PROGRAM:	ERASMUS+
ACTION / SUBPROGRAM:	Key Action 2 / Strategic Partnerships
PROJECT TITLE:	"OSH+ for the European Agriculture sector - Stimulating growth in rural areas through capacity building for providers (and beneficiaries) of occupational medicine and OSH services"
Intellectual Output :	O5 "Course 2 Training Materials - Occupational Physicians"
Module:	**2 – Economic sub-sectors within agriculture**
Document:	**Manual**

2 Economic sub-sectors within agriculture

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2.1 Aquaculture

2.1.1 Definition of aquaculture as economic subsector / CAEN code

AQUACULTURE, a sub-sector of animal husbandry, is the farming of aquatic animals and plants by means of intensive or super intensive production, in sweet or salt water, in continuous flow or recirculating systems, in open or closed environments, with the aim of selling the aquaculture products.

CAEN Code: 0502/125

2.1.2 Classification of aquaculture activities:

Aquaculture has the following sub-branches:

- Fish farming
- Clam farming
- Oyster farming
- Mussel farming
- Pearl oyster farming
- Crustacean farming: shrimp, crab, lobster, crayfish
- Algae farming

List of fields of activities – CAEN Codes 2015

- 05. Fishing and aquaculture
- 050. Fishing, aquaculture and related services
- 0502. Marine aquaculture
- 0502/125. Sweetwater aquaculture

2.1.3 The main components of aquaculture in Romania

In the past 50 years, aquaculture has grown exponentially, from an output of under 1 million tons in 1950 to 51.7 million tons in 2006. While the output of wild fish has been flat and sometime even dropping, aquaculture keeps growing faster than any other sector in the animal food field. It is estimated that aquaculture will keep holding pride of place in terms of global fish output.
Some 75% of the maritime resources are exploited to the limit and even beyond that. National fish consumption increased from 45 million tons in 1973, to more than 130 million tons in 2000. According to the Food and Agriculture Organization of the United Nations (FOA), some 40 million tons of fish and shellfish will be needed by 2030 just to maintain the current level of consumption.

For such a demand to be supported in the long run, sustainable alternatives must be developed, and the most promising of all is aquaculture.
As of 1980, the growth rate of the sector has been 8% per year, thus ranking high among the food industry's most developed branches, currently covering 50% of the fish consumed at global level.
In Romania, just like elsewhere in the world, aquaculture has been growing fast, thanks to an increasing demand for fish and shellfish and the dropping reserves in the world's oceans and domestic freshwaters.
A sustainable development of aquaculture farms entails the observance of environmental safety rules, as well as the principles of economic viability and social development.

2.1.4 Production cycles in aquaculture

Fish farming in super-intensive circulating systems, as compared to raising fish in open ponds, has the following advantages: it saves land and water resources, location can be anywhere, allows an increased level of control over the breeding environment, fish can be raised anytime during the year, in optimum conditions, harvesting can take place anytime, the output and revenues can be established more precisely.

Fish maintenance in a recirculating aquaculture system (RAS)

- Establishing the load capacity: the maximum quantity of biomass that can be maintained inside the system or the mass per volume unit of the culture system; in order to be profitable, an RAS must be properly sized
- The water circuit in super intensive recirculating aquaculture system: fresh water is taken out from a deep well (70-12.); by means of a submersible pump, the water is pumped into a buffer tank (V=30 m^3), which mixes the fresh water with the recirculating one; from the buffer tank, the water pours gravitationally into the fish tanks, at a flow that allows a complete change of water 2 times/hour; evacuation is through a pneumatic evacuation system;
- Mechanical filtering, bio filtration and sterilization: the water with impurities in the breeding tanks gets into a drum filter, with a filtering capacity of 350 m^3/h and a filtering sieve (0,07 mm); upon exiting the mechanical filter, the clear water gets into a biofilter (biological or nitrifying filter) where the layer of biological spheres is cultivated with nitrifying bacteria of the Nitrosomonas and Nitrobacter genus, which convert ammonia into nitrate, which is less toxic to fish; through the biofilter, the water gets to a sterilizing ultraviolet pump; sodium chloride is added to the water, as this reduces the osmotic stress; the salt concentration is 0.0002-0.2%; 10% of the total volume of water in the system is eliminated; the treated water is pumped into the buffer tank;
- The dashboard of a recirculating aquaculture system: on the front side of the dashboard there is a signaling lamp for each pump; starting the pump is conditional on the level of water in the biofilter tank, which is equipped with low and high level sensors; the motors of the pumps are protected by magnetic-electric circuit breakers;
- Water quality monitoring: the following parameters are taken into consideration: temperature, oxygen, carbon dioxide, Ph., ammonia, nitrites and solids; to maintain a high level of water quality, the water is continuously evacuated from the farming tanks and goes through various processes: mechanical filtering, bio-filtering, sterilization, oxygenation, aeration, heating/cooling; 10% of the water volume is eliminated every day'
- Fish feeding in a RAS: in the first stages, juvenile fish are fed with live food (Artenia salina, Daphnia, Tubifex), then with simple or extruded granulated feed; the feed can be distributed manually, using automated dispensers or through computerized equipment;
- Monitoring bio-productive indicators: the real and apparent growth rate, daily growth rate, specific growth rate and food conversion rate;

Calendar operations in a RAS:
Given that operations carried out in a RAS are not seasonal, they cannot be differentiated in keeping with this criterion.

Type of staff/employees involved in the production cycle
In super-intensive RAS, the staff is skilled, with secondary or high-school education. Employees are coordinated by a fish engineer, who is very familiar with the system. Failure to properly manage the system can lead to massive economic loss.

Equipment used in aquaculture
The following types of equipment are used in a super-intensive RAS:

- Fish breeding tanks: square(1,5 x 1,5 x 0,7 m; V=1,125 m^3), circular(Ø=3 m; V=5,63 m^3), big-round(Ø 4 m; H=1,20 m; V=12,56 m^3), larvae trough (330 x 40 x 30 cm);
- Quality control equipment: Hanna multi-parameter;
- Water welling and recirculation equipment: submersible pump, recirculating pump, pump for water with solids;
- Solid removal equipment: drum filter (max capacity 350 mc/h)
- Food distribution equipment: bunker type feeder, belt feeder
- Oxygenation and aeration equipment: cryogenic tanks for liquefied gas, vaporizers, oxygen or air diffusers, aeration pumps, aerators fitted in the rearing tanks;
- Staff protective equipment: rubber overalls, rubber apron, rubber gloves, rubber boots;

Chemical substances used in aquaculture
The following substances are used in a super-intensive recirculating aquaculture system:

- sodium hydrate: a 10-15 cm thick sponge impregnated with sodium hydrate is placed in a wooden box, at the entrance to the production halls; it is used to disinfect footwear;
- Sodium chloride in water: concentration of 0.002-0.2%; it reduces osmotic stress; it can also be used to clean the tanks after exhaustion;

2.2 Beekeeping – apiculture

2.2.1 Definition of apiculture as economic sub-sector / CAEN code

Apiculture is the practice of keeping bees and manufacturing honey and beeswax; one major role of apiculture is plant pollination in the vicinity of beekeeping areas. CAEN code: 0125

2.2.2 Classification of apiculture

List of fields of activity – CAEN code 0125:

- 01. Agriculture, hunting and related services;
- 012. Animal husbandry
- 0125. Other types of animal husbandry: beekeeping

2.2.3 The main components of apiculture in Romania

Within the broader context of agriculture, apiculture is a precious instrument, by means of which people can produce both food and generate income. Apiculture is an easy to start activity, because it does not require a big investment, as compared to other types of agricultural activities. Apiculture can become a profession for those who earn a living by keeping bees or a means of entertainment for those who keep a small number of bee families.

