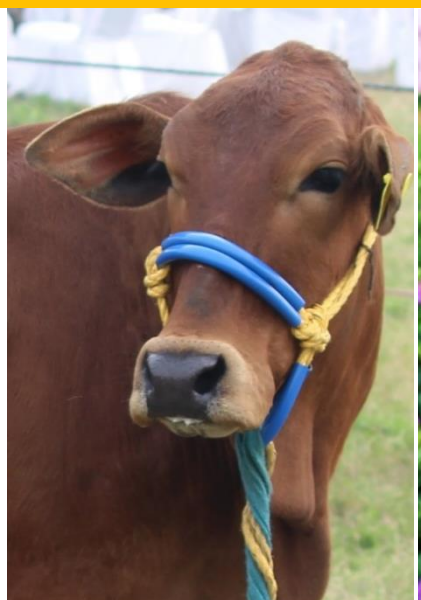
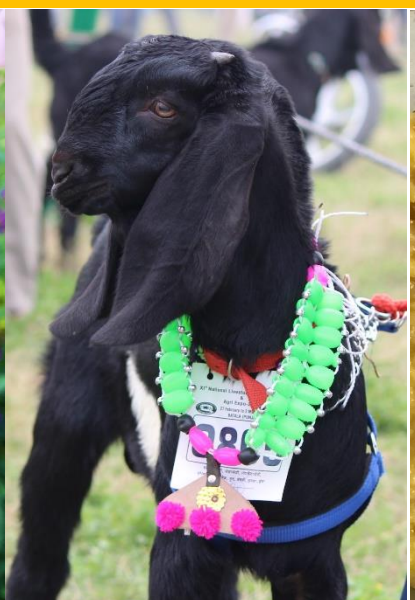
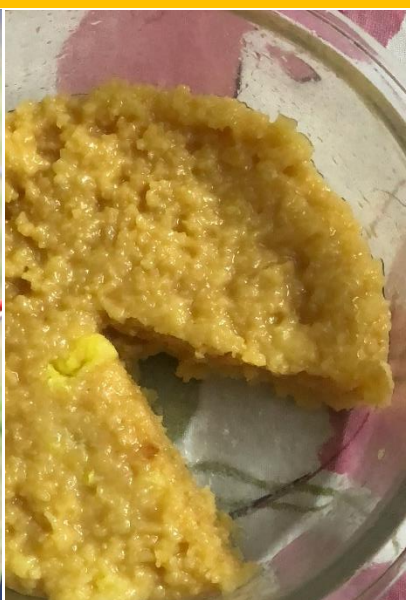
Bulletin No.1

# Scientific Interventions and Technology for Sustainable Livestock Production



Training Workshop on
Scientific Interventions and Technology for Sustainable Livestock Production

March 4, 2022

Directorate of Extension Education
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

and

Agricultural Technology Application Research Institute
Zone-1, Ludhiana

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# Feeding Management of Layers for Enhanced Productivity

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Punjab produces around 5638.8 million eggs per annum and per capita availability of eggs in the state is 203 (GADVASU Hand Book 2022). According to report published in The Hindustan Times on 26th March 2020 regarding the poultry crisis in Punjab due to COVID-19, there are less than 600 commercial layer farms in the state rearing nearly20 million improved strains of high egg producing layers besides 0.25 million eggs are also being produced from local breeds (Statistical Abstract, Punjab 2021). For the last year or so the price of feed ingredients has increased tremendously especially oilseed cakes e.g. Soybean meal. Moreover bigger players have installed huge bins for grain storage. Taking the advantage of essential commodity act, raw materials are being hoarded to exploit the situation. The egg prices are determined by demand & supply which keeps fluctuating due to season, days, festivals etc. At present most of the layer farmers are not satisfied with the prevailing price of eggs (Rs. 367/100) being offered as cost of production is becoming dearer (Rs. 445/100) @ 80% hen house production as on 01.03.22. This situation will become grimmer in coming days if Ukraine – Russia war continues as oil prices are already gone up and both these countries are major producers of wheat and mustard.

To economize the production cost, layer farmer are being advised / forced to change the feed formulation by so called consultants who regularly visit the farms especially for disease diagnose but are venturing unprofessionally in ration formulation. It is being reported that incidence of diseases, egg breakage, weak eggs and eggs infested with antibiotics are increasing. To make the feed cheaper, some agro byproducts are being overfed thereby compromising the quality of the feed and health of the birds. Certain layer farmers have stopped rearing birds or have reduced their production to minimize the losses. Layer ration is designed to optimize egg production in terms of egg number, egg size or egg mass. But most of the eggs available in market are under weight (< 55 g) as eggs are sold by number not by weight.

Once the bird starts laying eggs (around 20th week), layer feed is advocated which contains more energy, protein than grower feed especially calcium level as required for egg shell formation. Feeding programme that use only single feed formulation during the entire laying period is simple and easy to manage but costly. Therefore, BIS (2007) recommends phase feeding programme in two phases i.e. phase - I and phase - II. The concept of phase feeding was introduced by Dr. GF Combs (1960). Phase feeding is the feeding of layer birds in different phases to adjust their nutrient intake in accordance with the rate of egg production. Phase – I continues from 21st to 45th week and phase – II from 46th to 72nd week. Layer feed for phase – II contains less concentration of nutrients such as energy, protein and amino acids compared to that of phase – I, because feed intake increases with age and body weight. Phase feeding controls the feed intake and body weight of layers and thereby egg size also. Thus it minimizes the production cost. Some private players are advocating phase – III also of their strains (1st egg to 25th, 26th to 50th& 51st to 72nd week respectively).

