 1 % and mortality is usually 100 %.

Other disease condition

Fatty liver is likely to develop concurrently with the disease, typically disorders that are seen at or shortly after calving, including metritis, mastitis, displaced abomasum, acidosis, and hypocalcemia and ketosis.

CAUSES:

The most important cause of fatty liver is negative energy balance.

Mobilization of excessive body fats to the liver during periods of negative energy balance at the time of parturition or early in lactation in dairy cows and late pregnant of beef cows.

There are two main mechanisms which are responsible for Fat Cow Syndrome.

1. Greater uptake of fatty acids mobilized from peripheral tissues.
2. Inadequate secretion of liver triglycerides.

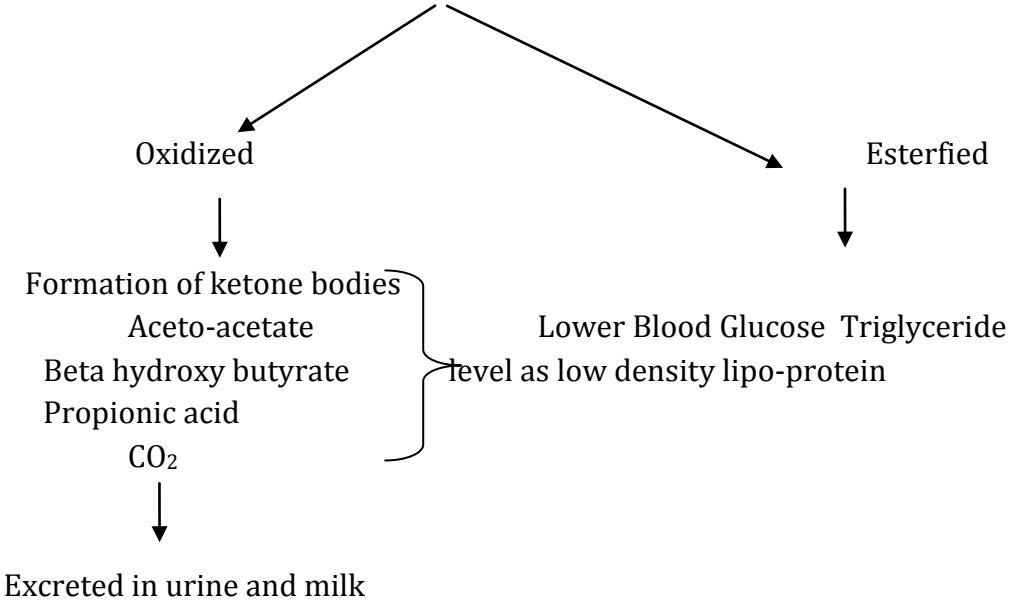
Fatty liver occurs during periods when blood concentrations of non-esterified fatty acids (NEFA) are increased. The greatest increase in liver triglyceride typically occurs at calving.

PATHOGENESIS

Under normal physiological conditions, the total amount of fat increases in the liver beginning a few weeks before calving rises to an average of about 20 % (of wet weight) one week after calving and declines slowly to the normal level of less than 5 % by 26 weeks after calving. Fat mobilization begins 2-3 weeks before calving and is probably induced by a changing hormonal environment prior to calving rather than an energy deficit.

As animal goes to off feed, fatty liver can develop within 24 hours. As animal required energy to maintain, it absorbs energy from liver and other peripheral tissue.

NEFA in liver



CLINICAL FINDINGS:

There are no known clinical signs that are unique to cows with fatty liver.

Fatty liver has been associated with the following disease

- Low milk production, Clinical mastitis, Parturient hypocalcemia, Left-sided displacement of the abomasum, Indigestion, Retained fetal membranes, Dystocia.

Animal shows following signs

In dairy cattle

- Fat cow syndrome occurs usually within the first few days following parturition.
- The animal may become depressed and anorectic.
- Rumen contractions are weak or absent and the feces are usually scanty.
- A severe ketosis occurs. When it is not treated early, ketonuria occurs.
- Affected cows will not eat and gradually become weaker, totally recumbent and die in 7-10 days. .
- Some cattle exhibit nervous signs consisting of star gazing, holding the head high and muscular tremors of head and neck.
- Decreased milk production.

In beef cattle

- Shortly before calving, affected cows are aggressive, restlessness, excited, and uncoordinated with a stumbling gait and sometimes have difficulty in rising and they fall easily.

- When disease occurs 2 months before calving, the cows are depressed for 10-14 days and do not eat, and become exhibit sternal recumbency.

CLINICAL PATHOLOGY:

1. Serum biochemistry:

There are four main serum tests that can be performed

a) Gamma-glutamyl transferase (GGT)
b) Aspartate aminotransferase (AST)
c) Sorbitol dehydrogenase (SDH)
d) Bile concentrations

Cattle with severe fatty liver have significantly higher serum bilirubin concentrations, AST values and SDH values than cattle with the less severe fatty liver. Serum glucose level is significantly lower in cattle in this condition.

2. Milk ketones:

Milk ketone tests are available for detection of sub-clinical ketosis in post-partum dairy cattle. The pink test liquid and ketorolac test strip are highly sensitive for sub-clinical ketosis when tested with milk sample. The routine testing of cows postpartum for subclinical ketosis provides a screening test for cows in early stages of fatty liver.

3. Liver biopsy:

A liver biopsy can be used to determine the severity of the fatty liver and the concentration of triglyceride. It is the most reliable method of estimating the degree of fatty infiltration of the liver. The triglyceride concentration of liver in cows normally ranges from 10 % to 15 %.

The lipid (triglyceride) content of bovine liver is highly correlated with its specific gravity and submersion of biopsy specimen into water and Copper sulphate ($CuSO_4$) solution with specific gravities of 1.025 and 1.055.

Water (with sp gravity 1.0)	CuSo4 (with sp gravity 1.025)	CuSo4 (with sp gravity 1.055)	Approx. % of lipid content in liver	Disease condition
Float	Float	Float	<34%	Severely affected
Sink	Float	Float	<25% and >34%	Moderately affected
Sink	Sink	Float	<13% and >25%	Mild affected*
Sink	Sink	Sink	>13%	Inconsequential

*Most postpartum dairy cows without evidence of disease or clinical signs

4. Ultrasonography of liver:

It is used to evaluate fatty infiltration in dairy cattle and it has the highest sensitivity, specificity, accuracy.

5. Haemogram:

In cattle with subclinical fatty liver, there may be leucopenia, neutropenia and lymphopenia.

Necropsy Findings

In several fatal cases, the liver is grossly enlarged, pale yellow, friable and greasy.

The histological changes include the occurrence of fatty cysts or lipogranulomas, enlarged hepatocytes, and compression of hepatic sinusoids.