Taking into consideration the number of flowering plants and the environmental conditions, it is estimated that some 2 million bee families can be kept in Romania, which would be double as compared to the existing number today, ensuring a honey production of 40000 tons. Data provided by the National Statistics Institute

show that honey production in Romania grew in 2001-2004, and in 2004 the maximum output was 19150 tons of honey.
According to data made public by the Ministry of Agriculture, Forestry and Rural Development, in Romania family bee density stands at 4 families /square km, higher than the European average of 2.8 families/ square km.

In 2006, in Romania the most numerous were honey bee farms of 1-23 families (34.10%), followed by those of 24-50 families (27.20%), of 50-150 families (21.3%) and of more than 150 families (17.40%). In the same year, there were 36,900 beekeepers and 975,000 bee families registered in Romania.

Romania is considered an exporter of honey, as it exports more than it imports. Honey is collected in acquisition centers at a price of 1.2-1.8 Euro/kg, and then exported at a price of 5-6 Euro/kg, which means that it is highly profitable. Acquisition centers in Romania pay 7.5-10 lei for one kg of polyfloral or lime tree blossom honey, 9-10 lei for one kg of rapeseed honey, 30-45 lei for one kg of pollen, 130-200 lei for one kg of propolis and 15 lei for one kg of raw wax.

There are two types of harvesting in apiculture, depending on how much nectar and pollen are there in nature: 'maintenance' or 'production' (main). Maintenance harvesting covers only the daily consumption of the bee families, while production harvesting means that bees bring to the hives quantities of nectar and pollen that exceed their consumption needs and therefore the remaining honey and pollen are deposited to be used later. The most important types of production harvesting are those of acacia, lime tree and sun flower.

2.2.4 Production cycles in apiculture

The annual cycle of a bee family is closely linked with the succession of seasons and the climate of the area where they are grown, as these characteristics influence the blossoming cycle and ensure the living of the bees. The season starts in autumn. The number of bees that get out of winter, as compared to the number of bees in autumn, depends on the family's power with regard to capitalizing on the harvest.

Maintenance operations

- *Preparing bee families for winter* : consists in replacing the exhausted queen bees with young mated bees, ensuring the bees that are going to winter, ensuring the necessary food supplies for winter, sizing the hive in keeping with the power of the bee family, organizing the family nest.
- *Taking care of the bee families during winter* includes measures of audio (in Romanian language it is called "furtunul sub ghem") and visual (control sheet) control as well as operations aimed at correcting abnormal situations (insufficient supplies, losing the queen bee, diarrhea, excessive humidity, mice).
- *The cleansing flight*: during this flight, bees eliminate their body wastes; the flight takes place in late February and early March, when the air temperature rises to 11-13 degrees Celsius; to let the bees do their cleansing flight, the metallic bars and blocks are removed from the hives; entrances are opened wide and checked; caps and thermal protection mattresses are removed; the flat horizontal rack in which bees are staying (in Romanian language it is named "podisorul") it is replaced by a thick window;
- the cleansing flight is monitored in order to see how the bees overwintered; a feeder is placed in the hive; polyethylene foil is prepared for the bees to land on upon returning to the hive; after a one hour flight, the entrance to the hive is closed and the metallic grids and thermoinsulating materials are placed back.
- *The spring revision* is made on the first warm days (over 12 degrees Celsius) of spring ; this is done to evaluate the health of the bee colony and to take immediate measures ; the check up is fast, and does not require a full uncovering of the hive ; the revision establishes : the strength of the family,

the presence of the queen bee, the existence of food supplies, the condition of the honeycomb and the general condition of the hive.

- *The main check-up of the bee family* is carried out in spring, when temperatures rise to 15 degrees Celsius and above; each family is checked frame by frame; the check-up establishes: the strength of the family, the presence and quality of the queen bee, the existing amount of honey in the hive, the resistance to overwintering and the quality of the honeycombs, the sanitary condition of the bee families, the need to reorganize and reduce the hive.
- *Stimulating feeding* is carried out in order to replace maintenance harvesting in nature ; to this end, bee families are fed regularly with honey, sugar syrup, candy, pollen and pollen substitutes; stimulating feeding starts at least 6 week before the start of acacia harvesting (in April) and lasts 2-3 weeks.
- *Enhancing the habitat* means ensuring the necessary space for nesting. In horizontal hives, this is done by introducing an empty comb between the last comb with baby bees and the lateral supply comb. This is done regularly, every other week. In stackable hives wintered in two boxes, when there are 7-8 combs in the upper box, the two boxes are replaced with one another. After 10-15 days since the first reversal, a new one must be done. These reversals have to be done regularly.
- *Maintenance and exploitation works* are carried out in order to ensure an intensive harvesting and consist in: ensuring the necessary space to store honey and larvae, applying the methods for an intensive development of bee families and maintaining bee families active.
- *Bee families can multiply* through natural swarming or directed swarming. In Romania, natural swarming starts on May 15-20 and can last until June 5-10. The quiet families, with higher production characteristics, can be multiplied by means of directed swarming.
- *Estimating the amount of bees and honey in a hive :*
  - *Bee quantity:* a horizontal comb contains on both sides 270g of bees, and a multi-layer comb 200 g of bees;
  - *Honey quantity:* a horizontal comb has some 3.5 kg of honey on both walls, and a multi-layer hive comb has some 2.5 kg of honey;
- *Food needed by bees in a hive for one year:*
  - *One family: 90-100 kg of honey + 12-15 kg bee bread + 12-30 kg product honey*
  - *One cluster: 40-50 kg of honey + 7-8 kg of bee bread*
  - *One nucleus: 8-10 kg of honey + 1-2 kg of bee bread*
- *Breeding plan: 20% clusters and 10% nuclei*

Beekeeping calendar

In a calendar year, a beekeeper carries out the following operations:

1. **January**: supervises overwintering by means of weekly audio controls and by resolving abnormalities; removes without noise the ice and snow on the flying pads; removes the dead bees from the entrance to the hive in order to let the air get into the hive; ensures the tranquility of the hive by preventing attacks by mice, woodpeckers, poultry, etc.; ensures additional protection by equipping the hives with additional wind protection panels; fixes, cleans and disinfects all tools and equipment; wires the combs needed for the next active season; protects the combs against rodents;
2. **February**: carries out weekly audio controls while monitoring overwintering and resolves all abnormalities; prepares the apiaries for the bees' cleansing flight; ensures food supplies; starts stimulating feeding after the cleansing flight; fixes, cleans and disinfects all tools and equipment; treats combs with brimstone smoke;
3. **March** : stimulates and supervises the general cleansing flight; places a shelter with water and salt (5 g salt/l of water); carries out the basic spring check-up; applies, if needed, various treatments to combat diseases (varroosis and nosemosis); provides additional food to bee families with a view to capitalizing on early intensive harvesting (acacia and rape seed);
4. **April:** carries out a general spring maintenance check and removes all abnormalities observed during the evaluation; transfers the bee families into clean and disinfected hives; gradually enlarges the

nests during the tree blossoming period, with built combs and then with artificial combs; installs pollen collectors; finds and rebuilds the combs that are not right; extracts and conditions the wax obtained from the formed combs; treats reserve combs against wax moth pest; takes measures to prevent wax moth pest; checks the health of all bee families; applies treatments for varroosis and European foulbrood; carries the bee families to pollinize fruit trees; prevents poisoning caused by phytosanitary treatment;

