Chapter - 41
Domestication, Culture and Economic Importance of Animals

Keeping animal species at home or making them pet animals, according to their utility for human is known as domestication. In other words bringing animal species under human management to use them as a source of food, increase in production and other useful products or sub products for human such as leather, wool, manure etc. is known as domestication.

Domestication had perhaps started in ancient times of human civilization. To fulfill his own needs, human started preying and promoting animals, to use them or make them domestic to fulfill his purpose deservedly has been used.

For fulfilling these objectives, with the help to systematic and advanced scientific technique human started production of many useful and beneficial animals, which is also known as culturing of animals. Brief description of culture of some useful animals for human is mentioned below-

I. Poultry Farming

Since ancient times, chickens have been used as domestic animals. In 20th century poultry farming has been given a status of cottage industry due to human's flavor tendency and need of nutritious food. Chickens provide nutritious meal in both forms from their eggs and adult's meat. Due to this use of chickens, scientists were attracted for research on new techniques of chicken breading, hatching and upbringing. Increasing the use of eggs was necessary for a country like India with a heavy population to fulfill its need of proper nutritious food. For successful management of poultry farming industry it is important to have proper knowledge about place of poultry farming, nature of poultry, breed and their breeding and upbringing.

Birds useful in poultry

Many species of birds are used in poultry farming, out of which main species are as follow :

(i) Breeds of fowl - Domestic fowl - *Gallus domesticus* are mainly reared in India. Two types of fowls are used for poultry farming.

(a) Indigenous or Desi breeds - It includes breeds such as Aseel, Kakarnath, Brahma, Busara, Ghagus, Chittagong etc. Out of above mentioned Aseel breed is reared as game bird for cock fighting.

(b) Exotic Breeds - It is mostly include European breeds. Main exotic breeds are White leghorn, Plymouth Rock, Rhode Island Red, New Hampshire etc. These breeds are considered as most advanced breeds.

(ii) Ducks - Eggs and meat can be obtained from ducks such as *Anas platyrhynchos*. Ducks contribute to 6% of total of poultry population in India. They are generally found in southern and eastern regions of India. Among Indian breeds Indian runner, Sylhet, Meta and Nageshwari are main whereas Muscori, Pekin, Aylesbury, Campbell etc. are important exotic breeds.

(iii) Turkey - Recently in last few years *Meleagris gallopavo* turkey (Meleagris) have been domesticated bird. British white, Nar fold, Broad breasted bronze, Beltsville small white etc. are its main breeds.

Some fowl breeds used in poultry farming are suitable for meat production which is known as Broilers, *i.e.* Plymoth rock. On the contrary, there are other breeds which show high rate of egg production and are more suitable for production of eggs of best quality. Generally one fowl lays 60 eggs in a year, but its advanced breeds lay approximately 240 eggs per year. Therefore, fowls used for egg production are known as layers. Human has successfully developed best and advanced breeds of fowls for egg and meat production by artificial selection method.

Selection of fowls for breeding

It is most important to know that how to select best breeds of cocks and hens for breeding. It needs to pay attention on following points for this-

1. Selection of cock for breeding - The body of cock should be shiny, broad and cobby. He should have shiny eyes, small and bent beak, shiny crest; it should be red and big, broad back, thin and flexible skin, long tail bent upwards. There should not be any deformity in his organs. He should be playful in nature and always ready to protect hens. His bang should be very good.

If cock has all these mentioned qualities, then is considered best for breeding.

2. **Selection of hen for breeding -** Body shape of hen should be good and big in size. Her head should be in good shape and eyes should be emerged. At least one year younger matured hen should be selected. She should be healthy, growing at fast growth rate, becomes fast maturing and should be laying maximum eggs. If the hen has good health, then chicks will be born out in good health.

Systems of mating of birds

Pen Mating - In this method one cock is left in a chicken coop with many hens. Per 10 hen one cock can be kept in the coop.

Flock Mating - Many cocks are left in flock of hens. By doing this mostly cocks start fighting with each other and mighty ones does not left confluence of other, in this way breeding becomes difficult. This method can be used where there is no need to keep records.

Stud Mating - Cocks and hens are kept in separate coops, and as per need cocks are left in coop for confluence of hens.

Alternating males - Two cocks are used in flock of hens. One day one cock is left with the flock and second day second one. It becomes difficult to keep records in this method.

Systems of Breeding

Inbreeding - Confluence of close relatives of same type of breeds, for example brother, sister, father, daughter, mother and son etc. This method is not correct because breeds become weak in it.

Line Breeding - Any one bird which is regularly used in 'inbreeding' method due to its good quality is known as line breeding. Its objective is to stabilize a specific quality in a breed. In this method confluence of nearby relatives is not done, but far relatives are used for breeding.

Outcrossing - Crossing of same type of birds with different strains is known as out crossing. For example if a breed of white leg horn has the capacity of laying more eggs but eggs are of small sized then that should be crossed with the breed which lays less amount of eggs but large in size.

Crossing - confluence of birds of different type of breeds is known crossing. Breeds produced by this method are known as hybrid breeds. They have hybrid vigor.

Grading - Confluence of male birds of pure breeds with female birds of other breeds, where there is no pure cast available, eventually in some time pure breeds can be produced by this method. With commercial point of view, hybrid birds are domesticated in today's developed poultry farming.

Incubation and Hatching - Incubation period of poultry eggs is different in different breeds. For example Hen 21 days, Turkey 28 days, Ducks 28 days, Japanese quail 17 to 18 days.

Different processes are applied during incubation. Mainly are respiration, excretion, nutrition and protection. External fetal membranes which come out of fetal body (Amnion, Chorionic Allantois) make these functions possible. None of the external fetal membrane becomes any body part of the chick.