1 **2** **3**

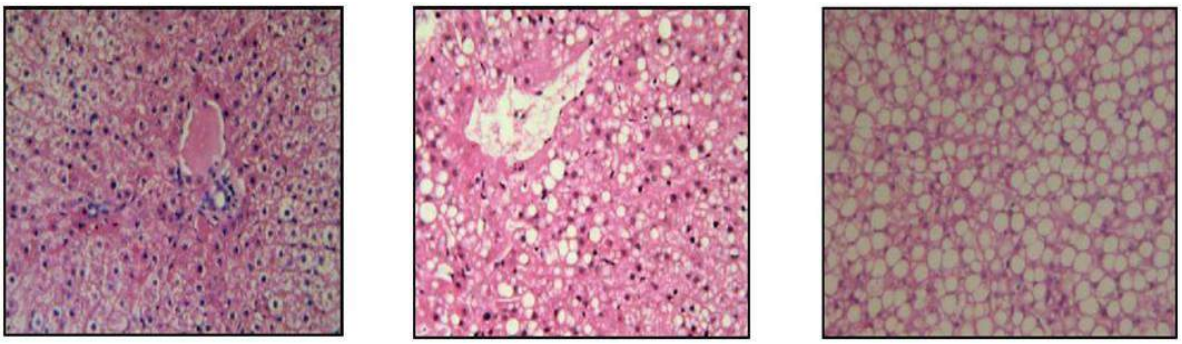


Figure 1 Liver Showing multiple fat droplets with centrally placed nucleus in hepatocyte (H&E x 400)

Figure 2 Liver showing varied sized fat globules in the hepatocytes around the central vein (H&E x 400)

Figure 3 Liver showing large fat globules in all the hepatocytes along with displaced nucleus (H&E x 400)

Differential diagnosis

In dairy cows, fatty liver must be differentiated from those diseases which commonly occur immediately following parturition.

a) Left-side displacement of the abomasums: It results in a secondary ketosis, inappetence, and pings over the left abdomen.
b) ROP and metritis: There may be fever, inappetence to anorexia, ruminal atony and a foul smelling vaginal discharge.
c) Primary ketosis: It may occur immediately after parturition or within several days, about 6 to 8 weeks of lactation. Inappetence, rumen hypotonicity, marked ketonuria and a good response to glucose treatment are characteristic.
d) In beef cattle, pregnancy toxemia before parturition must be differentiated from abomasal impaction, vagus indigestion and chronic peritonitis.

TREATMENT

The prognosis for the severe fatty liver is unfavorable and there is no specific therapy.

In general, cows with severe fat cow syndrome, which are totally anorexic for 3 days or more usually die in spite of intensive therapy.

Liberal quantities of highly palatable good quality hay and an ample amount of water should be provided; those which continue to eat increasing daily amounts will recover with supportive therapy and palatable therapy.

Intensive therapies for correcting the effects of ketosis are required, which include:

a) Fluid and electrolyte therapy: The recommended treatment includes continuous IV infusion of 5% glucose and multiple electrolyte solutions.
b) Intra-ruminal administration of rumen fluid (5 -10 L) from a normal cow in an attempt to stimulate the appetite.
c) Glucagon administration: The subcutaneous injection of 15mg/ day of glucagon for 14 days. Glucagon containing 29 amino acids, which is a pancreatic hormone which improves carbohydrate status of cows by stimulating hepatic gluconeogenesis, glycogenolysis, amino acids uptake and ureagenesis.
d) Glucocorticoids: Prednisolone at 200mg IM daily for 3-5 days decreases liver triglyceride concentrations.
e) Propylene glycol: It should be given orally at 1lit/ day as it promotes gluconeogenesis and is used for the treatment of ketosis.
f) Insulin: Insulin as zinc protamine at 200-300 subcutaneous twice daily promotes the peripheral utilization of glucose.

REFERENCES

Dairy Production Medicine by Sandra Godden (From Internet)

Merck's Veterinary Manual (9th Edition)

Morrow DA., J. Dairy Sci. 1976 Sep; 59(9):1625-9.Fat cow syndrome. (From Internet)

Veterinary Medicine, A textbook of the disease of cattle, sheep, goats, pigs and horses, 10th edition by Otto M Radostits, Clive C Gay, Kenneth W Hinchcliff, Peter D Constable.

R. Ramyadevi1, K.K. Ponnuswamy, G. Vijayakumar and A. Arulmozhi. 2017. Clinicopathological Evaluation of Fatty Cow Syndrome in Dairy Cattle. Ind Vet J. 94(10): 35-38.

On-farm conservation: an approach to conserve landraces in fast changing climatic conditions

Gayacharan* and Kuldeep Tripathi

ICAR-National Bureau of Plant Genetic Resources, New Delhi-110012
** Corresponding Author: gayacharan@icar.gov.in*

Why on-farm conservation?

'On-farm conservation is the sustainable maintenance of landraces and obsolete cultivars (lines, populations) by growing them in conformity with environmental conditions; additionally, using growing technologies close to the conditions under which these materials had originated and evolved' (Holubec et al 2010). This dynamic conservation enables the development and evolutionary continuation of materials under the influence of the regional environment and the technologies used.

In dynamic conservation, strategies of plant genetic resources natural selection and other evolutionary processes continue along with the changing climatic conditions. Similarly, landraces can increase their tolerance/resistance to new races of pest and pathogens as they get the opportunity of co-evolution along with these new races. However, best strategy of PGR conservation is to follow *ex situ* conservation along with on-farm conservation as complementary to each other. *Ex situ* conservation takes care of existing diversity from chances of undergoing genetic bottlenecks in gene pool due to natural calamities or due to any other reasons while on-farm conservation takes care of arising new threats like aberrant climatic changes and newly evolved races of pathogens and insect pests. In on-farm conservation, crop genomes keep on renovating and evolving by adding or deleting alleles / genes to it which is an inherent property of a living to survive. Natural and artificial selection processes keep on selecting newly evolved genomic diversity. Two types of major selection forces continue against constantly changing genome of crops in on-farm conservation: one is natural selection and another is farmers' selections according to their need. Natural selection pressure of changing climatic conditions and new evolved races of pathogens and insect pests results in renovating adaptive variations of crops. Another is farmer's conscious or unconscious selection pressure which mainly affects the yield contributing agronomic traits and traits related to local taste, medicinal and ethnic values.

Photograph: *Maize landrace being conserved on-farm at Sarkaghat, Mandi, Himachal Pradesh*

LOSS OF CROP LANDRACE DIVERSITY

Though green revolution has changed economic status of farmers and millions of starving people particularly from developing and poor nations, crop landraces diversity was one of the most adversely affected areas by it. Green revolution impact was so high that nobody cared about the existence of local landraces and which resulted in unrecoverable rapid replacement of landraces by high yielding varieties. Landraces of wheat and rice are the most adversely affected by it. Presently landraces are only being grown in conditions of highlands, tribal areas, and local niche areas which are not suitable for cultivating high yielding varieties. For example high yielding dwarf varieties of rice have replaced most of the locally common rice landraces from most part of the rice growing regions in India but, substantial rice landrace diversity still exists in North Eastern Himalayan (NEH) region. The adoption rate of high yielding varieties (HYVs) is low in this region. There are a number of landraces like Chakhao, Kalajoha, Bhog joha, Malsara dhan, Lypya goal, Suhagmani, and many more rice landraces being cultivated in the region because of their local taste, aroma, medicinal and ethnic properties. In fact any landrace has at least one important trait for which it is preferred by farmers. The remarkable rice landrace diversity existing in NEH region may be due to ethnic diversity and their food habits, other local importance, climate, topography, small land holdings, lack of resources to cultivate HYV, etc. Despite the good resistance from HYVs, it is very important to promote local farming communities to continue growing local landraces before these disappear forever. It can be done by increasing awareness about importance of local rice landraces, taking up on-farm conservation activities and equitable benefit sharing to farmers as local germplasm conservator.