5. **May:** enhances the nest in keeping with the evolution of harvesting and the development of the bee family; periodically picks-up larvae from the strong families in order to strengthen the weaker ones; introduces artificial combs into the hive in order to use the bees' wax secreting potential and to ensure the built combs; prepares the bee families and their transport for acacia harvesting; extracts the honey and melts the wax; takes measures to combat the mycotic disease of bees manifested through dead, dried, and mummified bees found on the bottom of the hive (in Romanian language it is named "puietul văros") and American and European foulbrood;
6. **June:** harvests the combs for overwintering and puts them into storage; extracts the honey and wax obtained from acacia harvesting; installs a pollen collector with a view to ensuring the necessary supplies; shadows the hives and increases nest ventilation; forms new families to prevent natural swarming; strengthens the newly formed families with larvae combs and young bees from the strong families that seem to want to start swarming; prepares the bee families for summer harvesting; carries the hives to lime tree forests and son-flower fields; regularly controls the health and strength of the bee families; applies treatments against the mycotic disease of bees and against the American and European foulbrood;
7. **July:** strengthens the bee families formed in the previous months; replaces the old and exhausted queens with young and prolific queens; extracts and conditions the honey obtained from summer harvesting; carries out a general check-up of the nests; carries the hives to a place for maintenance harvesting (melon fields, meadows); conducts stimulating feeding in the absence of harvesting and prevents stealing; reconditions the deteriorated tools and equipment; carries on treatment for families suffering from the mycotic disease of bees and from the American and European foulbrood;
8. **August:** extracts the honey obtained from summer harvesting; hives are transported for late maintenance harvesting; reduces the main entrance of bees into the bee hive (in Romanian language it is called " urdinis") when there is no harvesting, in order to prevent stealing; unseals the combs that need to be reformed and places them beyond the diaphragm for honey to be released; conducts stimulating feeding in order to stimulate the development of the larvae in times of poor harvesting; treats the combs in the supply against wax moths; conducts a check-up of the families in order to remove all abnormalities; applies specific treatment in case of disease.
9. **September:** reduces the nest and carries out the final fitting of the combs for overwintering; completes the food reserves for winter with spare combs; reshapes and melts the combs that are not right; treats the spare combs against wax moth pest; applies treatment to combat varroosis and nosemosis.
10. **October**: wraps the bee family nest with insulating materials to protect it against sudden temperature variations; installs grids against mice; stimulates and supervises the late cleansing flights; disinfects all agricultural tools and equipment; installs protective walls against strong winds and drafts;
11. **November:** surveils and controls overwintering; stimulates and supervises late cleansing flights; sorts the spare combs; extracts and conditions the products remained from the previous months; cleans and disinfects the hives with no bees; fixes the hives and agricultural equipment; ensures the tranquility that bee families need; supplies the hives with materials needed for the next season;
12. **December**: weekly supervises and controls overwintering; stimulates and supervises late cleansing flights; removes without noise the ice and snow from the flying pads; provides additional protection against cold wind; makes sure there is quiet in the apiary; fixes equipment, wires the frames and fixes artificial combs;

Type of staff/employees involved in the production cycle

In Romania, apiculture is predominantly a private sector (98%). In 2006, there were 36,900 beekeepers registered in Romania, of whom 59% aged 35 to 50, 23% aged over 50 and 18% under 35.
The main factors taken into account when organizing and setting up a bee yard are the optimum size of the farm and the skills of the beekeepers. Apiaries of 1 – 25 hives are considered subsistence or family apiaries, where beekeepers work during their spare time in order to get production that covers the consumption needs of their family and something extra than can be sold and thus cover production costs.
Colonies made up of more than 50 families and the entire inventory used in order to carry out the necessary apicultural activities need to be taken care of by people who have the necessary technical skills, acquired during training courses organized by the County Agricultural Advising Office. These people carry out beekeeping activities in their spare time, and can obtain significant incomes.

Colonies of 150-300 families (2000) are in the care of professional beekeepers, with years of experience and graduates of professional training courses. Sometimes seasonal workers are also hired.

Equipment and tools used in apiculture

In order to make work in an apiary easier and to prevent accidents, beekeepers use :

- Tools used to examine a hive: the hive tool(scraper), the smoker, the beekeeping brush, the frame spacer, the stool, the queen cage;
- Tools used to wire the frames, fix the artificial combs and preserve spare combs: caliber, perforator, the toold for adjusting the wood parts of the hive (please see below the picture number 1 – in Romanian language these tools are called “planșeta calapod si pintenul apicol”), the chemical pencil used by some Romanian bee-keepers for testing the quality of the honey (in Romanian it is called “creionul apicol“), sulfur burner, the board where combs are kept and smoked;

- *pollen collecting tools :* pollen collector
- *honey extraction and conditioning tools :* fork and knife, tray for unwaxing the combs, table for unwaxing the combs, radial or tangential extractor, honey sieve
- *wax extraction tools:* solar melter, steam melter, wax press

The following shelters are used to maintain the bee families :

- stackable hives: made of three boxes, with 10 frames/body; total volume of 126 liters (0.126 cubic meters); made up of: bottom, frames (435x230 mm); the body of the hive (20 mm thick), bridge, feeder, ventilation frame, lid; the hive with all its components weighs 30 kg;
- vertical hive with one box and storage space: made up of one main box and two stores, with a volume of 84 liters (0.084 cubic meters), 20 mm thick walls; the frames in the nest are 435x300 m in size, and those in the store 435x162; each box and store has 10 frames; lid, bridge, feeder;
- *RA-001*, made up of one box and two stores, with a volume of 114 liters; nest frames are 435x300 mm in size, and those of the stores 435x162 mm; each box and store has 10 frame, lid, bottom;
- *the horizontal hive :* has a box with 20 frames ; a volume of 116 l (0,116 cubic meters) and weighs 42 kg ; the frames are 435x300 cm ; diaphragms, bridge, lid ;
- *the bee pavilion:* hives arranged in 2-3 rows; home to 45-90 horizontal hives with 18 frames of 470x300 mm;

Beekeepers are protected by special equipment, which includes : hat and veil, coveralls, apron, gloves;

Chemical substances used in beekeeping
To protect the combs outside the hives, they are treated chemically in isolated spaces. For this, the following are used:

- Sulphur dioxide: Sulphur is spread over hot charcoals in a tray; the space should be big enough for 50-150 g Sulphur/m3; the tray is placed on top of the frames; the Sulphur dioxide kills the wax moth larvae and the moths, but not their eggs; the treatment must be repeated every 10 days; Sulphur fumigation combats wax moth pest in autumn (August – September) and spring (April- May); the Sulphur attacks the frames' wire; reeds impregnated with Sulphur can also be used; they are lit in special burners;
- *naphthalene :* blocks the biological cycle of the wax moth ; for this, little gauze bags with 25 g of naphthalene are introduced for 24-48 hours; this must be repeated every 10 days; naphthalene has a strong and persistent smell and can have undesirable effects;
- *paradichlorbenzene:* one teaspoon of paradichlorbenzene placed on a sheet of paper on the bottom ensures protection against wax moth, for a box with 10 frames;
- the commercial product named "Galezon" (produced in Romania by the National Institute for Research and Produciton for Apiculture): 25 ml per box, destroys wax moth pest; it is highly volatile, so it must be poured in a pot or over a piece of cloth, which is then placed on top of the frames;
- the commercial product named "Galerin" (produced in Romania by the National Institute for Research and Produciton for Apiculture): prepared from 40 g of powder and 1 liter of cold water; it is sprayed on both sides of the comb; the combs that are attacked can be powdered with galerin;
- glacial acetic acid: destroys both wax moths and spores of Nosema apis; 120 ml are poured into a pot, which is then placed on the upper backs of the frames;

2.3 Mollusk farming

2.3.1 Definition of mollusk farming as economic sub-sector in Romania / CAEN CODE

MOLLUSK FARMING consists in growing terrestrial molluscs, such as edible snails (heliciculture), marine mollusks (Ostrea, Mytilus, Pecten, Cardium) and freshwater mollusks (Anodonta and Unio).
CAEN code: 0125

2.3.2 Classification of mollusk farming

List of fields of activity – CAEN code 0125:

- Agriculture, hunting and related services
- 012 Animal husbandry
- 0125 other types of animal husbandry; mollusk farming

2.3.3 The main components of mollusk farming in Romania

From prehistoric times, people have eaten snails, as their meat is rich in proteins and salts, but poor in fat. When it's fresh, the edible part of a snail (accounting for 40% of its total weight) contains 79-79.5% water, 16-17% proteins, 2% sugar, 1.7% fat and 1-1.5% mineral substances. The proteins include 9 of the 10 amino acids that humans need. Snail meat is easy to digest, nourishing and healthy. 1000g of snails has approx. 80 calories. One kilogram of snail meat is obtained from 4-4.5 g of fresh snails. Some parts of the snail (sexual glands, mucus, hepatopancreas) are used in medicine.

In the last decades, the consumption of snail meat has increased, and therefore their number has decreased dramatically due to excessive harvesting, pollution and the use of chemical fertilizers, which have gradually

destroyed their natural habitats and therefore their natural breeding habitats. In order to ensure the protection of the snail populations in countries such as France, Germany and Italy, their harvesting in nature was banned and measures were taken for snails to be raised in special farms.

At the moment, snail production only covers 15% of the global demand. In 2002, 420,000 tons of snail were consumed, in particular in France, Italy, the US, the United Araba Emirates and Japan.
The International Snail Breeding Institute in Cherasco, Italy, played an important contribution to the full biological cycle. The institute created, out of the Helix pomatia species, a population of snails with sweater meat, and also bigger and more homogenous. They reach sexual maturity at the age of 6 months, as compared to the 'wild' snails, who reach such maturity at the age of 3 years.

40,000 tons of snails are consumed in France alone, of which 2,500 from imports. In late 1979, in France, a Heliciculture Experimental Resort was set up as part of the National Agricultural Research Institute in Poiton-Charentes, Magneraud, where a system was developed to breed and raise snails in a controlled environment. The price of a kg of snail meat is established in September, at the Paris Stock Exchange. In 2003, one kg of snails cost 5.2 Euro.
In the farms where snails are raised in full biological cycle, there is not much work to do, the investment is not big and amortization is quick.

2.3.4 Production cycles in mollusk breeding

Outdoor full-cycle snail farming was developed and completed in 30 years by the Cherasco Snail Breeding Institute, in Italy. This technology has also been applied in Romania.

Operations for setting up and exploiting an outdoor snail farm

- *Choosing and preparing the ground:* the chemical composition of the soil is first analyzed; the best ones are clay soils, soils containing clay and sand , with a pH ranging between 5.8-7.5, with a balanced sand – mud – clay ratio (granulometry), with 1.5-2% calcium and good fertility; the location should provide easy access to the production place; the farm must be placed in sunny areas, on flat or slightly inclined surfaces; in the areas where green crops are to be cultivated (feeds), the land is enriched with manure, is ploughed and harrowed; also, draining channels are built and the irrigation system is put in place.
- *Designing the farm*: the green crops layers are established, separated by 1 m wide alleys, on which workers can circulate; the central alley should be 2.5 m wide; there must a 3 m free space between the outer fence and the layers within; a fence made of zinc-coated sheet is set up, enforced by external pillars; the irrigation system is developed; a well is drilled; the interior fence and the wooden pillars are installed; the breeding and rearing layers are surrounded by a Helitex net, with two stoppers; a disinfection area for shoes and machines is set up at the entrance to the farm.
- *Fertilizing and disinfecting the land : nitrogen fertilizers are used (50kg/2000 square meters) ; rodents are combated with Malathion 5% (50 kg granules / 2000 square meters) ; manure is used for fertilization (100 kg manure per layer) ; the delimitated layers are ploughed ; a second disinfection with Malathion is carried out ; the plants that have grown on the alleys between the layers are removed;*
- *Green cropping :* longitudinal bands of clover, lettuce or a mix of typhone and cabbage are sowed in the breeding layers, with sunflower, rape and beetroot in the middle ; this vegetal food can be completed with concentrates and PVM supplements; when vegetation in the layers grows up to 1-15 centimeters, it is populated with breeding snails of the Helix pomatia type (22 snails per square meter);
- *Ensuring additional food :* more plants are grown outside the farm, which will provide snails with the food they need ; these plants are distributed when plants in the rearing layers are blooming ; the main such additional food is provided by sunflower, which is sowed 8-10 times during a season ; a mix of rapeseed oil and beetroot can also be used ;

- *Harvesting and selling the snails* : the *Helix pomatia* snails are harvested when the shell is solid and strong, when it reaches maturity and a certain size; the snails are placed in lid boxes or containers covered by a net; when sold, the snails are classified in keeping with their aperture; the preferred ones are those with an aperture of 28-32mm.