Important events of embryo development

Before laying eggs : Fertilization

Between laying egg and incubation : No growth

During incubation

16 Hours - First sign of chick embryo

20 Hours - Disclosure of vertebral column

22 Hours - Starting of head formation

24 Hours - Starting of eye formation

42 Hours - Heart beat appears

62 Hours - Starting of legs formation

64 Hours - Starting of feathers formation

5^{th} day - Starting of genital organs formation and sex differentiation

6^{th} day - Starting of beak formation

17^{th} day - Beak is turned towards air sac.

19^{th} day - Yolk sac starts entering in body cavity

20^{th} day - Yolk sac completely enters in body cavity

21^{th} day - Chick comes out the egg.

Selection of eggs for hatching - Desired eggs for hatching should be selected carefully, because any kind of dissimilarity would lead to adverse effect on hatch ability. To select eggs for hatching some qualities are- shape, colour, form, quality of shell and internal quality observed by fault testing.

Artificial Incubation - This activity is performed by an incubator, which provides necessary conditions required for egg hatching. In 21 days chick is developed in an egg. Egg is kept in incubator for 18 days and 3 days in hatcher.

Benefits of artificial Incubation

Following benefits of artificial incubations are -

1. Many chicks can be produced in one time
2. Hatching of eggs can be done as per needs
3. Protection can be done from infectious disease
4. Percentage of chick production may be high
5. Reduction in care and cost

Brooding and Rearing - Hatching is called brooding and after releasing the chick from incubator, its upbringing process is known as rearing. Upbringing of chicks can be done by two types.

Natural Brooding - Hen itself works as an incubator and brooder. Normally hen can hatch chicks from the effect of its body heat from 8-10 eggs.

Artificial Brooding - Upbringing of chicks without any help of hen is known as artificial brooding. It has many benefits as compared to natural method -

(1) It can be done in any month of the year.

(2) Chicks can be reared in large numbers

(3) Arrangement for cleanness, disease can be done.

(4) Temperature can be regulated

(5) Food can be given regularly

(6) There is no need of strong chickens

Brooder House - Before getting chicks out, it is necessary to prepare brooder house. It should have complete arrangement of air, temperature can be controlled, safety from outside animals, should be safe from high speed air, storm or cold breeze etc. Large brooder house can be divided into small parts and chicks of different age groups can be reared in it.

Floor Brooder - The hod, which is covered by mixture of clay soil and dung on both sides, can be used as good brooder. In the same way wooden brooders, tin or aluminum brooders can also be used.

Fig. 41.1 Poultry farming from cage system

Battery Brooder - Battery brooder is used for rearing more chicks in limited space. After hatching, chicks can be reared in it for 4 weeks. This method is not cheap so it is not much popular. If birds are to be kept in cage system then they should be reared in battery brooders. Battery brooder may have many tiers. There is also a cold place where chicks can go when it is needed.

Youngest birds are kept in top tier of battery brooder. Arrangement of water and food is outside in battery brooder therefore birds waste does not mix in it and protects from disease.

Poultry farming by cage system- Poultry farming was done by "Deep litter Method" before developing this system. Large number of hens couldn't be reared in deep litter method because in this method each hen required approximately 3 feet space and big house or poultry farm is required for large number of hens. In many countries of the world, now poultry farming is done in cage instead of "deep litter" method. Main reason of it is increasing expenses by which expenditure on hen housing is on increasing trended.

Benefits of cage system

1. More birds in less space - As compared to deep litter method, less space is required in this system. Therefore where 1000 birds are kept in one hen house, 2000-2500 birds can be reared in same space in cage.

2. Prevention from disease - Since hens stay in cage, disease does not affect the whole group of hens which is definitely beneficial.

3. Less of food intake - Scientists believe that hens kept in cages consume less diet.

4. Upbringing facility - Since hens do not remain stable in deep litter method, therefore their care and monitoring becomes difficult. Monitoring facility is easy in this method. If selection is to be done, it is easy in this method. In other methods all hens are to be caught and due to stress egg production decreases.

5. Labour saving - It is believed that less labor is required in cage system of poultry farming. In other words one person can take care of many hens.

Management tips for cage layers

As compared to deep litter method, different type of arrangement is required in this method. Some important points are as follows

1. Food arrangement - Food should be provided to all birds in cage at proper time. If they do not have proper food for one hour, production will decrease. Therefore it is necessary that food should be provided at thrice a day i.e. morning afternoon and evening. Food pipe should be checked periodically.

2. Water Arrangement - Fresh water should be available every time in this method. Water gullies / utensils of water should be washed periodically.

3. Poultry Manure Management - This arrangement depends on types of cage. As bird excretion is only collected in cage system therefore it will create more odors as compared to deep litter method. It is essential to clean cage at time to time.

4. Light Arrangement - Light arrangement should be essential on principle of deep litter method. Light should be scattered equally so that hens can easily use of their food and can have desired effect of rays on production.

5. Egg collection - Eggs should be collected at least thrice a day.

6. House construction - In comparison of cage system, the house should also be of special type in cage layer. Height of house depends on how many tiers of cage are to be made, if 2 tiers of cage are to be made, then height of the roof should be at least 12 feet, if 3 tiers of cage are to be made minimum height should be 14 feet. Flat roof is most appropriate. If cottage type roof is to be made, then side height should be at least 9-10 feet.

House should be made in dry place. Moist surface makes the bird excretion moist because of which insects increase in large numbers, and excretion will not be dried soon.

Poultry food

Poultry food is prepared by keeping in mind the following objectives -

1. To convert poultry food from non edible to edible food.

2. To fulfill nutritional needs of poultry.
3. Growth, to become fat and for reproduction.
4. To provide energy for voluntary and non-voluntary functions.

Different poultry feeds

(a) Carbohydrate Feeds - It forms about 70-80% of poultry food. Basically these are used for production of heat, fat and energy. These are cheap as compared to other food and are easily available. Some main sources are mentioned below.

Maize - This poultry food is used in high amount. It is starch and rich with fat.