IMPORTANCE OF ON-FARM CONSERVATION

On-farm conservation can play an important role in: (a) improvement of local landraces (b) increasing local crop diversity by re-establishing local landraces of the region

presently not under cultivation, but present in national gene bank (c) promoting local farmers by giving monetary incentives for his role as local conservator of diversity and cultural heritage, and providing benefits derived from improved local genetic resources on equitable basis (d) strengthening local informal seed supply system (e) developing market linkage for better earning of farmers (f) encouraging and making aware of importance of on-farm conservation among policy makers to support farmers commitment in on-farm conservation (g) by way of incentives to local farmers like adding value to products of local varieties that enhances income of farmers, training in breeding particularly participatory plant breeding, registration of farmers' varieties and enhancing local Government supports..

SOME IMPORTANT STEPS TO BE TAKEN FOR ON-FARM CONSERVATION

1. Survey for diversity in local landraces and wild relatives: categorical classification, spread areas and local importance.
2. Gap analysis for studies and collections to be taken up.
3. Finding landraces which are *ex situ* conserved but absent in their original habitat to reestablish cultivation of those landraces in their original habitat.
4. Identifying locally highly adapted crop land races to different niche regions/ environments in a selected area.
5. Diversity assessment of local landraces at morphological, molecular and biochemical level.
6. Comparison of genetic diversity of named landraces existing in *ex situ* and on farm conditions simultaneously to find out loss or gain of allelic/gene diversity over the period of time.
7. To find out if the selected crop has faced genetic bottleneck in that region. This may help in conservation, utilization and germplasm enhancement activities.
8. Identifying genes, adaptive traits which are playing crucial role for their natural and artificial selection (farmers' preference) to utilize them in region specific breeding programs.
9. Promotion of landrace cultivation by inventing alternate/new uses of crops. Thus, old landraces can be used for new, non-traditional purposes.
10. Value addition to the landraces by identifying their nutritional qualities like protein quantity and quality, aroma, anti-oxidant capacity, mineral contents, etc. and marketing farm produce at premium price.
11. Promoting local ethnic dishes made from specific landrace.

A Brief Idea on Exploratory Behavior of Animal

Tripti Kumari[1*], R.K Choudhary[2] and Cellina Gurung[3]

[1]Ph.D. Scholar, LPM Section, ICAR- ERS, NDRI Kalyani- 741235
[2]MVSc. Scholar, Veterinary Pathology, WBUAFS, Kolkata-700037
[3]Ph.D. Scholar, Veterinary Microbiology, WBUAFS, Kolkata-700037
** Corresponding Author - triptilpm@gmail.com*

- Also termed as Investigatory behavior.
- It is an activity which has the potential for the individual to acquire new information about its environment.

Activity includes

1.Perception of the environment - Animal performs this activity by using its sensory organs (i.e., auditory, visual, olfactory, gustatory and tactile.

2. Gathers information - Animals collects the information with curiosity and awareness to new stimuli. Potential food sources and escape routes are two vital pieces of information.

3. Acquires experience - On the basis of its experiences animal become familiar with its novel environment and exploratory behavior subsides, but it reappears if any change in environment occurs.

Role

- It facilitates learning.
- An animal learns all the characteristic of its surrounding environment i.e., food, water, shelter, predators etc by exploring and remember its landmarks.

Learning occurs in a variety of ways

- Sometimes it is the result of direct observation of another
- Other times it is the result of experience through personal interactions with the environment.
- Responses to an environmental stimulus
- As a result of trial and error- it is a form of exploration of animal's own abilities. If the actions attempted by the animals are beneficial it is repeated. These actions are of great value as animal grows and matures.

Characteristics

It is a curiosity inducing stimuli.

Two major characteristics are-

1. They do not induce fear.
2. They are unfamiliar (either old object is in new setting or new object in old setting). The object itself may be large or small, animate or inanimate, moving or stationary; it matters little , so long as fear is not induced.

SOME IMPORTANT POINTS

- Exploration and fear both are overlapping categories.
- There are very little demarcation between exploration and fear.
- Magnitude of the stimulus decide the exploratory behavior.
- Low level of stimulus elicit exploration whereas high level elicit fear with the threshold between the two responses depending upon the animal's internal state.
- Too slow responses in a novel environment can lead to loss of opportunity (e.g.:- loss of food) and too fast responses can lead to danger (e.g.:- predation).
- Animal spend time exploring their environment in identifying food and water.
- Hungary animals explore before feeding and animals will even explore when recently eaten and drunk and not in mating condition.

FACTORS AFFECTING EXPLORATORY BEHAVIOR

1. Species – Cattle, pigs, horses and dairy goats are highly curious to investigate any strange object, approach carefully, slowly sniffing and looking as they approach. Sheep are less curious and more timid.
2. Age – The expression of exploratory behavior is inversely related to age. It increases up to one year of age and thereafter decreases. Older animals are more familiar with most of the objects in their environment. So, they are less curious and exploratory behavior than younger animal.
3. Past experiences- On the basis of past experiences, animals have a strong internal motivational state for exploration. Prior experiences of similar environment influences cattle, sheep and horses to explore extensively.
4. Hormones – It may influence the exploration.
5. Housing effects- It may modify calf exploratory behavior. Calves from a single pen system have a greater tendency to approach a novel stimulus than the calves from the group housing system.

Some examples of exploratory activities

- Interaction with inanimate environment i.e., environmental testing and investigation : like,
  - Horning of trees, bushes and turf, scrapping earth and snow
  - Nosing artifacts closely to sniff and to touch with the upper lip
  - Rooting into soil and bedding
  - Head pressing on fenced perimeters for movability

- Licking hard surfaces and
- Overseeing from vantage points.

Exploratory Behavior of Cattle

- It is affected as long as emotions of fear are not present.
- If fear is not induced, the animal approaches the strange object cautiously with forehead parallel to the ground, ears up and aimed forward, and eyes fixed on the object.
- The posture resembles the submissive posture, except that when an animal is investigating it sniffs and nostrils quiver.
- When the object is reached , sniffing is replaced by licking.
- If the object is small and pliable, the animal may take it up and chew it and swallow it.
- This kind of exploratory behavior of cattle is often induced by the sight of familiar objects in an unfamiliar surroundings and vice – versa.
- The size and nature of the object in which the animal has become interested , determines the speed of approach.
- Most dominant cattle in herds are the most exploratory.

Exploratory Behavior of Sheep

- When sheep explore any new field they pay most attention to the field boundaries.
- They bunched in a closer intra-group spatial organization than usual. In small pastures which permit overall vision, the group disperses quickly and adopts the extensive grazing system.
- In large pastures, several days or weeks may elapse before part of it has been explored by all the stock.
- In tall grass or land in which there are obstructions to view, sheep may explore far from their point of input.
- Some breeds of sheep such as, Dorset - shows little exploration, while, Landrace - shows more exploration
- In temperate conditions, a flock will set out into the pasture, moving together and then fanning out.
- Although they may move some distance from each other, they often form subgroups within the main flock and continue to exist as a concerted group, following a routine of movement around the grazing land.
- Lambs raised in a social environment respond to novel situations by actively searching the area and interacting with the stimulus.
- But isolated reared lambs reared in socially deprived environments attempts to avoid the stressful situation by showing withdrawal behavior.