The monthly calendar of operations carried out in a full production cycle snail farm

The cycle in a snail farm starts with the introduction of breeders between May and June. The operations by month are:

1. **May** - the first part of complementary plants are sowed (lettuce, cabbage, sunflower); the sowed land is watered;
2. **June, July, August**: the external fence is checked (for holes); the upper part of the plants is cut down to 20-25 cm; the crops are watered early in the morning and in the evening, every 2-3 days; the place is checked for pests;
3. **September:** the plants are cut to stay at a certain height; the farm is checked for cleanliness; the layers are watered in keeping with the humidity of the environment; green forage is added to once a week; dry feeding is carried out every 4-5 days;
4. **October** : complementary feeding is carried out ; vegetation is mowed and let to fall on the ground ; then the plants are removed, and the plots are ploughed and sowed ;
5. **November**: snail operculation starts; vegetation should not be too tall and prevent snails from getting into the ground; all the snails that have not buried themselves are collected and transferred to cellars where temperature is maintained below 0 centigrade;
6. **December, January, February** - farm organization continues and layers are prepared for singling; the new layers are sowed (around February 15) and covered by an unknit kilt; disinfestation is carried out
7. **March :** complementary food sowing ; the dry food is prepared ; complementary feeding is carried out ; the snails hatched in the previous year are introduced in the layers for singling ; the mating of adult snails starts ; passages between layers are cleaned and the grass on them is cut ;
8. **May, June** - complementary feeding continues; the farm equipment and facilities are checked; vegetation growing in the layers is harvested; green crops continue to be planted;
9. **July** – August: the grown-up individuals are collected; vegetation cutting and irrigation continues; second-year snails' breeding is monitored;
10. **September** – the harvesting of the snails that fed from the singling layers is completed; the harvesting of the snails that matured in the reproduction layers starts;
11. **October** – snails in the layers are harvested; the layers are prepared for another seeding and the season works are carried out;
12. **November** – the operculated snails are harvested from the soil (around November 20-25); layers are prepared for next year.

Type of staff/employees involved in the production cycle

Thanks to its temperate-continental climate, characterized by more precipitation than in the countries that have a tradition in snail farming (France, Italy, Spain, Greece) and a lower cost of the labor force, in Romania this activity registered a boom in 2003-2007. Therefore, in late 2006, according to estimates by the Institute in Cherasco, Romania ranked 2nd in the world in terms of number of snail farms (more than 1500) and the areas covered by them.

All farms were set up from private funds, and production and management activities were carried out by members of the owners's families. Hired staff was rarely resorted to.

Equipment used in snail farming

In snail farming, the following types of equipment are used:

- Protective equipment for the staff: overalls, robes, gloves;
- Tools for planting the green crops: drill machine, tractor, miller;

- Materials that prevent the access of pests and do not allow snails to leave the farm: outer wall made up of zinc-coated tin, pillars (wooden, iron, cement), Helitex net; iron net (plasticized or zinc-coated; 3-4 mm), disinfector (it contains a 10-15 cm thick sponge impregnated with sodium hydroxide;

Chemical substances used in snail farming
The following substances are used in an outdoor full-cycle snail farm:

- sodium hydroxide: a 10-15 cm thick sponge is placed on a disinfection barrier; the disinfector is a 30-35 cm deep hole, 2 m long and 1.5 wide, in which a 5-10 cm concrete layer is cast; it is used to disinfect the footwear and the wheels of the miller;
- nitrogen-based organic fertilizers (type 12/12/123): 50 kg of nitrogen-based fertilizer for an area of 2000 square meters;
- malathion: used to combat pests: 50 kg granules per 2000 square meters;

2.4 Pisciculture (fish farming)

2.4.1 Definition of pisciculture as economic-subsector in Romania / CAEN code

PISCICULTURE is a branch of animal husbandry, which deals in breeding and multiplying fish in natural waters, ponds, stews, etc.

CAEN CODE: 0502

2.4.2 Classification of pisciculture

List of fields of activity – CAEN Code 0502
05. Fishing, pisciculture and connected services
050. Fishing, pisciculture and connected services
0501. Fishing
0502. Pisciculture (fish farming)

2.4.3 The main component of this economic sub-sector in Romania

Fishing and fish farming, alongside fish processing and trading are activities that are carried out all across the country. In Romania, there are isolated areas such as the Danube Delta and the Danube Gorges where fishing is a top-ranked activity, a source of jobs and income for the local population.
Romania has a 843,700 hectare hydrographic network, which accounts for more than 3.5% of the country's surface.
In 2005, there were 100,025 fish farms in Romania, including 84,500 fish raising farms (84%), 15,500 fish nurseries (15%) and 25 hectares of salmon farms (1%). In 2011, licenses were issued for a total area of 98232.78 hectares, of which 8617.55 hectares of nursery farms (9%) and 89615.23 hectares of fish raising farm (91%). In 2005, salmon farms in our country covered only 25 hectares, an area that grew to 69.23 ha in 2012, represented by 85 units.
In 2005, 6811 people were working in the fishery sector, of whom 2781 in pisciculture, 866 in processing, 2532 in domestic fishing and 633 in maritime fishing. In 2008, the staff working in the sector dropped to 2700 people.

2.4.4 Production cycles in pisciculture

Fish farming in ponds and stews, besides knowing the biological particularities of the species prone for breeding, also requires measures to ensure a rational and profitable raising process.

Maintance operations in a fish farm

In a carp farm (ponds and stews), the production cycle includes the following stages :

- Preparing the pools/ponds for breeding: in the pools that are emptied in autumn, the following operations are carried out in spring: the draining channels and the bottom of the pool are cleaned and leveled, the worthless fish species are destroyed, the soil pH is corrected; the bottom of the pool is left to dry, then it is raked, the dam is prepared and organic and mineral fertilizers are spread; in stews/ponds operations are similar; 10-14 days before populating them, the ponds/pools are flooded.
- *populating the fish ponds:* this can be done when the water temperature is at least 8 degrees Celsius, in March or in autumn, after harvesting, in the pools flooded in winter; pools and stews can be populated in monoculture (only carp) or polyculture (carp and other species); in monoculture, carps can be of the same age (simple population) or of various ages (mixt population);
- *carp breeding* : depending on the specificities of each farm, breeding can be natural (usually in pools/lakes), natural-guided (in breeding ponds), directed (breeders are injected with hypophysis suspension, sexual products are milked, milt is mixed with the harvested eggs, and the fertilized eggs are incubated in Zug-Weis incubators);
- *rearing carp larvae* : the larvae hatched in incubators are set free in nets placed inside the ponds; the nets are cleaned every day with a soft hairbrush; the larvae period in carps lasts approximately 10 day; in the first 2-3 days, larvae fed endogenously (vitellus), then feeding is mixed (vitellus and phytoplankton), and then exogenous (zooplankton up to the age of 30-40 days, then they become benthophagers.
- *rearing alevins and fingerlings* : the alevin period is 11-20 days, and morphologically between the resorption of the vitelline sack and the appearance of the first scales ; the fingerling period ranges from 21 days till the age of sexual maturity (3 years in females and 4 years in males) ; starting at the age of 20-24 days, fingerlings feed on additional food, rich in proteins ;
- *rearing one-summer carps :* at the age of 40-45 days, fingerlings are relocated in raising ponds with a surface of 2-10 ha and 0.5-1.5 m deep; the ponds must contain natural live food (benthos, Daphnii, etc.); in autumn, the production of summer carp is 800-160 kg/ha;
- *raising carp for consumption* : this is done for 2 and 3 summers fingerlings; rearing ponds for 2 – summers carps are 5-20 ha, and those for 3 – summers cover 20-30 ha; the share of feed in the body mass of the fish is 2-3% in the second summer and 3-5% in the third summer;
- *pond fishing* : this is done in order to transfer carps from the rearing ponds to the wintering ponds or to deliver them for consumption (those aged 2-3 summers) ; fish harvesting is carried out in autumn (October) at temperatures below 10 degrees Celsius ; harvesting can be done by means of vacuuming or using a net;
- *preserving fish for consumption :* for gradual delivery, the fish can be kept in winter ponds (of small sizes), in nets placed in ponds or breeding ponds of large surfaces or in canals equipped with special boxes;

Calendar operations carried out in a full production cycle fish farm

1. October – ponds are vacuumed ;
2. March – draining channels are unmudded ;
3. April – the bottom of the pond is leveled and cleaned; worthless fish are destroyed; the soil pH is corrected; the bottom is raked in order to mobilize and aerate the soil; maintenance works are carried out on dams and other hydro technical operations; populating the ponds used for fish farming (below 8 degrees Celsius); reproducers are fished from winter ponds; hypophysis harvesting from wild carps or reformed reproducers;
4. April 15 – May 15 – the period of natural breeding in carps; sires are launched in the parking ponds; sires are fed (at a water temperature of 17-18 degrees Celsius); breeding ponds are inundated 24 hours before sires are launched; before the launch, sires are bathed in sodium chloride (3-5%) to

combat parasites; sires are launched in the breeding ponds (2 males and a female form a family) – 1-3 families per pond; after 1-3 days, the carp 'battering' takes place; the water level is raised by 15-20 cm; hatching within 3-6 days since fertilization.