Wheat - It takes a second position after maize. It has less calcium but high amount of phosphorus. It is best source of vitamin B and E. Wheat can be used in many forms for poultry food such as wheat chap.

Oat - It contains approximately 12% protein, 10.6% fibres and 4.7% fat. It can also be given as non-grinded, grinded and mixed with hen food.

Barley - It is also used in poultry food as oat.

Sorghum - Its shape is same as that of maize but it does not contain vitamin A. Its use is beneficial only when it is cheaper than wheat, maize, and barley.

Rice - This can be also used in place of other grains, since its rate is higher as compared to other grains so it is less used.

Molasses - It is the residue left after making sugar from sugarcane and it can be used as 5.10% part of grains.

Potatoes - The small sized potatoes which are not capable of using by human scan be fed to poultry after boiling them.

(b) Fat feed - These are the main source of energy, they can be mixed up to 2 to 5% level. The shape of hen is improved by using fat, feels more hungry and nutrient consumption increases by which body development and egg production increase. Following type of material are included in this category.

1. Soybean oil
2. Ground nut oil
3. Binola oil
4. Maize oil
5. Wheat germ oil
6. Animal's fat.
7. Frozen oil

(c) Protein feed - It is most valuable part of poultry feed. It is much necessary for body development and egg production.

Animal protein feed - It includes milk, meat scrap, fish meal etc. It contains high amount of minerals and vitamins are also more.

Vegetable protein feed - It contains mainly soybean meal, corngluten meal, binola cake, pea nut cakes, linseed cake, Sunflower cakes also can be used.

Milk - It is a good source of protein but its use is not possible as it is expensive.

Meat scrap - It is used in poultry feed to obtain protein and mineral substances.

Feather meal - It contains 86% to 88% of proteins, but lacks essential amino acids. It can be used 10 % to 20 % part of protein food.

Poultry blood meal - It contains 65% of proteins and to some extent it can be used instead of protein.

Soybean oil meal - It is widely used as a source of protein where soybean is grown. In India pea nut cakes are mostly used. But today the use of soya meal is also increased.

Mineral Meals

Calcium - Calcium carbonate is the best source of it. Calcium can also be obtained from oyster shells, marble chips and egg shells.

Phosphorus - It is bone meal which is mainly tri calcium phosphate that is obtained in the form of phosphorus.

Manganese - Its use is as ratio of 50 "parts per million". It is necessary for bone formation and hatching results.

Salt - Salt or Sodium chloride is necessary for taste and digestion. 0.5%, salt can be added to food. In the same way iron, iodine is required for poultry feed.

Common diseases of poultry

Some of the common diseases of poultry are as follow-

(i) Viral Diseases- It included fowl pox,

infectious bronchitis, and lymphoid leucosis and Ranikhet disease. Ranikhet is the most common disease among poultry in which patient hens have suffered from high fever and diarrhea. Symptoms like flow of mucus from beak, paralysis of feathers and round dizziness are observed when disease gets more intense.

(ii) Bacterial Diseases - It includes fowl cholera, Pullorum, Coryza, Mycoplasmosis and Spirochaetosis etc.

(iii) Fungal disease - It includes Afltoxicosis, Brooder pneumonia and Aspergillosis.

If infectious disease becomes more serious, and then it should be killed diseased animal, it is the proper decision. In case of poultry farming management business man should have complete knowledge about general disease so that health of hens and human can be made secured.

II. Fishculture, Piscicultrue or Fisheries

As per person supply of milk and meat is less in developing country like India, supplementary food in which only grains are taken as unbalanced diet, importance of fish is increased. To fulfill need of fish protein in country is estimated about 1 crore tons fishes are required where as its yearly production is 35 lakh tons. Pisciculture provides income and employment to fisherman and farmers of coastal states. Seeing at increasing demand of fishes various new techniques are used to increase its production such as aqua culture and fisheries.

In India, inter terrestrial area of water for fish production is about 75 lakh hectare which is 2.34% of total area of country. The researchers conducted by **Central Inland Fisheries Research Institute** led revolution in fisheries sector in India resulting pure fish production of 85000 Kg/hectare/year achieved, which is a clear indication of successful future of fisheries.

Cultivation of useful fish species which are having high productive capacity under controlled conditions is known as pisciculture. Fishes are best sources of proteins. Beside proteins, It' also contains mineral salts vitamins (particularly A and D) and healthful fats in abundance. Therefore fish itself is a complete food. Beside food supply, products and sub products obtained from them are used as food for cattle's and domestic animals and many useful items which are used by human beings. Some fishes such as Common carp, Katla, Rohu (in fresh water) and Hilsa, Sardine and Pomfret(In saline water) are eaten. Due to their so many uses, various scientific techniques are used for their cultivation and rearing. Rearing and cultivation of other aquatic animals (Prawn, Lobster, Mollusca etc.) including fishes is known as water cultivation or aqua culture.

Type of cultivable Fishes

Cultivable fishes are of three types -

1. Indigenous fishes or fishes are found naturally in fresh water such as Major carps.
2. Saline water fishes which are customized for fresh water such as Chanos, Mullets.
3. Exotic fishes which are brought from other countries such as Mirror carp, Chinese carp, Crucian carp and common carp.

Management of Fish Culture Programme

Fish culture is a complex process therefore it is essential to have complete systematic information of various components of this process such as topographic situation, featuring water, source of water and other physical, chemical and biological factors for ideal fish culture. Reservoir is a place where fishes develop and grow. Therefore management of reservoirs is important which includes hatching, nursing, rearing, stocking and ponds.

Little change can be done in size type of pond as per fish species. Sometimes cultivation of one fish with different states can be done in ponds of different qualities. Keeping in mind different stages of fishes, different types of ponds are made for their cultivation.

1. Breeding Pond - Special types of ponds are made for breeding as first phase of fisheries which are called breeding ponds. These ponds are made near river or other natural water sources.