ADVANTAGES

Learning in young animals by exploring is helpful and important in its adult life.
For example :- Drinking milk from a bucket, mounting behavior during copulation, eating concentrates from an out of parlor feeder, responding to a feed out wagon, milk let down during milking as well as responding to a handler.

DISADVANTAGES

- Incomplete exploration lead to abnormal exploratory activities. It is a poor basis for adaptation.
- Exploratory deficits results two factors- 1. Cognitive deficits and 2. Associated fearfulness which creates stress in various demanding husbandry situations.

CONCLUSION

Exploratory behavior is provoked by the interaction of the state of the nervous system of the animal and the stimuli impinging upon its sense organs. It is terminated once the animal is acquainted with a formerly novel environment. Thus, it is an essential feature of an animal's behavioral strategy for survival.

Management of Heat Stress in Dairy Cattle

Tripti Kumari[1*], S. Pan[2], Champak Bhakat[3] and R. K. Choudhary[4]

[1]Ph.D Scholar, [3]Principal Scientist, Department of Livestock Production and Management, Eastern Regional Station, National Dairy Research Institute, Kalyani- 741235 (W.B)
[2]Professor, Department of Livestock Production and Management, [4]M.V.Sc Scholar, Department of Veterinary Pathology, West Bengal University of Animal and Fishery Sciences, Kolkata- 700037
***Corresponding Author: triptilpm@gmail.com*

Heat stress is a natural phenomenon that affects dairy cows severely during the summer months. Heat and humidity during the summer months combine to make very uncomfortable environment for dairy cows. The thermo-neutral zone of dairy cows ranges from just above zero to 22°C, above this critical temperature (combined with humidity) cows begin to alter their basal metabolism and metabolic rate which negatively impacts a variety of dairy parameters including milk yield and reproduction and therefore is a significant financial burden. But heat stress can be reduced by providing proper management at farm.

Management of heat stress

Three types of management can be done to reduce the heat stress in dairy cattle-
1. General management :- It can be done by
(A) Cooling method by reducing ambient air temperature
(B) Increasing cow's natural heat loss mechanism and
(C) Maximizing water availability .
2. Housing management :- It can be done by providing typical shade structure.
3. Nutritional /Feeding management: - It can be done by providing proper nutrients in appropriate amount to the heat stressed animal.

1. General Management- (A) Cooling method

It can be done by reducing ambient air temperature through Misters, High Pressure Foggers, Evaporative Cooling Pads and Fans.

Misters

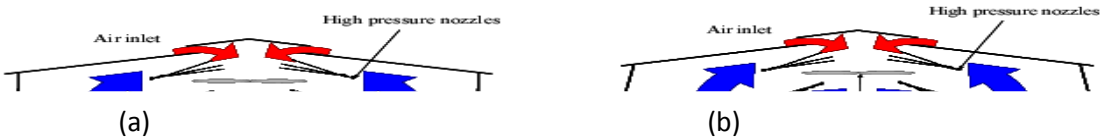
- ✓ Misters under the shade in the loafing area should be used in conjunction with fans, at 8 to 9 feet above grade and oriented down at about 30 degrees, so that the water is blown on to the

cows.

- ✓ The objective of misters is not to cool the air, but to
- ✓ put water on the cows where its evaporation provides the cooling.
- ✓ Bunk line misters should be oriented over the cows, and water volumes must be low enough to prevent slick conditions at the bunks. Bunk line misters are seldom required at night. Cattle in freelot can be provided this. There should be roof peak opening and sides of the wall opened to provide free flow of air through covered area.
- ❖ It is being practiced in the foreign countries.

High Pressure Foggers

- ✓ It is based on spraying the water as small droplets (in the fog range, 2-60 μm in diameter) in order to increase the water surface in contact with the air. Fog droplets can be generated by several methods, but using the high pressure nozzles is the most economic. The efficiency of this system can be increased by full or partial control of the air movement and circulation through the building.
- ✓ It is technically difficult, because of fine nozzles, per 1°C cooling, relative humidity increases by 5%.



Schematic view of the prepared system (a) Forced ventillation and (b) Natural ventillation

Evaporative cooling pad and fan

- ✓ It is based on forcing outside air into the building through a wet pad, which humidifies and cools it only at the entrance, where the wet pad is situated.

*In Indian condition gunny bag is used as pad.

Cooling livestock buildings by Pad and Fan Evaporative Cooling System (Pad Cooling)

(B) Enhancing the cow's natural mechanism of heat loss

I. Sprinkler and Fan Cooling Systems (Direct Evaporative Cooling)
II. Wallowing
III. Sprayers in Parlour exit lanes

I. Sprinkler and Fan Cooling Systems (Direct Evaporative Cooling)

(a) <u>Sprinkler Cooling Systems</u>

- ✓ Sprinkling (not misting) the cow with water to fully wet her body and using fans to evaporate the water cools the cow and encourages greater feed intake and milk production.
- ✓ Research shows an 11 % increase in milk yield when cows were cooled with fans and sprinklers compared with shading alone.
- ✓ Sprinklers and fans are usually placed next to the feed bunk so that the feeding area is the coolest place on the farm, helping to encourage greater feed intake.

(b) <u>Fan Cooling Systems</u>

- ✓ The use of fans, particularly in areas of poor ventilation, is generally considered beneficial in preventing cows from becoming hot.
- ✓ Supporting ventillation (a) required at air speeds <1m/s (b) highest cooling effect at 2.5 m/s air speed; harmless up to 5m/s.
- ✓ One particularly critical housing area is the crowd pen prior e milking parlor. Heat stress can occur here at relatively low environmental temperatures due to crowding. This area should have sufficient fans and misters to assure an air turnover of up to 1000 cubic feet per minute per cow.

II. Wallowing

- ✓ Wallowing is the cheapest and least laborious device to beat the heat in summer. Buffaloes are made to wallow in clusters in ponds, rivers, tanks or other water bodies for hours together.
- ✓ Wallowing is an important route of heat loss in view of the labile body temperature which enables the animal to store body temperature.
- ✓ During wallowing rectal temperature decreases gradually but falls abruptly after the buffaloes leave the water. Wallowing becomes more effective if buffaloes remain in shade after getting out of water. This device is more effective than showering, but

wallowing in dirty stagnant water exposes the animal to bacterial and parasitic invasions. Wallowing is more economical due to limited recurring expenditure and increase in milk production in comparison to shower.

III. Sprayers in Parlour exit lanes

- ✓ Cows should have access to fresh water at the parlor exit even if water is available in the pens. In addition, cow activated showers as the cows walk back to their pens, have been effective at reducing heat stress
- ❖ Only deliver enough water to wet the cow.

(C) Maximizing water availability

- ✓ It should be available as fresh and clean. Cool water should be provided during the summer months.
- ✓ Drinking water three-four times a day is a need in summer months in general farm practice.