**Phase – I**: This phase is most critical period. In this phase egg production increases from zero to peak (90-95%). Egg size increase from 40 to 56 g and the body weight of birds is also increased.

**Phase – II**: From 46th week, when bird's egg productivity starts declining below 90%, the protein level is reduced (16% CP) according to level of production to reduce the cost of production. If the older birds produce less than 75% hen house egg production, the protein content is further advised to reduce up to 15%.

Phase feeding refers essentially to reduction in the protein and amino acid levels of thediet as the bird progresses through a laying cycle. The concept of phase feeding is based on thefact that as birds get older and their feed intake increases, while their egg production decreases. Forthis reason, it should be economical to reduce the nutrient concentration of the diet. If nutrient density is to be reduced, this should not occurimmediately after peak egg numbers, but rather after peak egg mass has been achieved. There aretwo reasons for reducing the level of dietary protein and amino acids during the latter stages ofegg production, first, to reduce feed costs and secondly, to reduce egg size. The advantages ofthe first point are readily apparent if protein costs are high, but the advantages of the secondpoint are not so easily defined and will vary depending upon the price of eggs. When a produceris being paid a premium for extra large and jumbo eggs, there is no advantage to using a phasefeeding programme unless egg shell quality is a problem.

The appropriatereduction in protein level will depend on the season of the year (effect of temperature on feedconsumption), age and production of the bird, and energy level of the diet. Hence, it is necessarythat every flock be considered on an individual basis before a decision is made to reduce thelevel of dietary protein. As a guide, it is recommended that protein intake be reduced from17g/day to 16g/day after the birds have dropped to 80% production and to 15g/day after theyhave dropped to 70% production. With an average feed intake of 100 g/day, this would beequivalent to diets containing 17, 16 and 15% protein. It must be stressed that these valuesshould be used only as a guide after all other factors have been properly considered. If areduction in the level of protein is made and egg production drops, then the decrease in intakehas been too severe and it should be immediately increased. If, on the other hand, production isheld constant and egg size is not reduced then the decrease in protein intake has not been severeenough and it can be reduced still further. The amino acid to be considered in this exercise ismethionine, since this is the amino acid that has the greatest effect on egg size. Phase feeding ofphosphorus has also been recommended as a method of halting the decline in shell quality oftenseen with older birds. Using this technique, available phosphorus levels may be reduced fromapproximately 0.4% at peak production to slightly less than 0.3% at the end of lay.

**Calcium for Layer**

The major mineral required for egg shell quality is calcium. Thin egg shells are observedwhen calcium, phosphorus, zinc and vitamin D3 are not provided in diets at adequate levels. Layers need 3 – 3.5 gram of calcium per day from first egg throughout the laying period. Therecommended strategy is to feed a constant, modest level of calcium in the feed and to usecalcium grit (e.g. limestone or oyster shell) to provide the additional requirement. After peakproduction the feed intake is gradually reduced and by increasing the amount of calcium grit, thetotal amount of calcium per day from feed and grit can be secured. The metabolic requirementfor calcium occurs mainly during the night when the egg shell is formed. Feeding the additionalgrit in the afternoon can provide the bird with calcium during the night when it is needed most. Laying hens should have some portion of calcium available free-choice while calcium is beingadded to feed.

**Dietary Manipulation for Improvement of Egg Quality**

Nutritional quality of eggs is also affected by type of feed consumed by birds. Quality offeed can be enhanced by following dietary manipulation.

1. Egg yolk is considered one of the richest sources of cholesterol in human diet. Normalcholesterol content of eggs (about 200-250 mg) and blood (around 150mg %) in chickenhas been found to vary quite considerably. The cholesterol content of chicken egg can bereduced up to 25 % through the use of additives, dietary fibre and polyunsaturated fatty acid (PUFA) supplementation.

2. Omega-3 fatty acids have cardio protective and other beneficial effects. Poultrynutritionists have started research to incorporate more of these fatty acids in the egg andhave succeeded in developing such an egg called Omega-3 enriched ‘designer egg’. This egg can be called as the ‘diet egg’ or the ‘functional egg’.

3. Diet eggs can have a high percentage of Vitamin E, an antioxidant, which preventsoxidation of cholesterol and therefore its ill effects. These eggs may also contain 600 mgof Omega-3 fatty acids. Omega-3 fatty acids help to reduce cholesterol triglycerides, clogformation, tumor growth and improved immunity.

4. In order to improve the quality of these eggs further selenium, carotenoid pigments, etc. are also being increased in these eggs.

**Feeding of Breeding Stock**

A breeder diet should have proper level of energy and protein. Providing adequatevitamins in a breeding ration is very important. Vitamins may account for about 6% of the costof a breeder feed. Deficiencies of various trace elements and vitamins may lead to reducedhatchability and poor chick quality. The amount of feed required daily depends on the body size, the rate of production and atmospheric temperature. Breeder stocks must be prevented frombecoming fatty to maintain their optimum reproductive performances. Both male and femalebreeders should be placed on a breeder diet five to six weeks before saving hatching eggs.