Types of breeding - There are two types of breeding.

1. Natural breeding 2. Induced breeding

(i) Natural breeding Bundh breeding

Natural dams are special kind of ponds where under natural riverain conditions or with any natural water source is used for breeding of cultivable fishes. These specially designed bundhs are made in low areas and they have large capacity to hold rain water. These bundhs have the exit arrangement for extra water than required. The shallow part of bundh is used for spawning. Bundhs (Dam) are of three types-

1. Wet bundh - These are filled with water throughout the year.

2. Dry bundh - This bundh is seasonal, it gets dry after rainy season.

3. Modern bundh - These are also called masonry bundh. They are made of masonry walls. Presence of exit gate at bottom of bundh is main characteristic feature of this bundh. With the help of exit gate total water is lay out after spawning.

According to specialty of breeding of different fishes suitable bundhs are used for spawning.

(ii) Induced Breeding

Generally fish seeds are collected from the place where fishes breed but this arrangement has some demerits. Eggs collected by this method may be of various fishes; out of them some eggs may be of predator fishes. Keeping these demerits in mind, various new and advanced techniques are developed for collection of seeds of good quality by which fishes are fertilized artificially.

For artificial fertilization mature female fish having eggs is kept in hand is slightly pressed from front towards back and eggs are collected. After this a male fish is taken and its semen is collected separately by pressing its abdomen downwards, after this fertilization completed by proper method.

1. Fish seed - Fish seeds are collected from breeding pond. There has built many stations to collect fishes in rivers like Ganga, Yamuna and Brahmaputra etc. Fish seeds are collected from breeding places of the Ganga, Yamuna, Gomati, Betwa, Ghagra, and other rivers. Appropriate sites for fish seed collection are turning place of these rivers. Net used to collect spawn is generally named as Benchi Jal or Shooting net. All stages of development of fishes can be collected in gumcha, from where they are taken to hatching pit.

2. Hatching pit - Fertilized eggs are kept in hatching pit for hatching. At the time of making pit, below mentioned points are needed for care-

(i) Hatching pit should be near breeding place

(ii) It should be small in size

(iii) It should have such amount of water that should dry in one or two months.

(iv) It should be more in number.

Types of Hatching Pits

These are of two types

(i) Hatcheries - These are small sized ponds where fertilized eggs can be transferred. Within about 2 to 15 hours fish fry comes out from egg on hatching.

(ii) Hatching Hapa- These are rectangular trough shaped tanks. Due to regular flow of water in this kind of hapa fish eggs receives sufficient air. They are made by bamboo pieces put and fixed inside river with a thick cloth wrapped around it. Mosquito net is tied inside this outer hapa. The size of hapa is approximately 3'x 1.5' x 1'.

Fish fry are collected and transferred to cultivable pond. During transfer there is possibility of dying of fish fry.

Alcathene bags are used to transfer fish fry or zero in nursing pond from hatching hapas.

Fig. 41.2 Hatching Hapa

3. Nursing - It is correct to prepare nursing pond before hatching fish fry or zero. Entry and exit of water in this pond should be controlled. There

should not any predator in nursing pond, and then some natural and chemical fertilizers are also used by which planktons are developed which serve as food for fishes. As death rate increases in nursing pond so due caution to complete precaution should be required. When length of fry or zero becomes 10-15 cm in nursing pond then they are transferred to rearing ponds.

4. Rearing - Finger lings take complete nutrition in rearing ponds because they are long ponds and there are no predator animals but complete arrangement is available for growth and health of finger lings. These may be seasonal or yearly. When length of finger lings becomes 20 cm then they are transferred to stocking ponds.

Vessels of 1000 liter capacity are used to transfer finger lings to stocking ponds. These vessels contain foam on the inner side by which small fishes may be protected from injury and shocks. These vessels have proper management of aeration for oxygen.

5. Stocking- Complete care of sufficient amount of food is taken in stocking ponds, so that fishes are shifted in them can grow well. Along with proper and sufficient food, stocking ponds are free from unwanted and predator fishes. Arrangement of appropriate amount of manure is also done which helps in increasing number of zooplanktons and phytoplankton's. All these points depend on fish's species and number, when length and weight of fishes become maximum then processing of their catching starts.

Fully developed adult fishes are taken to market for sale but on the basis of their length and weight the small fishes are again transferred to rearing ponds or stocking ponds.

6. Methods of Fishing or Harvesting - Fishes are caught since ancient time. Earlier they were caught by stones or javelins, but now they are caught by complex loopholes, nets and lines. Different methods are used at different places in our country. Catching of fishes is known as fishing.

Some main types of fishing are as follow :-

1. Standing Fishing
2. Angling Fishing
3. Trap Fishing
4. Fishing by scooping
5. Dip or lift net fishing
6. Fishing by Ghagaria Jal or cast net
7. Fishing by Purse net
8. Fishing by Gill net
9. Fishing by Drag net
10. Electric Fishing

Fishing is completed by above mentioned methods and are also preserved them. If they are not preserved at proper time they soon decompose and destroy. For preserving the fishes, following methods are used-

(i) Refrigeration
(ii) Deep Freezing
(iii) Drying after freezing
(iv) Sun drying
(v) Sun curing
(vi) Mona curing
(vii) Wet Curing
(viii) Salting
(ix) Smoking
(x) Canning.

III. Apiculture or Beekeeping

Honey bee or bee is a member of class insects of phylum Arthropoda which is social insect showing polymorphism and division of labour. Bee is useful insect by which useful products such as honey and wax are obtained. Although human knows 4600 years ago about apiculture, but bee keeping is a scientific technique and establishment of it as an industry has started few years ago. Such technique of beekeeping is known as apiculture. Following points are important for successful apiculture-

1. Knowledge about nature and behaviour of bee.
2. Catching flock of bees and keeping them in beehive

3. Management of beehives in different seasons, maintenance and collection of honey and wax.

Important species of Honey bee

There are 4 types of species of honey bee from which honey is obtained.