2. HOUSING MANAGEMENT

Typical shade structure-

- ➢ The effect of shades on performance of dairy cows in dry lots demonstrate increased DMI and milk production from cows provided with shades in the loafing area.
- ➢ Cows provided with shades in the loafing area are less hot (i.e., their body temperatures are lower) and that they feel less hot (i.e., their respiration rate is lower).
- ➢ Shaded cows also produced more milk and had fewer services per conception than unshaded cows.

(i) Natural shade

(ii) Artificial shade - (a) Portable Shade (b) Permanent Shade Struc

(i) Natural shade

- ✓ Trees are an excellent source of shade and if given the choice cows will generally seek the protection of trees rather than man-made structures. They are not only effective blockers of solar radiation but the evaporation of moisture from leaf surfaces cools the surrounding air without appreciably interfering with air circulation.

(ii) Artificial Shade

(a) Portable shades

- These shades should be oriented in a North/South direction, provide about 40 to 45 square feet of shade per cow, and be about 12 to 13 feet high. There should be a raised dirt mound under the shades to prevent accumulation of moisture, and it should be groomed regularly.

- Mesh shadecloth is lightweight, available in numerous sizes can be used in portable installations.
- Most studies on shade have used solid roof structures although shade cloths, such as woven polypropylene, provide about 80 to 85% as much shading and are considerably less expensive.


Portable sheds

(b) Permanent Shade Structures

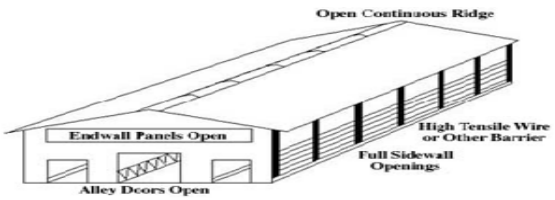
1) Shade structures of 40 feet or less require a minimum eave height of 12 feet. Structures widerthan 40 feet should have eave heights of 16 feet.

2) There should be at least 50 feet of clearance between adjacent buildings or other obstructions.

3) Gable roofs should have at least a 4:12 slope (6:12 is acceptable but difficult to work on) and a continuous open ridge. Ridge caps if desired should have a minimum of 1 foot of clearance between it and the roof peak.

4) Ridge openings should be a minimum of 1 foot wide plus 2 inches for each 10 feet of structure width over 20 feet.

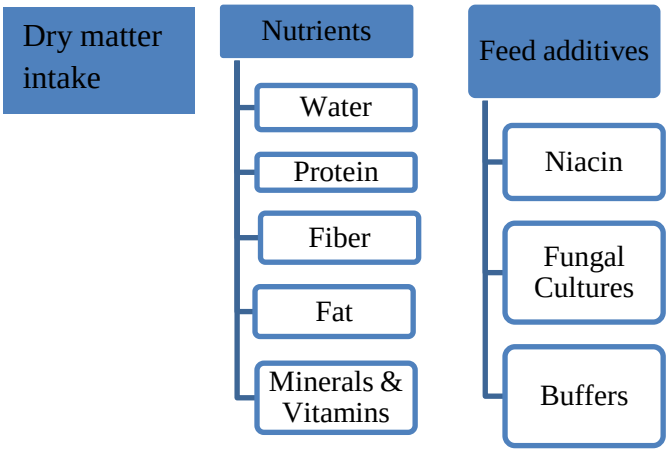
5) Painting metal roofs white and adding insulation directly beneath the roofing will reflect and insulate from effects of solar radiation and will reduce thermal radiation on cows.

Permanent Shed Structures

3. Nutritional /Feeding management

It includes:



- Energy is a critical nutrient during heat stress. The diet must be made more energy dense to provide sufficient energy to maintain milk yield.
- Increasing the energy in the diet can be achieved by increasing concentrates (grains) and decreasing forages in the diet. However increasing concentrates to greater than 55 to 60% of the diet dry matter is risky and can result in depressed milk fat content, acidosis, off-feed, laminitis, and reduced efficiency of nutrient use.
- Added dietary fat is an excellent way to increase energy content of the diet, especially during summer when feed intake is depressed.
- Fat is high in energy (about 2.25 times as much as carbohydrate), does not add starch to the diet (minimizing rumen acidosis), and may reduce heat load in summer. Added dietary fat often boosts milk fat.
- Minerals play a very important role in reducing heat stress.
- Care should be taken to supplement extra minerals

Nutrients	**Change and dietary concentration (DM basis)**
Energy	Increase to compensate for reduced DMI. A .80 Mcal NE_L per pound is probably the maximum that can be obtained with adequate fiber levels.
Fat	Added amount should not exceed 4%. Strategy suggested is add 1 lb from animal, 1 lb from vegetable and a final 1 lb from a rumen inert source.
Protein	Meet overall CP requirement by adjusting concentration as needed. Use a combination of rumen degradable and undegradable sources achieving a rumen undegradable level of 36 to 40% of CP.
Sodium	Increase using buffers to .45 to .55.
Potassium	Increase to 1.2% or more. High quality alfalfa is a good source.

Salt	Feed 3 to 4 ounces per cow per day.
Chlorine	Minimum - .25%, maximum - .35%.
DCAB (Dietary cation-anion balance)	Na + K - Cl ~ 35 to 45 meq/100g DM(Na + K) - (Cl + S) ~ 25 to 35 meq/100g DM
Magnesium	Increase to between .3 and .35%.
Niacin	6 g per cow per day
Aspergillus *oryzae*	3 g per cow per day

CONCLUSION

Heat stress is one of the most important factor to be considered in dairy cattle during summer months. It is one of the leading causes of decreased production and fertility in the animals during hot environment. It severely affects the animals which signifies really a challenge to livestock sector. However some heat stress is unavoidable, but effects can be minimized if certain management practices are followed regarding cooling of animals and temperature inside the shed, housing and feeding. Hence by the implementation of appropriate strategies with proper management at farm, the negative effect due to heat stress in dairy cattle can be alleviated.

Natural dyes: importance and its uses in food and fabric industry

Amit Lohar, Raghupathi B*, Jayoti Majumder and Abhishek Mangrati

Dept. of Floriculture and Landscape Architecture, Faculty of Horticulture,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia (Dist), West Bengal-74125
**Corresponding author: raghuabrhortico@gmail.com*

Natural dyes are known for their use in colouring of food substrate, leather as well as natural protein fibres like wool, silk and cotton as major areas of application since pre-historic times. The use of non-allergic, non-toxic and eco-friendly natural dyes on textiles have become a matter of significant importance due to the increased environmental awareness in order to avoid some hazardous synthetic dyes. However, worldwide the use of natural dyes for the coloration of textiles has mainly been confined to artisan/craftsman, small scale/cottage level dyers and printers as well as to small scale exporters and producers dealing with high-valued eco-friendly textile production and sales. (Samanta & Agarwal, 2009; Bechtold & Mussak, 2009; Vankar, 2007). Natural dyes have a wide range of shades that can be obtained from various parts of plants, including roots, bark, leaves, flowers and fruits (Allen, 1971). Since the advent of widely available and cheaper synthetic dyes in 1856 having moderate to excellent colour fastness properties, the use of natural dyes having poor to moderate wash and light fastness has declined to a great extent. However, recently there has been revival of the growing interest on the application of natural dyes on natural fibers due to worldwide environmental consciousness (Samanta & Agarwal, 2009). Although this ancient art of dyeing with natural dyeing with natural dyes withstood the ravages of time, a rapid decline in natural dyeing continued due to the wide available of synthetic dyes at an economical price. However, even after a century, the use of natural dyes never erodes completely and they are still being used. Thus, natural dyeing of different textiles and leathers has been continued mainly in the decentralized sector for specialty products along with the use of synthetic dyes in the large scale sector for general textiles owing to the specific advantages and limitations of both natural dyes and synthetic dyes small textile export houses have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes (Glover & Pierce, 1993). Natural dyes produce very uncommon, soothing and soft shades as compared to synthetic dyes. On the other hand, synthetic dyes are widely available at an economical price and produce a wide variety of colours; these dyes however produce skin allergy, toxic wastes and other harmfulness to human body.