Male weight and body condition are controlled by adjusting feed quantity so that a slowconstant increase in weight (30g/week) is achieved as the male grows older. After 30 weeks ofage, male’s weekly body weight gain should be approximately 30 grams when averaged over athree week period. Normally an adult cock consumes 130-160 grams feed daily. Bothunderfeeding and overfeeding of males are possible, and can cause problems. Underfeeding ismore common after 40 weeks of age. Cocks may appear dull and listless, having excess feather oss, reduced mating ability and vent color may become pale and overall there may be reducedfertility. Overfeeding of cocks leads to excessive breast development and excessive weightwhich can lead to injury of hen while mating, more stress on the cock’s joints and foot pads andreduced sex drive.

**Feeding of Back Yard Poultry**

The backyard poultry farming is more beneficial to small, marginal farmers and land lesslaborers. Backyard poultry farming generates small income for house hold requirement. Backyard poultry usually feed on household wastes, farm products and green vegetation,besides free scavenging for waste grains and insects. These birds can perform well with dietshigh in crude fiber. It has better feed efficiency even with diets containing low energy andprotein diets. During the process of scavenging on grass fields these

birds have an access toinsects, white ants, green grass, grass seeds, waste grains etc., thereby the supplemental feedrequirement is much less than those reared under intensive poultry farming. Feed supplementation in the form of scratch is usually given in the morning and eveningto develop habit to reach owner's place for laying eggs and for night shelter. Depending on theavailability of free range area and also the intensity of vegetation growth, the requirement ofsupplemental feed varies between 25-50 g/bird/day. Backyard birds can also perform well onwhole grain feeding under scavenging conditions. For better shell quality, shell grit or limestoneneeds to be supplemented at the rate of 5-7 g/bird/day during laying period. However, color ofegg yolk or even meat of the birds reared in this system becomes bright yellow or orange as birdscan get good amount of carotenoids from scavenging. Birds that get all their nutrients from scavenging may eat an excess of protein, if insects,worms, larvae etc. are available. Hence supplemental feeding of energy in the form ofcarbohydrate (cereal grains, etc.) is needed. Fenced or backyard poultry fed with household orgarden waste may lack both energy and protein for good growth or egg production. In such casessupplementation with energy sources, protein sources and micronutrients are required.

**Disease and Condition in Poultry due to Imbalance in Nutrition**

**Cannibalism**

It occurs in flocks due to deficiency of common salt of sodium and also due to deficiencyof crude fiber. If fiber free diet which contain less than 3% crude fiber is fed to chickencannibalism is more observed. Methionine deficiency also resultsin cannibalism. However, overalldeficiency of feed or nutrient(s) for some days can produce cannibalism in chicken.

**Fatty Liver and Kidney Syndrome (FLKS)**

The deficiency of biotin can lead to this condition in oldlayers. This condition ismost commonly seen in last phase of birds fed wheat based diet because wheat is deficient inbiotin. Pyruvate carboxylase enzyme is biotin dependent and due to its deficiency death is caused by hypoglycaemia due to failure of hepatic gluconeogenesis. This affects kidneys becausekidneys are vital organs having high energy demand and are affected adversely leading tocondition called as FLKS.

**Fatty Liver Haemorrhagic Syndrome (FLHS)**

This condition is accompanied by excessive accumulation of fat in the liver. The mainreason is low protein and high energy ration. Amino acid deficiency or their imbalance is alsoresponsible for this condition. Deficiency of lipotrophic factors is responsible. Certain mouldtoxins have also been reported as a cause of this condition. The lesions are excessive fat deposition in the liver with haemorrhage. This conditionmay be prevented by increasing the level (1-2%) of dietary protein supplementation with 50 g ofCuSO4, 500 g of choline, 3 mg of Vitamin B12, 500 I.U of Vitamin E and 500 g of methionineper 100 kg of ration.

**Cage Layer Fatigue and Bone Breakage in Layer**

High producing laying hens maintained in cages, sometimes show paralysis at peak eggproduction. The condition is caused by breakage of the vertebrae which subsequently affects thespinal cord. The reason is an impaired calcium mobilization due to high output of Ca through theegg shell. This condition is more common in caged birds; the birds reared on deep littersystem are rarely affected. It is because of the deficiency of exercise and the effects whichinfluence the metabolism of Ca. The condition

can be cured or prevented by increasing birds'exercise, reducing deposition of fat in the body and improving calcium metabolism by birds.

**Salt Poisoning**

The requirement of salt is very less in poultry as compared to other animals. The excessof salt either in water or in feed is toxic. The symptom of salt poisoning are watery droppings, increased water intake, muscular weakness, convulsion and death. On post mortem examination severe congestion and haemorrhages are observed in alimentary canal, liver, lungs, kidney andmuscles. The level of salt should not exceed 0.5% in ration and 3000 ppm in drinking water.

**Stress**

When reactive oxygen species (ROS) in the body deforms the lipid layers in cellmembranes and decreases the function of membranes, the susceptibility to infectionin the birds increase. The condition is called oxidative stress. Commercial strains are subjected to stress and this stress decreases the lymphocytesnumber and increase birds' susceptibility to diseases. ROS which are produced in body bynormal metabolic process are responsible for distraction of lipid layer in cell membrane thuscauses death of the cell. When antioxidants like vitamin E, vitamin C, vitamin A, carotenoids, Se, Cu, Zn and Mn is supplemented the ROS are neutralized by their antioxidant effects thatreduce the free radical damage to the cells and help in improving immunity, growth andproduction. It has been reported that the layers subjected to stress are benefited by inclusion ofvitamin E at higher concentration in diet. Vitamin E level of 20-50 mg/kg feed has been foundeffective. It also helps in preventing the rancidity of fat in the feed. When poultry feed containingoil, fat, rice polish or rice bran which are rich in unsaturated fatty acids are stored for long periodthe unsaturated fatty acids (UFA) are oxidized by oxidative rancidity. To protect UFA fromdestruction vitamin E or other antioxidants are necessary to be added in feed. To prevent such conditions, optimum level ofvitamin E should be included in poultry ration.