5. July 15 – breeding are drained ; they are left to dry ; the bottom is raked , then fertilized with fermented manure ;
6. September 1 – April 1 – the fish used to populate the ponds is transported;
7. October – November – consumption carp is harvested (2-3 summers); consumption fish is transported alive or fresh (cold and not processed);

Type of staff/employees involved the production cycle

Only skilled workers, trained on specific health and safety rules and procedures can work in fish farms; they must be properly equipped and have all the necessary materials required by working in such an environment. The staff shall not circulate on the muddy bottoms of the water ponds or of the drained ponds, unless the situation has been previously assessed. To facilitate moving on the dry bottom of the pond, timber or cane decks must be built. People will move in small groups and carrying loads that are not too heavy. Fishing using any kind of tool shall be done only by trained staff, people with long experience in the field. In case of net fishing, loading shall be done in the middle of the boat, in order to prevent it from toppling down. In case of electric fishing, the staff must wear rubber gloves and boots.
Whitewash and fertilizers are to be distributed only when there is no wind, by workers who are properly equipped, including with masks.

Equipment used in pisciculture
The typical equipment used by workers in fish farms includes :

- Personal protective equipment: rubber boots, rubber gloves, masks;
- Fishing tools: trawls, cast nets, seines;
- Equipment for fodder/feed distribution: boats (motor boats or rowboats)
- Tools for cutting vegetation that has grown in excess: mechanical mower

Chemical substances used in fish farming
In a full fish farming cycle, the following substances are used :

- Slack lime: 2500 kg/ha; after vacuuming, in the lower parts, where water has turned stale;
- lime chloride: 120 kg/m^3 water ; it is distributed for the same purpose as the quick lime ;
- sodium chloride: 3-5%; used to bathe carp reproducers, before launching them into ponds, in order to remove body parasites;
- superphosphate: 30kg/ha; it is administered directly into the water (over the entire surface)in order to boost natural feeding as of day 3-4 after breeding;

2.5 Sericulture

2.5.1 Definition of sericulture as economic sub-sector / CAEN code

SERICULTURE is the field dealing in the study of biology and technology of feeding, cultivating, rearing and improving all cocoon-producing species, from which natural silk is extracted
CAEN Code: 0125

2.5.2 Classification of Sericulture

List of fields of activity – Cod CAEN 0125
01. Agriculture, hunting and connected services
012. Animal husbandry

0125. Other types of animal husbandry: silkworms

2.5.3 The main components of sericulture in Romania

Silk farming was a practice in China, 4,500 years before Christ. In the beginning, rearing the larvae and producing raw silk was done only for the imperial courts. The Chinese kept the secret of silk farming for almost 3000 years. In the year 552 BC, two Persian monks secretly brought to Constantinople silkworm eggs hidden in bamboos rods. This is how silkworms started spreading in Spain, Italy and France.
The Turks brought the first elements of sericulture in the Romanian Principalities. In the year 1348, silk farming was documented in the regions of Transylvania and Banat. In Banat there were very good conditions for growing mulberries, so they were actually planted along the roads. Following the extension of this practice, a natural silk spinning mill was established in Lugoj in 1904, and the 'Sacosu Turcesc' Sericulture Centre was set up in 1963, focusing on the production of seeding materials for mulberries.

The Sericulture Station and the Mulberry Nursery in Cotroceni were established in 1906. In 1916, the center was moved to Baneasa and became the Baneasa Central Sericulture Station, which coordinated scientific research conducted in the experimental centres in Orsova, Cislau, Cazaci si Sacosu Turcesc. Thanks to its outstanding performance in sericultural production and research, in 1959 Romania was one of the founding members of the International Sericulture Commission. In 1989, Romania ranked 6th in the world and 2nd in Europe in terms of the production and research of raw silk. Contributing to that were some 200,000 silk farmers with a production of more than 1800 tons of cocoons. After 1999, sericulture suffered a heavy blow. Efforts have been made in the past years to revive this sector. The strategy aimed to rebuild the sector includes ensuring biological material (silkworm eggs and mulberry seedlings) for all silk farmers, gathered in farming associations.

2.5.4 Production cycles in sericulture

Programming production cycles in sericulture starts from the quantity of available leaves, which influences the quantity of worms than can be reared, in correlation with the needed accommodation space, tools and equipment, bedding (perforated paper) and labor force.

Operations part of the production cycle in sericulture

Producing food for silkworms

Depending on the species they belong to, silkworm larvae feed on mulberry leaves (Bombyx mori), ricinus leaves (Phylosamia ricini) and oak leaves (Antheraea perni). In Romania, due to pedo-climatic conditions and market requirements, silkworms of the Bombyx mori type are predominant. Therefore, in Romanian sericulture, the white mulberry is used (Morus alba), which grows in almost all types of soil, except for marshy and salty soils. Mulberries planted in light, permeable and sunny soils produce the best quality leaves.

In feeding silkworms of the Bombyx mori species, leaves are used from several types of plantations: trunk (tall, average, small), bush (tall, small), meadows and hedges.
Preparation works for setting up a mulberry plantation include: cleaning and leveling the land, fertilizing and trenching the soil, picketing the plots, digging the holes, shaping and mudding the roots, and planting the mulberry trees.
Maintenance works: sitting the soil between the rows, combatting weeds and crust, fertilizing the soil with chemical fertilizers, irrigating the cultures and cutting the leaves;
There are two distinct periods in the annual cycle of a mulberry plantation: a rest period and an active period (vegetation). There are also two intermediary periods: transition from rest to vegetation and transition from vegetation to relative rest.

Bombyx mori egg incubation operations

The incubation of Bombyx mori eggs includes the following operations:

- establishing the start of incubation: depending on the evolution of mulberry's vegetation and the frequency of late frostings; incubation can start 2-3 after the mulberry buds start sprouting; in years with normal spring, incubation can start around 10-15 April in the plain areas and 20-30 April in hilly areas;
- preparing the incubation room: 8-10 days before the start of incubation, the incubation room is fixed, it is mechanically cleaned, the room is sealed off, the equipment is washed with caustic soda, the room and the equipment are disinfected (formalin sprayer 3%); the room is sealed off for 24-48 hours, then the room is aired, the walls are painted, the equipment is washed and let to dry; the disinfector is placed at the entrance of the incubation room;
- incubation : the eggs are placed in the incubation casket of the incubator ; the necessary micro-climate conditions are ensured, depending on the stage of development (see table 2.5.4-1). For grouped hatching, the incubation caskets are rotated from the upper shelves to the lower shelves and the other way round, every 2-3 days; hatching occurs within 6-7 days, between 3-11 am.