SOURCE OF NATURAL DYES

There are different sources of natural dyes. Natural dyes of plants, minerals and animal sources are fascinating beautiful and sometimes they challenge the wits of researchers and educators. Most of them produce very colourful effects that are so amazing to be hold. Natural colours are beautiful to be hold. Colouring matter extracted from the roots, stems, leaves or barriers and flowers of various plants have various expectations.

Plant Dyes

The roots, nuts and flowers of plant that grow in our back yards are all sources of colouring pigments and dyes. Most natural dyes come from such parts of plants that back berries, flowers, leaves and roots while the use of seeds fruits and young shoots as other source of natural dyes. The outer, inner bark and heart wood of trees also produce. The existence over 1000 sources of plants based dyes that were used across the word until the early 1900s included in these vast arrays of dyes yielding plants are the following. Henna (orange-red) - from leave of henna plants, Carechu (brown) - from resin (sticky substance from plant of acacia tree, Fustic (yellow)-from the wood of the fustic tree, Indigo ($C_{16}H_{10}N_2O_2$ (blue)-from leaves and stems of the indigo plant, Logwood (black)- from the core (heart) of the log wood tree, Turmeric (violet) -from the roots the turmeric plant and Saffron (yellow) - from stigmas of the common crocus are the common ones.

Animal Dyes

Red animal dyes derived from certain species of tiny scale insects known as co-chi-near that fed on red cactus berries. The insects can be gathered by hand and ground in to pigment. Major sources of animal dyes are: Cochineal (red) - from bodies of cochineal insects and Tyriam purple or crimson-from the bodies of same textile of marine snails.

Mineral dyes

Derive from coloured clays and earth oxide; Chrom green-from a compound of chromium and oxygen, Chrom red -from from a compound of chromium and lead, Chrom yellow-from a compound of chromic acid and lead and Prussion blue-from a compound of iron and cyanide.

Table 1: Natural Dye consumption state-wise (Singh et.al 2015)

Sl. No.	State	No. Of artisans engaged	Expected length of cloths dyed m/yr	Qnty. of dye used (Ton)	Requirement of raw material (Ton)
1	Andhra Pradesh	350	10.50	52.50	2620
2.	Orissa	550	16.50	82.50	4120
3.	Assam	600	18.00	105.00	5250
4.	Arunachal Pradesh	400	12.00	75.00	3750
5.	Manipur	300	9.00	45.00	2250
6.	Meghalaya	300	9.00	45.00	2250

7.	Rajasthan	1000	30.00	150.00	7500
8.	Karnataka	400	12.00	60.00	3000
9.	Himachal Pradesh	250	7.50	37.50	1870
10.	Uttaranchal	150	4.50	22.50	1120
Total		**4300**	**127.00**	**675.00**	**33730**

SOME IMPORTANT PLANT PIGMENTS

Carotenoids: are yellow, orange, or red pigments synthesized by many plants, fungi, and bacteria. In plants, carotenoids can occur in roots, stems, leaves, flowers, and fruits. Within a plant cell, carotenoids are found in the membranes of plastids, organelles surrounded by characteristic double membranes. Chloroplasts are the most important type of plastid and they synthesize and store carotenoids as well as perform photosynthesis. Two of the best known carotenoids are Beta-carotene and lycopene. Beta-carotene gives carrots, sweet potatoes, and other vegetables their orange color. Lycopene gives tomatoes their red color. When a human eats carrots or other foods containing carotenoids, the liver splits the carotenoid molecule in half to create two molecules of vitamin-A, an essential micro-nutrient

Anthocyanins: are water-soluble scarlet, magenta, purple and blue pigments that colour the fruit and flowers of many plants. They also provide the red colours of many autumn leaves. They are flavonoids, formed by phenylpropanoid metabolism from phenylalanine. In addition to colouring specific plant organs, often to attract pollinators and dispersers, they may serve to protect photosynthetic tissues from oxidative stress induced by light under stressful conditions. They are synthesised by gymnosperms and most angiosperms except the Caryophyllales (beets, cacti, *Bougainvillia, Amaranthus*), which synthesise the unrelated betalain pigments from tyrosine instead.

Chlorophyll: is any of several closely related green pigments found in cyanobacteria and the chloroplasts of algae and plants. Chlorophyll is essential in photosynthesis, allowing plants to absorb energy from light. Chlorophyll absorbs light most strongly in the blue portion of the electromagnetic spectrum, followed by the red portion. Conversely, it is a poor absorber of green and near-green portions of the spectrum, which it reflects, producing the green color of chlorophyll-containing tissues.

Betalains: are a class of red and yellow indole-derived pigments found in plants of the Caryophyllales, where they replace anthocyanin pigments. Betalains also occur in some higher order fungi. They are most often noticeable in the petals of flowers, but may colour the fruits, leaves, stems, and roots of plants that contain them. They include pigments such as those found in beets. Betacyanins, Betacyanidins and Betaxanthins

- Betacyanins- reddish to violet hues, but lack bluer
- Betaxanthins- yellows
- Betacyanidins- reds and purples

Table 2: Sources of natural food colours, pigments and their applications

Colour	Source	Applications/uses
Natural green and green	Celery, collard greens, sea vegetables, green beans, peas, green olives, parsley, spinach, green turnips, asparagus, bell peppers, broccoli, Brussels sprouts,green cabbage, barley and other herbs	Pastas, confectionery, medicines, processed food, vegetable oils, spice preparations, ice cream and colouring materials
Natural orange	Mushrooms	Tanning pills, fruit-spreads, candies, syrups, sauces and carbonated drinks
Yellow and red	Gardenia	Confectionery, agricultural products and processed marine products
Yellow–orange	Vegetables	Baby foods, sauces, processed cheese and fruit drinks
Orange–yellow	Turmeric	Food products, cosmetic and pharmaceutical products
Greenish yellow to yellow	Stinging nettle	Ice cream, delicatessen, baked goods, fruit preparations, and foods such as nettle soup and nettle cheese
Red	Red-fleshed potato	Colorant used as an additive to foods tuffs, beverages, pharmaceuticals, toiletries, etc
Bright red, purple	Hibiscus	Soft drinks and alcoholic beverages