(i) *Apis dorsata* or Rock bee- It is also known as multi coloured fly. It is the largest sized and produces honey in maximum quantity, their keeping is not possible because they are aggressive and migrant in nature.

(ii) *Apis indica* or Indian Monabee- It is available in whole parts of India, They are small than multi coloured fly and are of quiet in nature. 3-4 kg honey is received from its each beehive. It can be reared easily.

(iii) *Apis florea* or Bhringa bee - It is the smallest in size and sneaky in nature. It's one beehive can give only 250 gm honey; therefore it is not useful for commercial point of view.

(iv) *Apis melifera* - It is also known as European fly and is quiet in nature. Its each beehive gives 9-10 times more honey as compared to Mona-bee. It is the most useful for commercial point of view. Its Italian variety is more important.

Social Organization of Honey Bee

High level of social organization is found in colony of honey bee which shows developed type of division of labour. Three types of castes are found in honey- bees.

(i) Queen - There is only one large sized queen bee in the colony. She is given royal jelly named best food. Only breeding is her work.

(ii) Male or Drone- They are developed from unfertilized eggs, and their work is to copulate with queen and fertilize eggs.

(iii) Workers - They are thousands in number and they are sterile females developed from fertilized eggs. They do complete internal and external work of the colony. Their function is to collect pollen grains, formation of honey and wax, food collection and protection of beehive.

Methods of Apiculture

Following two methods are used in apiculture.

1. Old indigenous method
2. Modern scientific method.

1. Old indigenous method - This method is used for honey collection since ancient times. In this method honey bees are flown by inducing smoke in the beehive, and beehive is squeezed to obtain honey by killing rest of bees. Obtained honey in this way is not pure because remaining eggs and small bees are mixed in it. Along with it beehives are also destroyed permanently. Therefore, now a day this method is not used for honey collection.

2. Modern scientific methods- In this method honey is obtained by scientific methods from artificial beehives. Obtained honey is also pure and it causes no harm to beehive. Today bee keeping has taken a form of an industry and many people are getting employment by this.

Appliances of Apiculture

Following appliances are used in bee keeping

1. Artificial honey bee box
2. Comb foundation
3. Honey removal device
4. Uncapping knife
5. Other appliances

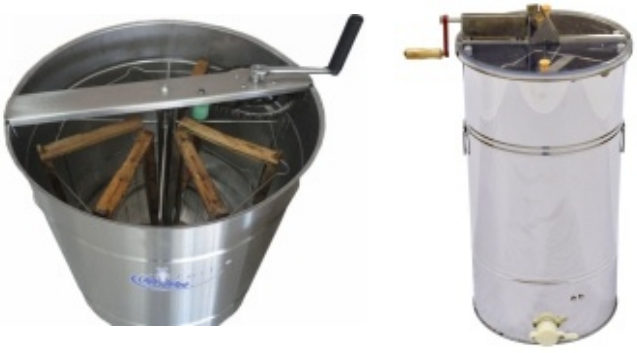
1. Artificial honey bee box (Bee hive) - It was invented by Langstroth in 1851. Today many wooden boxes or beehive are used. Normal beehive box is divided into two parts by net. Lower bigger

Fig. 41.3 Artificial Bee hive for apiculture

part is known as brood chamber and upper smaller part is super chamber. The net differentiates both chambers are known as queen excluder. The holes of this net are so small that only worker flies can pass in and out of the super chamber from brood chamber.

2. Comb foundation- Comb foundations are found in boxes of brood chamber. They are framed by wax. Hexagonal chambers are formed on its both sides. On the both sides honey bees make same sized chambers in which queen lays eggs. Comb foundation is also kept in super chamber where honey bee collect honey.

3. Honey extracting apparatus- Honey of artificial bee- hive is taken out by honey extracting apparatus. It is a big drum of tin. It has some netted bags fixed on rotating sticks (Fig. 41.4 (A)). Lower part of drum has a spout (Fig 41.4 (B)). Expulsion of honey is made possible by principal of centrifugal force. Combs are separated from the frames and are kept in neted bags and are rotated with high speed. Honey falls down with striking the wall of drum and is taken out from the spout. This method does not cause any harm to comb or bee hives and can be used again and again.



(A) (B)

Fig. 41.4 Apparatus used for honey extraction

4. Uncapping knife - Honey collected in honey part of bee hive is covered with cap of wax. Therefore before keeping beehive in honey extraction appliance, heat the knife and touch the cap it will melt down and open.

5. Miscellaneous- Smoking appliance is in the form of tin box. Smoke comes out from its one end. To control honey bees smoke is released from it. Hands are saved from sting of honey bee by wearing rubber gloves. To be safe from outbreak of honey bee silk or cotton thread made net is worn.

Precautions -

Following precautions are important for bee keeping

1. Distance of beehive from fruiting and flowering plants should not be more than half mile.
2. Bee keeper box should be kept in cold and shady place
3. Source of fresh water should be located nearby.

Advantage of modern method

There are many benefits of beekeeping by modern method

1. Activities of honeybees can be monitored.
2. A colony can be developed by giving them artificial food.
3. One beehive can be used again and again; therefore workers pay more attention on honey collection.
4. In adverse weather artificial beehive can be moved to safe place.
5. Beehive can be protected from enemies.

IV. Sericulture

Keeping and rearing silk worms to obtain raw silk from commercial point is known as sericulture. First of all in 2697 B.C. empress Lotzu of K Wang Ti state of China invented silk. In India first experiment for studying and rearing of silk worm was started by Lefroy in 1905 in Pusa Institute of Delhi. In India since last 15, 20 years there has been great improvement in quality and type of silk. Indian silk is famous in the world for its best quality, lustrous shining and traditional colour combinations. Assam, West Bengal, Tamil Nadu, Punjab, Kashmir and Karnataka are main areas of silk production in India.