**Disease and Condition due to Vitamin Deficiency**

Vitamin deficiencies are most commonly due to inadvertent omission of a vitamin premixfrom the birds' diet. Multiple signs are therefore seen, although in general, problems withdeficiencies of the B vitamins appear first. Because there are some stores of fat-soluble vitaminsin the body, it often takes longer for these deficiencies to affect the bird. Treatment and prevention rely on an adequate dietary supply, usually microencapsulatedin gelatin or starch along with an antioxidant. Vitamin destruction in feeds is a factor of time, temperature, and humidity. For most feeds, vitamin efficiency is little affected over 2-monthstorage within mixed feed.

# Mozzarella Cheese Manufacturing

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India has emerged as a potential big market in terms of cheese consumption. Cheese market in India is largely untapped. Less than 0.1% of the total milk production is utilized for cheese making. Since, there is a rising saturation in Europe and North America cheese markets, therefore, current major importers of cheese are Japan and Russia, and developing markets like India. In India, Cheese industry is in its nascent stages but growing very fast as compared to global cheese market showing its potential. Rising disposable incomes, ambitious growth plans of organised food service outlets and cafe chains viz. Domino's, Pizza Hut , McDonald's, Cafe coffee day and growth in demands of western style fast foods in hotels, restaurants, caterers and household level are driving the growth of formal cheese market in India as well as Punjab.

Punjab is one of the leading milk producing state in India with annual milk production of more than 10 million tonnes. Cheese being a popular product may be a lucrative option for value addition due to its rising demand.

Among cheese, Mozzarella cheese is a highly popular variety prepared from cows' milk all over the world but buffalo milk is considered ideal for its preparation due to better yield, flavour and functional characteristcics.

Mozzarella cheese was originally manufactured from high fat buffalo milk in the Battipaglia

Region of Italy, but it is now made all over Italy, in other European countries and USA from cow milk. It belongs to the cheese classified as _pasta filata' which involves the principle of skillfully stretching the curd in hot water to get a smooth texture and grain in cheese. It is a soft, white unripened cheese which may be consumed shortly after manufacture. Its melting and stretching characteristics are highly appreciated in the manufacture of Pizza where it is a key ingredient. It forms strings (hence the term "string cheese") and become elastic in texture when heated due to which it is highly popular as a filling ingredient or as toppings in variety of snacks viz. fried snacks (samosas, patties etc.).

As per FSSAI, moisture in mozzarella cheese should not be more than 60% and milk on dry fat basis should not be less than 35%.

**Technology**

The technology of Mozzarella cheese manufacturing has been adopted, modified and standardized at Department of Dairy Technology and Experimental Dairy Plant of College of Dairy Science and Technology, GADVASU, Ludhiana. College of Dairy Science and Technology is manufacturing and selling mozzarella cheese from Experimental Dairy Plant.

The method of manufacture of Mozzarella cheese involves proper acidification of milk followed by coagulation using commercially available enzyme called rennet. After the curd is set, it is cut and cooked in whey at 36-40$^0$C to get proper consistency. Then the whey is drained and the curd is stretched and moulded in hot water to get desired stretch ability and melting characteristics in cheese.

- For mozzarella cheese making, fresh, clean, good quality milk preferably buffalo milk free from antibiotic or pesticides residues and off flavor should be accepted.
- Raw milk should be stored in Bulk milk cooler till the processing of milk starts. The purpose of storing the raw in Bulk Milk Cooler is to ensure the low temperature storage of milk preferably below 5 degrees centigrade to prevent any microbial growth in the milk.
- Raw milk should be tested for fat, SNF and acidity. Acidity of fresh raw milk received from the farms for mozzarella cheese making should be preferably 0.12-0.14% of lactic acid.
- Once the processing starts, milk is standardized to desired fat and SNF preferably 3.5-4% fat and 8.5-9% SNF to achieve a casein fat ratio of 0.69-0.70 for mozzarella cheese making. Standardization of milk for cheese making is carried out using skim milk. The standardization of milk is done to ensure optimum yield of the product and to achieve legal standards of moisture and fat content in final product.
- After standardization, milk is pasteurized at 65$^{o}$C for 30 minutes or 72 $^{o}$C for 15 seconds and chilled to 4-8$^{o}$C to destroy pathogenic and spoilage microorganisms in milk.
- Now the cheese milk is ready for mozzarella cheese making.
- The chilled pasteurized milk is acidified at this temperature i.e 4-8$^{o}$C with citric acid or any other suitable acidulant. The citric acid is added @ 0.325% or amount can be determined to attain the desired pH of 5.2-5.4 in chilled pasteurized acidified milk. The pH of acidified milk is the critical point in mozzarella cheese manufacturing as it is responsible for stretching property of the cheese. Therefore, pH should be maintained critically during the process with the help of pH meter.
- After acidification process, milk content is heated to 30-31 $^{o}$C.
- Rennet @ 13 mg/litre milk is added in the acidified milk. Rennet enzyme is responsible for the coagulation of milk and is the key ingredient in cheese making. Here we are using microbial originated rennet in powdered form. Before addition, rennet is diluted with approximately 40 times water and then added slowly with proper mixing.
- Then the milk is left undisturbed for setting (approx 15-20 min.).
- After 15-20 min, usually curd is set and can be checked using spatula or knife. Then the curd is cut. First, the horizontal curd knife is used through the length of the vat, followed by the vertical knife. The vertical knife is then used through the breadth of the vat too. The curd cubes are left undisturbed for few minutes to heal.
- After that, the curd is stirred slowly. At the same time, start increasing the temperature of the water in the jacket gradually at the rate of 5$^{o}$C/ min.. The stirring has to be continuous, or else, the curd cubes will cluster into a mass. Stop heating when temperature reaches 36-39 $^{o}$C. **This process is called cooking of the curd.** It usually takes 30-40 minutes. It should be carried out carefully as it ensures the whey removal from the curd which in turn affects yield, texture and final moisture content in cheese. For high moisture retention, curd are cooked to 36 degrees centrigrade and for low moisture retention curds can be heated upto 39 degrees centigrade. Continue stirring till the curd attains the right texture.
- Once cooking is completed, let the contents of the vat remain undisturbed for 5 min.