EXTRACTION OF DYE

The collected plant materials were shade dried until the moisture was reduced to below 3 percent. The dried plants were grinded and sieved to obtain the fine powder. The dyes from the plants were extracted by preparing the methanolic extract of the powdered sample (5gm in 25ml of methanol) and the extraction process was carried out in a soxhlet apparatus at 80-85°C for 1hr in 1lt capacity flask. After extraction, the extract was filtered and led to evaporate the solvent leaving the dye behind. The starch content present in the fabrics was removed by scouring. The fabrics to be scoured were pre-weighed. Soda ash was weighed equal to the 2% of the weight of the fabric and detergent at 5.5% of the weight of fabric. The salts were added to warm water and stirred well. The pre-weighed fabric was added and stirred further for about 20-30 mins holding the temperature at 85°C. Mordanting of the fabrics was performed using alum acetate/acetic acid equal to 5% of weight of the fabric (liquor ratio 1:40). The mordant bath was maintained at a temperature of 30°C for The fabrics were added with a further increase in temperature to 80°C. The temperature was maintained with continuous stirring for about 45mins. Then the fabrics were removed from the dye bath and washed gently in Sodium Lauryl Sulphate (SLS). Finally the dyed fabrics were dried and stretched. Tiwari and Vankar (2007) carried out standardisation and optimisation of dye extraction of Terminalia arjuna bark. The dyeability of aqueous extract was

evaluated for dyeing cotton fabric. Dyed cotton fabric shows good fastness properties and evaluated as commercially viable natural dye Source.

Table 3: Some promising natural dye sources

Sl.No.	Common name	Botanical name	Part used	Colour obtained
1	Siam weeds	*Eupatorium odoratum*	Whole plant	Yellow
2	Goat weed	*Ageratum conyzoides*	Whole plant	Yellow
3	Jack fruit tree	*Atrocarpus heterophyllus*	Bark	Yellow
4	Gulmohar	*Delonix regia*	Flower	Olive green
5	Teak	*Tectona grandis*	Leaves	Yellow
6	Babool	*Acacia nilotica*	Leaves, bark	Yellow/brown
7	Water lilly	*Nymphaea alba*	Rhizomes	Blue
8	Dahlia	*Dahlia variabilis*	Flowers	Orange
9	Amla	*Emblica officinalis*	Bark, fruit	Grey
10	Indian Jujube Ber	*Ziziphus mauritiana*	Leaf	Pink
11	Drumstick	*Moringa pterygosperma*	Leaf	Yellow
12	African tulip tree	*Spathodeacompanulata*	Flower	Yellow/orange
13	Tamarind	*Tamarindus indica*	Leaves, seeds	Yellow, brown
14	Eucalyptus	*Eucalyptus camaldulensis*	Bark	Yellow and brown
15	Red sandalwood	*Pterocarpus santalinus*	Wood	Red

ADVANTAGES OF NATURAL DYES/ COLORANTS

1. The shades produced by natural dyes/colorants are usually soft, lustrous and soothing to the human eye.
2. Natural dyestuff can produce a wide range of colours by mix and match system. A small variation in the dyeing technique or the use of different mordants with the same dye (polygenetic type natural dye) can shift the colours to a wide range or create totally new colours, which are not easily possible with synthetic dyestuffs.
3. Natural dyestuffs produce rare colour ideas and are automatically harmonizing.
4. Unlike non-renewable basic raw materials for synthetic dyes, the natural dyes are usually renewable, being agro-renewable/vegetable based and at the same time biodegradable.
5. In some cases like harda, indigo *etc.,* the waste in the process becomes an ideal fertilizer for use in agricultural fields. Therefore, no disposal problem of this natural waste.
6. Many plants thrive on wastelands. Thus, wasteland utilization is an added merit of the natural dyes. Dyes like madder grow as host in tea gardens. So there is no additional cost or effort required to grow it.

7. This is a labour intensive industry, thereby providing job opportunities for all those engaged in cultivation, extraction and application of these dyes on textile/food/leather etc.
8. Application of natural dyes has potential to earn carbon credit by reducing consumption of fossil fuel (petroleum) based synthetic dyes.

DISADVANTAGES OF NATURAL DYES/COLORANTS

1. It is difficult to reproduce shades by using natural dyes/colorants, as these agro products vary from one crop season to another crop season, place to place and species to species, maturity period etc.
2. It is difficult to standardize a recipe for the use of natural dyes, as the natural dyeing process and its colour development depends not only on colour component but also on materials.
3. Natural dyeing requires skilled workmanship and is therefore expensive. Low colour yield of source natural dyes thus necessitates the use of more dyestuffs, larger dyeing time and excess cost for mordants and mordanting.
4. Scientific backup of a large part of the science involved in natural dyeing is still need to be explored.
5. Lack of availability of precise technical knowledge on extraction and dyeing techniques.
6. The dyed textile may change colour when exposed to the sun, sweat and air.
7. Nearly all-natural dyes with a few exceptions require the use of mordants to fix them on to the textile substrate. While dyeing, a substantial portion of the mordant remains un exhausted in the residual dye bath and may pose serious effluent disposal problem.
8. With a few exceptions, most of the natural dyes are fugitive even when applied in conjunction with a mordant. Therefore, sometimes their colour fastness performance ratings are inadequate for modern textile usage.

Table 4: Plants Used on Fabric

Sl. No.	Name of plant	Botanical name	Code
1	Annatto	*Bixa orellana*	Bo
2	Kraman kote	*Sphenocentrum jollyanum*	Sj
3	Sobolo	*Hibiscus Sabdariffa*	Hs
4	Lalle	*Lawsonia inermis*	Li
5	Ayigbe mogya duro	*Pseudocedrela kotschyi*	Pk
6	Nim tree	*Azadirachta indica*	Ai
7	Bo womba gu woakyi	*Phyllanthus nuriri*	Pn
8	Camwood	*Baphia nitida*	S
9	Indian tamarind	*Tamarindus indica*	T
10	Onyama dua	*Alstonia booni*	Ab
11	Kumenini	*Lennea welwitschii*	Lw

12	Flamboyant fruit pods	*Delonix regia*	Dr
13	Sorghum leaves	*Sorghum bicolour*	Sb
14	Fresh mango leaves	*Mangnifera indica*	Mlf
15	Dried mango leaves	*Mangnifera indica*	Mld
16	Annatto	*Morinda lucida*	Ml
17	Mahogany	*Khaya senegalensis*	Ks
18	Fresh cashew leaves	*Anacardium occidentale*	Aof
19	Dry cashew leaves	*Anacardium occidentale*	Aod
20	Fresh teak leaves	*Tectona grandis*	Tgf

POTENTIAL USE IN INDUSTRIES

The natural dyes can be used for coloration of the product in food industry, pharmaceuticals industry, textile industry, leather industry, cosmetics industry.

Textile Industry - Dyes can be used for colouration of textile material like yarn, silk wool fabric and applied on the apparels. Common dyes used are annatto, indigo, harda kamala. Natural dyes are substantive and require a mordant to fix to the fabric. The Colours of Nature (TcoN) is one of only few remaining natural dyeing units in the world, entirely focused on an environmental friendly, vegetable dyeing process and research. The unit is specialized in the natural indigo fermentation Process. The products should be organic and grown without the use of pesticides and fertilizers. Production methods are environment-friendly and do not pollute the environment and practice water conservation. Water used is stored after each step of the dyeing process and recycled for agricultural use. Alum, a non-polluting mordant is only used to fix the colours. Materials which have beneficial effects like Tannin (mordant) - Powerful antiseptic, Turmeric - revitalises the skin; Indigo - Cooling sensation and relaxing are used in the dyeing process.)