Major species of silk worm

Major species of silk worm, type of silk is obtained from them and plants leaves which they are consumed as their food. Their description is

mentioned in table 41.1.

Out of all silkworms mentioned in table most important is *Bombyx mori.* It is found on mulberry leaves. Hence it is known as mulberry silk moth. This moth is a member of family Bombycidae of insect class.

Table 41.1 Major species of silk worm

S. No.	Species of silk worm	Type of silk produced	Food plant of silk worm
1	*Bombyx mori*	Mulberry silk	*Morus alba*
2	*Antheraea paphia*	Tasser silk	*Terminalia arjuna*
3.	*Antheraea assamensis*	Muga silk	*Machilus bombycina*
4.	*Attacus rechinii*	Eri silk	*Ricinus communis*
5.	*Thiopalia religiosa*	Devmuga silk	*Machilus and Ficus*

Life cycle of Mulberry Silk moth

Adult silk worms are about 4-5 cm long and dirty whitish coloured. Its life cycle contains egg, larva, pupa and adult moth stages. Fertilization is internal. Egg stage lasts for around 10 days and larva stage for around 30-35 days. Larva of silk worm is known as caterpillar. Larva stage is the most active stage of its life cycle, in which it accumulates all nutrient elements for operating the next stages to be developed. 5 Instar stages are found in larva stage of silk worms, in which it shows 4 times of moulting. Caterpillars are cylindrical, smooth and about 4-5 cm long. One pair of silk glands are developed which are modification of salivary glands. It actively eats leaves of mulberry in larval stage, and stops eating food when it becomes fully developed. At this time it wraps silk threads around itself and makes a cover named cocoon and is converted into pupa. Pupa is called chrysalis. After 10-12 days pupa melts cocoon and comes out like an adult.

Sericulture Industry

Rearing of silk worm for production of silk at commercial level is known as sericulture. Silk is the unique gift of nature, but production of silk at commercial level is a complex process. Before knowing sericulture industry in detail, it is important to know itsrequirements and main steps. Basic requirements of this industry are advanced species of ***Bombyxmori*** and mulberry plants with good nutritional value, Apart from this, other general requirements are as follow- (Fig. 41.5)

1. Machana- Appropriate place for rearing of silk worms.

2. Rearing tray- To keep silk worm larva with leaves of mulberry tree.

3. Spining tray- To keep fully developed larva which is about to enter pupa stage.

4. Dalas- To bring mulberry leaves

5. Chopping knife- To cut mulberry leaves into small pieces.

6. Baskets- To distribute mulberry leaves.

7. Hygrometer- To measure humidity % in atmosphere.

8. Thermometer- To measure temperature of room.

9. Oven- To keep some stages of silk worm at controlled temperature

10. Freezer- To collects eggs for next generation.

(A) Rearing Trays

(B) Spinning Trays

(C) Machana

Fig. 41.5 Sericulture Industry

(i) Rearing of silk worms

Rearing means all activities from egg laying to aestivation, Hibernation, incubation of eggs, taking care from early stage of larva to cocoon formation. Therefore for proper systematic care, it is essential to pay attention on Grainage technology.

(ii) Grainage management

The main objective of Grainage management is to provide appropriate silk worm eggs to care takers of silk worms and to sustain the fundamental qualities of species. To obtain seed eggs from reared silk moth or caterpillar stage for this purpose it should be focus on proper nutrition, prevention of diseases and other care. Cocoons are formed from catterpillar.

Fig. 41.6 Production of mulberry silk

After last selection, cocoons are separated as per their sex, for this one end of the cocoon is cut and opened with hand or Nagahara appliance. 10000 to 15000 cocoons can be cut in one hour by Nagahara machine. Loose type of cocoons are used for egg production at commercial level, and adult female silk worm by which eggs are to be obtained should collectively tested free from pebrine disease by mass pebrine detecting machine or simple microscope.

(iii) Supply of seeds to rearers and commercial rearing

After grainage management, next step is to supply of seeds to worm rearers. According to knowledge and experience of worm rearers this supply is of two types i.e. eggs supply and supply of 2^{nd} instar larva.

Old reares who are working this work since long time and are well known about rearing techniques, they can purchase eggs but new worm rearers who are doing this work for the first time and those whohavenoidea of rearing techniques they should always carry 2^{nd} instar larva. Care of I, II, and III instar larva should be taken carefully. Rearing of 4^{th} and 5^{th} instar caterpillar is done in tray hanging by nylon or kept on earth.

In this way the production of high quality of cocoons can be possible from advanced techniques of rearing of silk worm. For rearing of 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} instar larva best temperature is 27, 27, 25, 24 and C.

(iv) Spinning of cocoons

It is that time when fully developed larva stops taking food and starts excreting sticky fluid from its silk glands. In this stage larva is transferred to spinning tray and keeps diagonally for some time towards sun. After completion of spinning in three days cocoon is formed which is the last stage of sericulture.

(v) Method of obtaining silk from cocoons

Silk is obtained from cocoons by following method. First of all cocoons are killed by putting in hot water or keeping them in closed hot oven. The process of killing cocoons is called stifling. Silk is

unfolded from cocoons after boiling. This process is called reeling. Cocoon becomes soft on boiling and layers of thread become loose by which silk can be easily unfolded. Complete cocoon is made of single thread and 1000 -1500 meter long thread is obtained from single cocoon. Thread is wrapped around a big wheel and then wrapped on spool. It is called raw silk or reeled silk. Raw silk is again boiled in water and washed them with solutions of chemical acids by which it becomes clean and shiny. These are perk and converted into thread. They are known as fiber silk. This process is known as spinning.