- The curd mass are pushed very gently towards the back of the vat with the ladles and the whey is allowed to drain through vat outlet. The cheese whey is highly rich in whey proteins and minerals and can be utilized for the preparation of whey cheeses and refreshing beverages.
- In mean time, hot water at 80-85 $^{o}$C should be prepared to stretch the curd. The curds are kneaded and stretched under hot water and usually curd: water should be 1:2.
- After stretching the curd is molded into desired shape normally spherical.
- The cheese spheres are placed in the brine tank of 20- 22% salt solution at 4 $^{o}$C for 1.5-2 hours depending upon the size of the balls. The brine solution is prepared beforehand by dissolving measured quantity of salt in clean potable water to attain 20-22% of brine strength. The salt solution is pasteurized at 85 – 90 degrees centigrade for 5 min followed by cooling and stored in refrigerated conditions to be used later for brining of cheese balls.
- After the brining is completed the balls are taken out from the brine solution and placed in racks for draining of extra moisture and drying.
- The dried balls are placed in suitable material and vacuum packed and stored in refrigerator at 4-5 degrees centrigrade or freezer at -18 degrees in case of long storage. Vacuum packaging of mozzarella cheese is high preferred for long shelf life.

  Mozzarella cheese is a highly popular cheese among all the age groups due to its beautiful stretching property and amazing flavor. **It** is very good source of protein which is approximately 22%, fat soluble vitamins like Vitamin A, D, E and K and minerals like calcium, etc.. The technology of mozzarella cheese manufacturing can be easily adopted by small dairy entrepreneurs with existing milk processing facilities.

# Shrimp farming in Inland Saline Waters

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The soil salinization is a global challenge, which has affected the agricultural productivity of more than 100 countries worldwide. Since, such lands are degraded and no more suitable for any profitable agricultural activity, it has snatched livelihood of many farmers, leaving them debt ridden despite having large landholdings. The lack of proper drainage facilities and intensive irrigation (with canal water) practices has led to severe water logging (water table rise) problems in these areas. Out of total 6.74 million ha salt affected (including coastal saline soil) areas in India, around 12 lakh ha is located in the non-coastal Indo-Gangetic plains of Northern India, including seven states viz, Punjab (1.51 lakh ha), Haryana (2.32 lakh ha), Rajasthan (3.75 lakh ha), Bihar (1.53 lakh ha), Uttar Pradesh (1.37 lakh ha), Madhya Pradesh (1.39 lakh ha) and Jammu and Kashmir (0.17 lakh ha).

Development of viable, sustainable and suitable technologies for utilization of inland saline areas has been marked as a national priority by the Government of India. The states of Haryana, Punjab, Rajasthan and Uttar Pradesh are the worst affected with underground water salinity. The water logging and secondary salinization problem in these areas is aggravating due to non-utilization of saline waters. In order to make these areas agriculturally suitable, it is necessary to reduce the water table to safer levels (below root zone) by pumping out of ground water. Unfortunately, this task of pumping out the ground water is a challenging job; and it is only possible through evapotranspiration, which itself is a very costly process; beyond the investment capacity of the resource deficient farming community. However, these unproductive zero-earning lands can be converted into economically viable lands through aquaculture. The aquaculture can help in evapo-transpiration of a large proportion of water from these areas, besides generating livelihood for the affected farmers.

Globally, White leg shrimp *Litopenaeus vannamei* is considered as an important aquaculture species with high export potential and profit margins. Being a euryhaline species with wide range of salinity tolerance, inland waters with salinity as low as 5 ppt have emerged as attractive destinations for vannamei farming. The vannamei shrimp is native to Eastern Pacific Coast from Sonara, Mexico in North, through Central and South America as far as tumbes in Peru. During the last ten years, *Litopenaeus vannamei* (The Pacific White Shrimp) has proved to be a game changer in Indian shrimp culture Industry. After the introduction of this species in year 2009, the farming of this exotic species gained tremendous momentum owing to its special features like low salinity limit tolerance, faster growth rate, high stocking density culture and lower protein dietary requirement. The availability of Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) seed of this species has made it a choicest species for Indian shrimp industry. To ensure the sustainability of vannamei farming in Northern India, strict adoption of Best Management Practices (BMP's) and stringent adherence to Bio-security protocols is the need of the hour.