Food And Confectionery Industry - Most common dye used for coloration of the edible items are annatto seeds, The water soluble extract are used for coloration of butter while oil soluble extract are used for colouration of ghee & ice cream, etc. Producers of confectionery, soft drinks, alcoholic beverages, salad dressings and dairy products are the most significant users of natural colorants. Currently 43 colorants are authorized as food additives by the Council of the European Union. Juices or extracts from some fruit and vegetables are used for colouring purposes. The Food preservatives have antagonistic activity against micro organisms. Norton reported that corn carotenoids inhibit the synthesis of aflatoxin by Aspergillus flavus (90%) and by most of the A. parasiticus (30%) strains. Quality control markers are anthocyanin profiles used to determine the quality of fruit jams like adulteration of black berry jams with straw berries by pellargonidin test. As nutritional supplements bio colurants possess “vegetable principles” (biological active source). These are sources for obtaining drug substances (biologically active) and many other natural compounds used in various industries such as food, pharmaceuticals, cosmetics, with important commercial value

.Carotenoids are also used as vitamin supplements, since β-carotene is the precursor of vitamin A.

Pharmaceutical and Therapeutic industry - Natural colorants also play an important role in human health because they contain some biologically active compounds, which possess a number of pharmacological properties like strong antioxidant, antimutagenic, anti-inflammatory and antiartheritic effect. Carotenoids also act as biological antioxidants, protecting cells and tissues from the damaging effects of free radicals and singlet oxygen and also as a good source of anti-tumor agent. Grape seed extract is the primary commercial source of a group of powerful antioxidants known as oligomeric proanthocyanidins (OPCs), also generically called pycnogenol, a class of flavonoids. Also bio colourants are used to colour pills and tonics.

Cosmetic industry - Dyes derived from plants like Bixa orellana and Lithospermum erythrorhizon serves as sources for colouring lipstick and eye shadow liners

Leather industry - Vegetable tannin are used for tanning the leather, Walnut bark, eucalyptus bark, turmeric rhizomes and tea leaves commonly used, confined to cottage and small-scale leather units while large units use Chrome Tanning.

Table 5: Some Common Natural Dyestuffs Obtained From Different Crops Origin

Part of the Plant	Dyestuffs
Root	Turmeric, Madder (Manjistha), Onions, Beet-root
Bark/ Branches	Purple bark, Sappan wood, Shillicorai, Khair, Red bark, Sandalwood
Leaf	Indigo, Henna, Eucalyptus, Tea, Cardamon, Coral Jasmine, Lemon Grass
Flowers (Petals)	Marigold, Dahlia, Tesu, Kusum
Fruits/Seeds	Latkan, Pomegranate rind, Beetle nut, Myrobolan (Harda)

CONCLUSION

Natural dyes are more constructive, eco friendly, renewable, cost efficient and observed harmless with soothing effect. They have various medicinal properties. Due to nontoxic, non-carcinogenic, and non-allergic nature it is popular among natives for dyeing textile, paper, cosmetics, and food. Hence to fill demand-supply gap of colour bearing plant production necessarily improved. Ultimately, natural dyes may be beneficial to medicinal, and environmental /synthetic chemistry and enhance the severance to society for it large scale production and reducing pollution problems by synthetic dyes. Hence, recent years have seen renewed interest in dyes that are derived from natural sources.

FUTURE THRUST

Optimization of the selection, cultivation and extraction process of the major “historical” dye plants, improving the quality and yield of natural dye substances is likely by understanding the physiological and agronomic factors affecting the quality and yield factors plant. To improve the quality and yield by selection, conventional breeding, and by genetic manipulation and transformation is needed. We have to develop efficient

systems of dye plant production (e.g. nutrition, pest, weed and disease control, husbandry, suitable rotations and soil type. Researching "new" sources of natural dyes from local sources is necessary. Waste products from dye plant exploitation should be diverted for other uses, like food or timber.

REFERENCES

Agarwal, S. and Gupta, K. (2009). Optimization of dyeing conditions for natural dye madder

roots (Rubia cordifolia). Colourage, **10**: 43-46.

Bansal, S. and Sood, A. (2001). Development of vegetable dye on cotton from Eupatorium

leaves. Textile Magazine, **8**: 81-84.

Bechtold, T., Mahmud-Alia, A. and R, Mussaka. (2009). Natural dyes for textile dyeing: A comparison of methods to assess the quality of Canadian golden rod plant material. Dyes and Pigments, **2**: 287-293.

Baishya, D., Talukdar, J. and Sandhya, S. (2012). Cotton Dying with Natural Dye Extracted from Flower of Bottlebrush (Callistemon citrinus*).* Universal Journal of Environmental Research and Technology. **5**: 377-382.

Chandan, K. J., Ratan K., Venkat, K. S. and Devi, Rajeswari. V. (2015). Extraction of natural dye from marigold flower (*Tagetes erecta* L.) and dyeing of fabric and yarns: A focus on colorimetric analysis and fastness properties. School of Biosciences and Technology, VIT University, Vellore, Tamilnadu, India, **1**:185-195.

Cristea, G. Y. and Vilarem, S. J. (2003). Ultrasound assisted enhancement in natural dye extraction frombeetroot for industrial applications and natural dyeing of leather, Ultrason. Sonochem, **6**: 782-789.

Doe, H. T. and Desai, B. K. (1999). Dyeing of cotton and jute with tea as a natural dye. JSDC, **115**: 224-227.

Glover, B. and Pierce, J. H. (1993). Natural colorants good for your health. Journal of the Society of Dyers and Colourists, **109**: 5-7

Gulrajani, M. L. and Gupta, D. (1992). Natural dyes and their application to textiles.81-96

Jothi, D. (2008). Extraction of Natural Dyes from African Marigold Flower (*Tagates erecta* L) for Textile Coloration. AUTEX Journal, **2**: 49-53

Kale, S., Deodhar, S. and S. Naik. (2007). Pipal Bark extract - A natural colorant for wool dyeing. Colourage, **3**: 57-60.

Kumaresan, M., Palanisamy, P. N. and Kumar, P. E. (2011). Application of Eco-friendly Natural dye obtained from flower of Spathodea campanulata on silk using combination of mordants, Eur J Sci Res, **3**: 306- 312.

Kanchana, R., Fernandes, A., Bhat, B., Budkule, S. and Mohan, R. (2013). Dyeing of Textiles with Natural Dyes. International Journal of Chemical Tech Research, **8**: 806- 812.

Mathur, J. P., Mehta, A., Karnawat, R. and Bhandari, C. S. (2003). Use of neem bark as wool colourant-optimum conditions of wool dyeing. Indian Journal of Fibre and Textile Research, **1**: 94-99.

Padma, S., Vankar, L., Warjeet, S. and Vandana, T. (2007). International Dyer, **192**, 11-14

Singh, S. L., Ramananda, R. K. and Neema, M. (2015). Natural dyes - prospects for entrepreneurship, *International Journal of Chemical and Natural Science*, 2: 249-252

Samanta, A. K., Singhee, D. and Sethia, M. (2003). Application of single and mixture of Selected natural dyes on cotton fabric: A scientific approach. Colourage, **10**: 29-32