Diseases of silk worm

There are many ailments of silk worms out of which main are

1. Pebrine - It is of two types

(a) Virus Pebrine - It is spread by *Borrelina bombycis* named virus and larva starts dying after 8-10 days. To protect from this dead larva should be separated and appliances should be washed with 30% trichloro acetic acid for 15 minutes and then with water.

(b) Protozoan Pebrine - It is caused by *Nasema bombycis* named protozoan. It attacks in both larva and adult worm. Body of adult worm is becomes irregular and reduced and larva also remains small and dies before cocoon formation. To protect from this it is necessary that the eggs of healthy adult worm should be used.

2. Flacherie and Garsserie- These diseases are caused by bacteria

V. Lac Culture

Lac is a resinous substance which is secreted by lac glands of lac worm. At first, it was described in Atharvaveda in which Lac worm was described by the name of Laksha. Laksha is a sanskrit word which means one lakh which was probably named on the base of individual numbers of this insect. On the basis of sanskrit name Laksha, it was started knowing by word Lakh in Hindi and Lac in English. As per Mahabharata epic, to kill Pandavas, Kauravas had built Lakshagraha by their architect Purocha. From this context it is proved that about 5000 years ago in Mahabharat period there was a good production of Lakh that's why Kauravas were able to build Lakshagraha. Abul Fazal (1590) has also described Lac in his book Aina-e-Akbari.

First of all this insect was scientifically described by Mr. J. Kerr in 1782 and named it as *Coccuslacca*. In 1812 Oken has named its genus *Laccifer* and it was started knowing by *Lacciferlacca*. Mr. Mehdi Hassan named it as *Lashadia indica* in 1913, but Mr. A.B. Mishra named it as *Laccifer indica* in 1930, which was again changed by A.P. Kapoor to *Lacca indicola*. But later by opinion of Mr. Glover it was again named *Laccifer lacca*, which was again changed in last few years to *Kerria lacca* on the name of explorer Mr. Ker.But its popular name is *Laccifer lacca.*

Mass rearing of lac insects for commercial production of Lac is known as Lac culture.

Out of total Lac production of the world 80% Lac is produced in India. Out of total production India exports 90% of its total production to other countries. Apart from India; other most lac producing countries are Thailand, Sri Lanka, Burma, China, Pakistan and Nepal. Rearing of lac insects and lac production is done in many places of Assam, Bengal, Bihar, Rajasthan, Uttar Pradesh, Madhya Pradesh, Karnataka, Tamil Nadu and Orissa states in India.

Salient features of Lac Insect

Male and females are different in lac insect and they show sexual dimorphism. Males are 1.2-1.5 mm long and are red in colour. These are smaller in size than females. Female's body is soft and oval shaped. Its size is bigger as compared to males, about 5 mm. Head, thorax and abdominal parts are not much clear in females. Females are shiny red in colour and they do not have wings. Female lives in a chamber made of resin.

Female lays 200-500 eggs in its resin chamber. First instar larva comes out after 6 weeks of laying eggs. It is also known as nymph- Nymphs are active organisms. They come out from female's chamber and are collected on small soft twigs of succulent plants. Lac is secreted by dermal glands situated on

their body which becomes dry when comes in contact of air. These nymphs receive nutrition from sap of succulent plants. After stable stage of 6 to 8 weeks of nymph, about 70% wings less females and 30% males with wings are developed from nymphs through metamorphosis. Lac insect completes their life cycle twice a year on a host plant (October November and June July).

Host plants of Lac Insects

There are many host plants of lac insects in India out of which some main plant species are as follow :-

S. No.	Common name of host plant	Scientific name
1	Kusum	*Schleichera oleosa*
2	Khair	*Acacia catechu/ Senegalia catechu*
3	Ber	*Ziziphus mauritiana*
4	Babul	*Acacia nilotica*
5	Fig	*Ficusc arica*
6	Palas	*Butea monosperma*
7	Shisam	*Dalbergia sissoo*

Lac insects enter their mouth parts in plant tissues and suck its sap. Quality of lac depends on host plant. Kusumic lac is obtained from Ber and Palas plants are of best quality.

Cultivation of Lac

Cultivation of lac is a complex process; therefore farmers should have complete knowledge about inoculation, swarming period and collection.

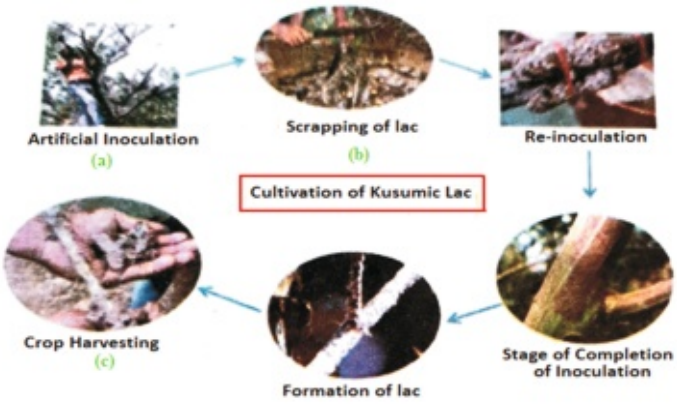


Fig. 41.7 Different steps of lac cultivation

1. Inoculation - First step in lac production is inoculation of lac insect. Inoculation is that process by which young insects become well settled on their host plant. Inoculation is of 2 types

(i) Natural Inoculation - Naturally or in general inoculation is a simple and normal process which completes during swarming of nymph. At the time of swarming nymph again attack those host plants and start sucking sap of twigs.

(ii) Artificial Inoculation - In this method host plants are harvested in the month of January or June. The twigs on which swarming of nymph will be done, are cut into 20-30 cm long pieces, these pieces are tied to branches of new host tree, closely touching the branches. After swarming, these branches are removed (Fig. 41.7(a)).

2. Swarming - It is the most important stage of life cycle of lac insect. Therefore it is necessary for lac production, person to have correct knowledge of date of swarming. Muscles of nymph contract during swarming and insect is separated from joining place. In this way it leaves a hollow cavity which is later covered by lac.