Incubation day	temperature (°C)	Humidity (%)	light		Ventilation
			Battery incubator	Paper box incubator	
1	15	75	Natural	diffuse	Windows must be opened every three hours
2	15	75			
3	15	75			
4	18-20	75		18 hours light and 6 hours dark	
5	23-24	80			
6	23-24	80			
7	23-24	80			
8	25-26	80			
9	25-26	80-85			
10	25-26	80-85			
11	25-26	80-85		whitening, 36 ore	
12	25-26	80-85		In the dark, then light	
13	25-26	80-85			
14	25-26	80-85			
15	25-26	80-85		Hatching	

Figure 2.5.4-1 Micro-climate factors in the incubation of Bombyx mori eggs

The rearing of Bombyx mori larvae consists in the following operations:

- ensuring the micro-climate factors: this is very important in rearing silkworm, as these factors influence directly the growth and development of the larvae (table 2.5.4-2)

Age	Growth day	Quantity of leaves (kg)	Number of feedings	Growth surface (m^2)	Temperature (°C)	Humidity (%)
I	1	2.6	6	15	27-26	80-85
	2	5	6	15	27-26	80-85
	3	7	6	15	27-26	80-85
	4	5	6	30	27-26	80-85
	sleep	-	-	30	27	75
II	1	11.4	6	30	27-26	80-85

	2	25	6	30	27-26	80-85
	3	15	6	30	27-26	80-85
	sleep	-	-	30	27	75
III	1	59	5	50	26-25	75-80
	2	100	5	50	26-25	75-80
	3	110	4	50	26-25	75-80
	4	9	4	70	26-25	75-80
	sleep	-	-	70	26	70
TOTAL		430				
IV	1	120	4	90	24-23	70
	2	140	4	140	24-23	70
	3	200	4	140	24-23	70
	4	240	4	200	24-23	70
	5	140	4	200	24-23	70
	sleep	-	-	-	24	65
sleep		-	-	-	24	65
V	1	100	4	250	23-22	70
	2	150	4	250	23-22	70
	3	200	4	300	23-22	70
	4	370	4	300	23-22	70
	5	400	4	300	23-22	70
	6	400	4	300	23-22	70
	7	350	4	300	23-22	70
	8	160	4	300	23-22	70
	9	100	4	300	23-22	70
	cocooning	-	-	-	23	65
TOTAL		3070				

Figure 2.5.4-2 Growth parameters for Bombyx mori larvae resulted from 100 g eggs

- keeping the larvae: changing the bedding, rarifying the larvae, leveling the larvae and caring for the larvae during sleep;

Cocooning takes place either in the same room in which the rearing took place and on the same surfaces where the larvae grew, or there can be a guided cocooning, in separated spaces, which must account for 20% of those occupied by larvae of the 5th age.

Calendar operations in the setting up and maintaining mulberry plantations and in incubating eggs and rearing Bombyx mori silkworms

Calendar operations prior to setting up a mulberry plantation:

1. **July – August:** leveling the ground;
2. **August – September**: fertilizing with 20-60 t/ha of manure; breaking the ground (ploughing, terracing); marking the plantations pots for mulberry seedlings (picketing); 50-60 cm deep holes are dug;
3. **October** – shaping and mudding the roots; planting
4. **March –** cutting the sprouts to form the crown;

Calendar maintenance operations in a mulberry plantation :

1. **September – October:** sacrificing heavy soils; ploughing 20-22 deep;
2. **April – May**: plowing 10-12 cm deep
3. **June – July:** tilling the soil with a disc harrow; tilling between the trees; spreading Gramoxine 3-4%
4. **September – October**: fertilizers P and K

5. **May – 15 September:** fertilizers with N
6. **April – July** : irrigating the plantation; cutting to produce leaves;

Calendar operations for Bombyx mori egg incubation and rearing larvae until they cocoon

1. **10 April** : 8-10 days before the start of incubation the incubation room is prepared (repair works on walls, doors, windows; revision of ventilation, heating and lighting equipment; the pieces of equipment are disinfected with caustic soda 3% and formalin 4%; the incubation room is sealed off; the incubation room is opened, the equipment is washed and the walls are painted; daily: disinfection with formalin 2% , sprayed over the floor; the larvae are placed to incubate in incubation caskets, which are put in the incubator; the micro-climate factors are monitored (temperature, humidity, light) and ensured for the proper incubation of the silkworms.
2. **20 April:** the eggs are placed for incubation in the plain areas ;
3. **5- 10 May**: after 13-15 of incubation, the silkworm larvae hatch; harvesting the larvae: in trays used to transport them to the rearing hall; prior to being populated with larvae, the halls are cleaned mechanically and disinfected; the larvae stage lasts 26-31 days in Bombyx mori;
4. **1-10 June** : after the 5th age, the larvae that reach maturity start cocooning; weaving the cocoon last 3-4 days; the cocoons are harvested 7 days after the start of cocooning; the butterfly stage lasts 8-10 in males and 10-12 in females;

The type of staff/employees involved in the production cycle

It's a known fact that, due to its economic and social dimensions, as well as due to its ecological functions, silk farming is a genuine national asset. Rearing silkworms in small farms has the advantage of incurring relatively low costs, of both the biological material and the necessary equipment, it requires just a small space, which can be found inside the household (barns, storage rooms, etc.); because the growing period for the production of a series of cocoons is short (32-35 days), the money circuit is quick; the works necessary to breed silkworms are usually carried out when other farming activities are not so intense.

A peasant household can turn into a family farm, which can both breed and rear silkworms and sell the cocoons, and also process the silk threads obtained and develop a trade of traditional items (such as traditional silk head dresses);
Sericulture can also have favorable social implications, because labor force is recruited from the rural environment, which leads to a drop in the unemployment rate.
Given that the production cycle is not at all complicated, people of all ages can breed silkworms (including children and elderly). Involving children in such activities has beneficial effects on their rearing, because they learn to be responsible and disciplined. Also, such activities can develop entrepreneurial skills in young people.
When the volume of work is big, temps can be hired to help the family members.