"Vannamei shrimp" farming offers a potential option of converting these waste lands into productive lands through aquaculture. Although 'Vannamei shrimp' is a cold sensitive species and doesn't survive at temperature below 20 ºC, it can be reared in Inland saline areas with strict adherence to "Best Management Practices"

**Requirements (For 1 Acre Shrimp farming unit)**

1. Pond in inland saline areas with clayey loam soil
2. Saline water source (Tube well with >5 ppt salinity)
3. Paddle wheel aerators (4-6 of 2 HP each)
4. Generator set (1 No) 12.5 KW for 4-6 aerators
5. Specific pathogen free (SPF)/Specific Pathogen resistant (SPR) seed
6. Commercial pelleted feed (Pre-Starter, Starter, Finisher, Grower)
7. Manures, fertilizers, water and soil probiotics
8. Stringent Biosecurity arrangements

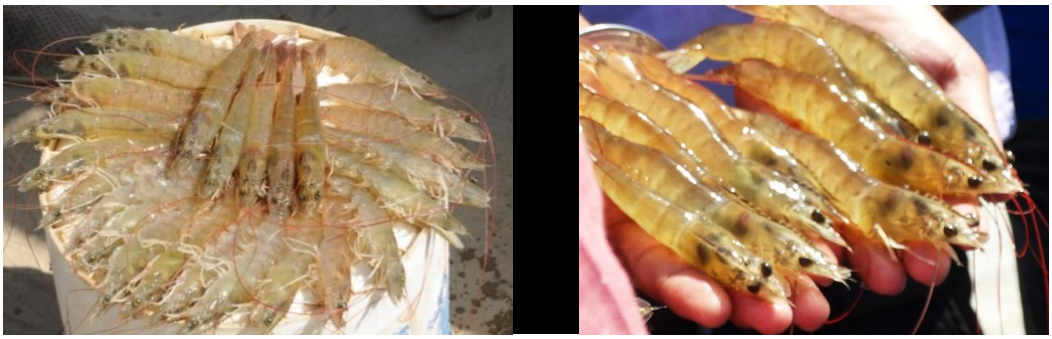

Fig 1: *Litopenaeus vannamei*

**Pond Preparation**

In case of older ponds, drain the pond, remove black soil patches in semi-moist condition, dry the bottom till cracks appear and then plough two to three times with the gap of two to three days up to a depth of 10-15 cm to oxidise the organic matter. Pond bottom drying for a period of 10-12 days will ensure soil cracking upto a depth of 20-50 mm. This process helps to reduce the risk of disease outbreak through cross contamination and is a key to the improved shrimp production. This process should be followed by ploughing and raking of the pond bottom to expose the nutrient rich sub soil, leading to fast mineralisation and oxidation of organic matter rich soil and release harmful gases.

**Water Source**

**Table 1:** Optimum water quality parameters for an Inland Saline Shrimp Farm

| S. No | Water Quality Parameters | Optimum Level |
|---|---|---|
| 1. | Temperature ($^{o}$c) | 28-35 |
| 2. | pH | 7.5-8.5 |
| 3. | Dissolved Oxygen (ppm) | >5 |
| 4. | Salinity (ppt) | 5-25 |
| 5. | Total alkalinity (ppm) | 150-250 |

| | | |
|---|---|---|
| 6. | Total Hardness (ppm) | <3000 |
| 7. | Nitrite (ppm) | <0.01 |
| 8. | Ammonia (ppm) | <0.01 |
| 9. | Na:K ratio | 40:1 |
| 10. | Ca:Mg ratio | 1:3 |

Water should be drawn from a pollution free Inland saline source with the parameters within the range as shown in Table 1. To avoid any disease outbreak or horizontal disease transmission the pond water should be treated with bleaching powder at the rate of 100 kg per acre followed by de-chlorination for 4-5 days to remove chlorine toxicity. The pond water depth should be maintained at least 5 feet throughout the culture period. After filling the pond water, the pond preparation should be undertaken as per the given protocol (Table. 2). Regular monitoring of the water quality parameters like salinity, pH, dissolved oxygen, alkalinity, hardness, calcium, magnesium and potassium should be done throughout the culture period. In order to maintain good soil and water quality parameters of pond, water and soil probiotics should be used (as per expert advice) at regular intervals throughout culture period. The optimum water quality parameters needed to start a pond in inland saline water are shown in Table 1.

**Table 2:** Pond preparation protocol

| Timeline | Activity |
|---|---|
| **Day-1** | Fill the pond with underground saline water up to 1.2 metre water depth , and leave it undisturbed for 2 days for settlement of suspended solids |
| **Day-4** | Chlorination to be done at @ 100 kg/acre with bleaching powder followed by dechlorination for 4 days |
| **Day-8** | Application of first dose of fermented prebiotic media (Jaggery 20 Kg+ Rice bran 20 Kg + Yeast 200 g+ Water Probiotic 250 g)/acre, and leaving the pond undisturbed for 1 day |
| **Day-9** | Application of soil probiotics, and leaving the pond undisturbed for 2 days |
| **Day-11** | Application of water probiotics, and leaving the pond undisturbed for 1 day |
| **Day-12** | Application of minerals & Muriate of Potash after Potassium estimation in the water, and leaving the pond undisturbed for 1 day |
| **Day-13** | Application of second dose of fermented prebiotic media (Jaggery 20 Kg+ Rice bran 20 Kg + Yeast 200 g+ Water Probiotic -250 g)/acre, and leaving the pond undisturbed for 2 day. Water quality should be |

| | |
|---|---|
| | rechecked again prior to seed stocking |
| **Day-15** | Stocking with good quality tested SPF Post Larvae (PL10-12) |

**Aeration**

Four to six aerators (2.0 H.P paddle wheel) should be installed in the pond following the pattern as shown in Fig.2 approximately 3-5 m away from the dykes in such a position that directs maximum water flow within the pond. Sufficient aeration is required in the pond at the rate of 1 HP aeration for 300-500 Kg of biomass.