3. Harvesting - Collection by cutting of lac covered branches from host plants is known as harvesting. Lac crop is harvested when it become mature(Fig.41.7 (C)).

Erie crop is harvested in April May, Kataki crop in October November, Ahgani in January February and Jethvin and Baisakhi is harvestd in June July.

There are many varieties of lac which are as follow :-

(i) Erie lac- The lac which is harvested in raw state i.e. harvested before maturation of crop.

(ii) Stick lac - When crop becomes matured, lac obtained in the form of twig is known as stick lac.

(iii) Grain lac - Lac which falls down from branches and is obtained after washing it.

(iv) Dust lac - Lac obtained after grinding grain lac minutely, is known as dust lac.

(v) Chapra Lac - Lac obtained when grain lac and dust lac are heated and a thin crust is formed, which is known as chapra lac.

4. Scrapping of brood lac - When baby comes out from old lac chambers, they open the branches and lac can be scrapped out with the help of knife (Fig. 47.7(b)). During scrapping it should be noted that pieces cut should not be very small. Probable date of ripening of crops can be known by following indications.

- Cracks appear in lac before 15-20 days.
- Sap of female insect becomes thick.
- Eggs of egg group are completely separated.
- Impression appears of eggs becoming granular.
- Outer colour of lac becomes yellow and dry.

5. Washing of lac- Scrapped lac is known as stick lac, which is rubbed and washed thoroughly with water. It leaves a type of color which is known as lac dye. It is dried in shade.

About 2 crore kg of lac is produced in India every year, which is more than 60% production of whole world. 50% of total production of lac is done in Chotta Nagpur area of Bihar in India. Lac is used to make bangles, utensils, toys, polish, warnish and electrical equipment. In India women use it as Mahavar. There has been significant contribution of Indian lac Research Institute Namkun (Ranchi) towards advanced production of lac.

Important Points

1. On utility point of view, animals are useful for human in many ways.
2. Keeping pets of useful animals and their management by human is called domestication. Such animal are collectively categorized under livestock.
3. Domestication of economically important animals and their management by scientific methods can provide employment and extra income to human.
4. Rearing and breeding of fowl and other bird species is known as poultry farming. We obtain meat (from broilers) and eggs (from layers) from them.
5. Cultivation of useful and high productive capacity of species of fishes is known as Pisciculture. High-quality of special proteins, Vitamin A and D and many other products and byproducts are obtained from fishes.
6. Rearing and cultivation of other water animals such as Prawns, Lobster, Mollucs including fishes etc. is known as water cultivation or aqua culture. India is ranked second in the world in aqua culture field.
7. Honey bee is useful insect by which useful products like honey and wax are obtained. Rearing of honey bees through scientific techniques is known as bee keeping or Apiculture. *Apis mellifera* species of honey bee is most useful for rearing.
8. On commercial point of view, rearing and management of silk worms for production of raw silk is known as sericulture. Mulberry silk moth *Bombyx mori* is main silk worm. Silk is produced by silk glands of larva of silk moth. Raw silk is obtained from cocoon.
9. Lac is a type of resin which is obtained from *Lacifera lacca* (*Tarcharida lacca*) named insect. India is highest lac producing country the world.

Practice Questions

Multiple Choice Questions -

1. Which of the following desi breed is used for poultry farming?

   (a) White Leghorn (b) Pekin

   (c) New hampshire (d) Legsr

2. What is incubation period of eggs of poultry (fowl) ?

   (a) 21 days (b) 28 days

   (c) 30 days (d) 12 days

3. From poultry farming are obtained

   (a) Eggs and honey (b) Meat and Lac

(c) Eggs and wax (d) Meat and eggs.

4. Silk is obtained from which stage of silk worm?
   (a) From egg (b) From caterpillar
   (c) From adult (d) From cocoon
5. The scientific name of European honey bee is
   (a) *Apis mellifera* (b) *Apis dorsata*
   (c) *Apis florea* (d) *Apis indica*
6. The function of queen honey bee is
   (a) Control other bees (b) Protect beehive
   (c) Breeding (d) Prepare honey
7. Which of the following does not come in class of major carp?
   (a) *Labeorohita*
   (b) *Catla Catla*
   (c) *Cirrhinus mrigala*
   (d) *Chainoze chainoze*
8. Anthrax disease in animals is
   (a) Virus borne (b) Helminthes bone
   (c) Bacteria borne (d) Protozoa borne
9. The host plant of kusumic lac is
   (a) Kher (b) Babul
   (c) Sheasam (d) Ber
10. Muga silk is obtained from which silk worm
   (a) *Bombyx mori*
   (b) *Antheraca assamensis*
   (c) *Antheraca paphia*
   (d) *Attacus rechinii*

Very short Answer Questions -

1. What is domestication?
2. What is fowl called used for production of eggs?
3. India holds which place in poultry farming in the world?
4. What is called rearing and management of fishes.
5. Write the name of two working research centers for pisciculture in India.
6. Write the scientific name of lac worm.
7. Write the name of any one disease of silk worm.
8. Silk glands are modification of which gland in silk worm?
9. Which precautions are to be taken during bee keeping?
10. What do you mean by fish seed?

Short Answer Questions -

1. Describe virus borne disease caused in poultry.
2. Write a brief note on social organization in honey bees?
3. Write use of lac.
4. Name the main species of silk worm and the silk produced by them.
5. Describe different diseases occurred in silk worms.

Essay Type Questions -

1. Write an essay on pisciculture.
2. Write main qualities of lac insects and name of their host plants.
3. Write in detail about poultry farming.
4. Describe in detail different stages of sericulture.

Answer Key-

1. (d) 2. (a) 3. (d) 4. (d)
5. (a) 6. (c) 7. (d) 8. (c) 9. (d) 10. (b)