Fig 2: Schematic Layout of aerators in the pond

**Bio-security Arrangements**

Strict adherence to bio-security protocols is the key to success in shrimp farming. Bio-security has to be implemented while filling water, stocking seed, during feeding, and during the use of any implements in the ponds. Following stringent bio-security protocols should be strictly adhered to:

- The inlet water should be filtered through minimum 60 mm mesh size to avoid entry of any pathogens, vectors, weed fishes etc.
- In order to prevent cross contamination and aquatic bird predation, tie nylon twines on the pond in a way that it prevents the entry of birds but doesn't kills the birds.
- Disinfect the pond with bleaching powder at the rate of 100-120 Kg/acre prior to seed stocking.
- Fence the pond with net to avoid entry of animals and to prevent disease outbreak.
- Allow any stranger in the pond only after ensuring disinfection of his hands and feet with potassium permanganate or any other suitable skin friendly disinfectant.
- Ensure provision of hand and foot dip at the entry of the farm for proper hand and foot disinfection.
- Disinfect all the implements like nets, feeding equipments etc. before use in the farm.
- Provision of a tyre dip should be made at the farm entrance, so that any vehicle entering the farm gets thorough tyre disinfection prior to the entry in the farm.

**Selection of the seed and stocking of the pond**

Specific Pathogen Free (SPF) or Specific Pathogen Resistant (SPR) PCR tested seed procured from Coastal Aquaculture Authority (CAA) approved hatcheries should only be stocked in the pond at the rate of 50-60 PL/$m^2$. The farmers should insist PL 12 -15 which will eventually give more seed survivability. Farmers should verify the track record of the hatchery during the last three years before buying the seed. The larvae should be screened using PCR testing at hatchery testing facility for pathogens like WSSV, IHHNV, MBV, AHPND and IMNV before packaging.

**Survival Test**

A 2.0 x 1.0 x 1.0 metre happa made of 40 mesh nylon cloth can be fixed in the pond and stocked with 100 Nos. of seed. This hapa should be left undisturbed for 96 hours to check the seed survival percentage. Two to three such happa's should be fixed in the pond to avoid any calculation error. During these 96 hours the seed should be regularly fed and at the end, the seed number can be counted to calculate the percentage survival. This survival percentage is taken as pond seed survival and is used to calculate the exact daily feed requirement.

**Feed Management**

For first month of culture, blind feeding method is followed. In a one acre shrimp farming unit feed the post larvae with 2 kg feed/day with 0.5 kg increase up to $11^{th}$ day, 0.6 kg up to $16^{th}$ day, 0.7 kg up to $22^{nd}$ day, 0.8 kg up to $28^{th}$ day and 0.9 up to $30^{th}$ day. Give feed in split doses (3-4 times a day) by broadcasting it around the pond. A minimum four check trays should be kept in a pond having 1.0 acre area for checking the feed consumption on daily basis. The farmers should only use ISO certified Pre-strater, Starter, Grower and Finisher feeds according to the requirement of shrimp and days of culture.

**Table 3: Recommended feeding rate for shrimp based on body weight from $30^{th}$ day onwards**

| Days | Mean body weight (g) | Feeding rate (%) body weight |
|---|---|---|
| 31-39 | 3-4 | 8.0 |
| 40-49 | 5-6 | 6.0 |
| 50-59 | 8-9 | 4.5 |
| 60-69 | 11-12 | 4.0 |
| 70-79 | 14-15 | 3.5 |
| 80-89 | 16-17 | 3.0 |
| 90-99 | 18-19 | 2.8 |
| 100-109 | 20-21 | 2.6 |
| 110-119 | 22-33 | 2.0 |
| 120-129 | ≥25 | 2.0 |

The farmers can also follow the feed chart given by the feed company.

**Note:** To check daily feed consumption, it is advised to put some feed in each check tray as per rate given below. The feed in the check tray should only be put after completion of the pond feeding. The check tray should be observed for 30-45 minutes for feed consumption.

- Upto 70 days of culture period : 5 g feed per kg of feed given
- From 70-120 days of culture period: 7-8 g per kg of feed given

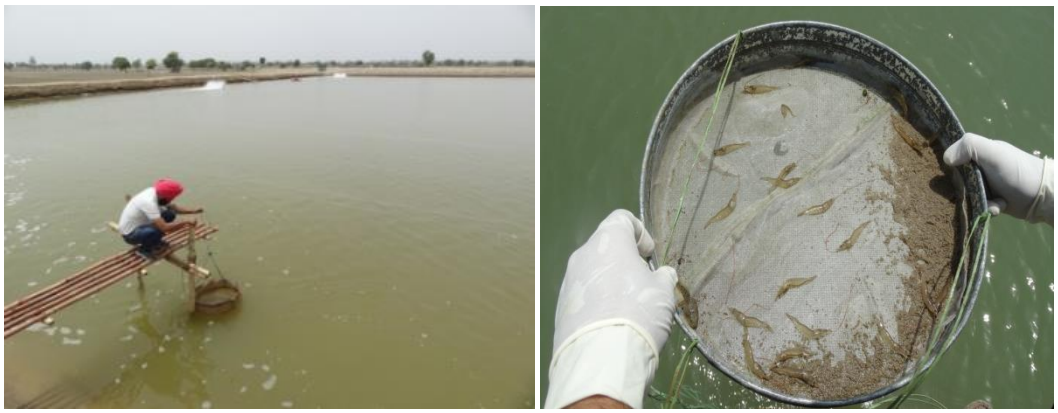

Fig 3: Check tray observation for checking the feed consumption and shrimp health status

**Maintenance of Ionic Composition**

In case of low inland saline waters, the ionic composition of water is more important than the salinity. The Vannamei shrimp due to its euryhaline nature can withstand the low saline conditions (≤5 ppt) but a proper ionic balance is of paramount importance for its growth and survival. The level of $K^+$, $Mg^{2+}$ and $Ca^{2+}$ will be a limiting factor for proper growth and survival of the shrimp. The presence of these ions in a proper ratio (refer to Table:1) determine the feasibility of culture in Inland saline waters. The level of potassium is a limiting factor for proper growth and survival of shrimp, but at the same time calcium and magnesium must be present in a balanced ratio. Generally, the Inland saline waters of India have low levels of potassium, high levels of calcium and variable amounts of magnesium.

**Health Management**

Throughout the culture, the shrimp samples should be regularly monitored for any health related issues, abnormalities and mortalities. To maintain the optimum health status of shrimps under inland low salinity conditions, shrimps should be regularly fed with gut probiotics, organic acids and immuno-stimulants etc. as per recommended dosages. Besides, the pond water should be regularly fortified with water and soil probiotics, suitable to the culture environment at recommended doses and intervals to keep pathogens at a bay through competitive exclusion, throughout the culture period. The use of any kind of antibiotics and other pharmacologically active substance is strictly banned in shrimp culture. A list of banned chemicals and antibiotics is available on the website of CAA for farmers' reference.

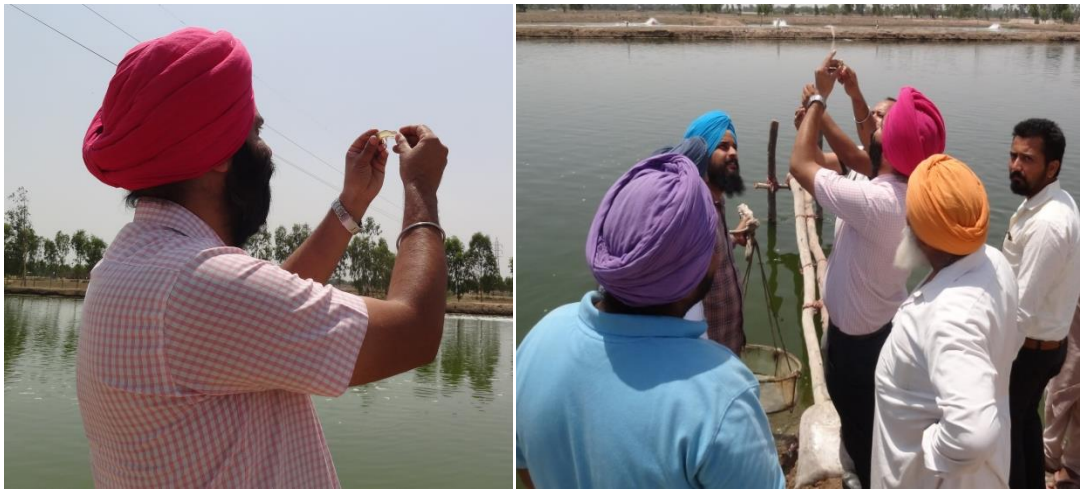

Fig 4: Visual inspections of shrimp gut health

**Registration of the Inland Saline Farms**

As per Government of India instructions, the shrimp farms of the inland saline areas should be registered with the State Government Fisheries Departments, since they dont fall under the jurisdiction of Coastal Aquaclture Authority (CAA) of India. No shrimp farmer should take the culture in fresh waters as per the guidelines of CAA and implementation of stringent bio-security measures should be ensured. Any sudden disease outbreak should be brought into the knowledge of the concerned State Government Fisheries office of the area. The farms should only be stocked with SPF or SPF seed procured from CAA approved hatcheries only.

**Conclusion**

The emerging shrimp farming industry in North Western parts of the country has a bright future, but some of the major concerns need to be addressed to esure sustainable future of shrimp farming industry in these states. The quality of seed and disease outbreak incidences are the two major concerns; affecting output, quality and marketing/export of shrimp. The lack of feed and processing industry is also a major concern since it is adding to the production cost of shrimp. Presently, the shrimp farmers of the State are completely dependent on the coastal states for seed, feed and marketing support (processing and export). A National Aquaculture Network is desired for judicious utilization of available aquaculture resources across the nation; through ensured input supply (seed, feed, pharmaceuticals etc.) and marketing support including processing and exports. Development of shrimp farming clusters for inland saline regions is a way forward to overcome existing limitations through collective efforts. Inland saline water aquaculture in the northern states like Punjab, Haryana, Rajasthan and Uttar Pradesh need to be developed in a mission mode with subsequent development of a processing hub in the region to cater these states, which holds gigantic resource to fulfil the future shrimp production/export targets of the country.