Facilities and equipment used in sericulture
To ensure the health and safety of those who work in sericulture, the following must be used :

- Farming tools and equipment used in setting up a mulberry plantation: a leveling aggregate connected to a tractor ; bulldozer, manure spreading machine; ponds for liquid fertilizers (3.5 m3), plow used for opening / broaching (also named in English "broach" and in Romanian "plug balansier de desfundare"), hole digging machine attached to the tractor;
- Tools and equipment used for maintenance works at a mulberry plantation: plow tractor, leveling aggregate, tractor with mechanical spraying pump, amendment spreading machine, sprinkling motor-pumps, pumping aggregate, manual or compressed air scissors to cut the thing branches and saw for cutting the thick ones;

- constructions and equipment for incubating silkworm eggs: the incubation room (3-4 square meters floor and -12 m3 air/kg egss), incubator battery, incubation casket, surfaces/boxes used for transporting silkworm eggs (in Romanian language it is called “telaini pentru transport ouă”), paper boxes, umidifier, thermohigrograph, sprayer and a heating source;
- constructions used for larvae rearing: heated sericulture halls type IFET (S=300 m2), type ZOO (S=600 m2), tunnel IFET (S=243 m2), the sericulture tent (in Romanian language it is called “cortul sericicol din arcuri metalice”) with a surface S=300 m^2, industrial constructions (bricks);
- equipment used for larvae rearing: metallic racks (in Romanian language “stelaje metalice”), beds used for frowing silkworms (in Romanian language the term is called “paturi de creștere sub formă de capre”), leamasi chopping machine, humidifier, technohigrograph, hamper;
- other materials needed in a larvae rearing facility : paper bedding (3 sheets/m2 seed), perforated paper (perforations of 2-5-7-12-14-15 mm), wooden ladder for leaf harvesting, knives to chop the leaves, brooms, buckets and cleaning rags ;
- materials used for cocooning: double wooden grids, a bunch of straws of cereals non treated by harvesting machines (in Romanian language theya re called “arici din paie de cereale netreierate”), a bunch of straws made of plastic (in Romanian language they are called “arici din material plastic”), cardboard boxes with interior cells, rotating celluar frameworks, wood shavings, fuzz cleaning machine (25 kg cocoons /hour), stifling in driers (Simplex, Tehnometal and Solar type);
- protective equipment: overalls, robe, apron and gloves

Chemical substances used in sericulture

Substances used for disinfection:

- formaldehyde: 1% solution, used for fine spraying on larvae and bedding, on the first day after getting out of sleep; 1.5% solution is used for disinfecting the spaces, tools and equipment; 19 g of formaldehyde should be used for disinfecting one cubic meter of room;
- calcium oxide (whitewash): concentration of 20%, used for fine spraying, in 3 stages; 1 l/m2 for each spraying;
- caustic soda (sodium hydroxide): it is a broad spectrum disinfectant; in concentrations of 2-3-4-5% it destroys spores of bacteria, viruses and parasites; it is sprayed finely in one or several stages, 1l/m2 of disinfectant; after disinfection, the surfaces that come in contact with the larvae are washed, and the rooms are ventilated;
- bleach powder: shelters are disinfected using bleach powder in concentrations of 3% or 5%, or active chlorine; the solution is sprayed finely on the surfaces that need to be disinfected; one application, 1 l/m2;
- chloramine : solution 3% active chlorine ; it acts as a microbe killer because of the disinfecting effect of sodium hypochlorite which is obtained by dissolving chloramine in water;
- *the commercial substance name in Romanian language “bromocet (the active substance it is bromure of cetilpiridin)*: 1‰ active substance, used to disinfect flat surfaces and hands ; it is applied through fine spraying, using 0.5 l.m2 ;
- *bluestone:* solution 1%, finely sprayed, to disinfect the larvae and the bedding;
- *chloramine:* 3% active chlorine; anti-microbial effect

2.6 Animal husbandry – Aviculture (poultry farming)

2.6.1 Definition of aviculture as economic sub-sector / CAEN code

Aviculture is the sector of animal husbandry dealing in the study of biology, races, feeding, breeding, improving and selecting birds, with a view to optimizing breeding, rearing and production technologies in order to render the activity economically effective.

2.6.2 Classification of aviculture

List of fields of activity – CAEN Code 0147
01. Agriculture, hunting and related services
014. Animal husbandry
0147. Aviculture (Poultry farming)

2.6.3 The main components of aviculture in Romania

The biological class *birds* (*Aves)* includes two subclasses: Saurure and Ornithurae. The only species of the Saurures sub-class is *Archaeopteryx litographica*, which is a transition species between reptiles and birds. The species that are of interest in animal husbandry are part of the Ornithurae sub-class, the Carenate super-order and are included in three orders: Galliformes, Anseriformes and Columbiformes. The monophyletic theory claims that all species of poultry are the result of domesticating one wild species: *Gallus bankiwa.*

The main forms of production in poultry farming are for meat, eggs and foix gras. Feathers, skin and fat are secondary products; slaughterhouse waste and egg shells are considered sub-products;
Poultry meat is a very important food, benefiting not only from a low cost of production and rapid adaptability to customers' requirements, but also significant nutritional benefits.
Eggs are extremely important to humans, and an indispensable ingredient for many industries (food, pharmacy, textile, leather).
Foix gras is a special product (due to its chemical composition), obtained by fattening ducks and geese.

2.6.4 Production cycles in aviculture

In poultry farming, the production cycle is largely influenced by the raising system and by the exploitation direction.
The factors that influence the production of meat or eggs are biological and environmental.
Age categories in poultry: young chicken/broilers (meat chicken, breeding chicks, replacement chicks) and adult (laying hens for consumption eggs or for incubation).
Production categories: chickens used for breeding (light and heavy breeds) divided into pure lines, grandparent and parent farms, and production chickens (replacement chicks and egg-laying hens, but also meat chickens). There are also some special production categories: turkeys, geese and ducks, with free feeding or fattening; guinea hens, pigeons, pheasants and partridges, birds bred and reared for ornamental purposes or as exhibits.

Operations carried out during a production cycle in aviculture

Maintenance systems in aviculture: extensive or traditional – peasant, semi-intensive or intensive household and intensive or industrial.
In the extensive system, less attention is paid to birds and hygiene. In the semi-intensive and intensive systems, birds are subject to a protocol of treatment and vaccination, and shelters are rigorously cleaned, as a means of preventing diseases.
In the intensive system, operations are specific to the respective fields of activity and can take place anytime throughout the year, given that maintenance is done in shelters that eliminate the influence of external environmental factors on production.

Sectors with distinct production cycles:

- Raising breeding youth from light and heavy breeds; growth duration 20 weeks plus another 4 weeks break between series; farms made up of young and adult sectors;
- Growing hybrid replacement chicks; growth duration 18 weeks plus 3 week break between series;

- Adult egg-laying hens; growth duration 59 weeks (from 18 to 77 weeks) plus 4 week break between series;
- broilers; growth duration 7-8 weeks (tendency to be reduced to 5-6 weeks) plus three weeks break between series; raising on permanent bedding or batteries;
- Turkey raising; growth duration for broilers 14-26 weeks (light and heavy hybrids) plus 3-4 weeks break; young turkeys for breeding 26-32 weeks in light breeds, 30-36 in intermediary breeds and 34-40 weeks in heavy breeds; adult turkey hens 26 (plus 3-4 weeks in intermediary and heavy breeds) – 52 weeks, plus 3-4 weeks break between series;
- Goose raising; 8-9 weeks growth period for meat broilers plus 3-4 weeks break; geese young for reproduction 18-22 weeks; adult gees for reproduction 4—85 weeks, depending on the breed;
- Sectors for raising guinea hens, pigeons, pheasants and partridges, birds raised for ornamental purposes or for exhibitions;

Type of staff/employees involved in the production cycle

The working staff is made up of: care takers (trained on the job, and in the case of mechanized, automated, computerized farms, vocational or agricultural high school graduates); electromechanical workers who have a training certificate and license; driver, filter care-taker (they can take over the responsibilities of a receptionist-distributor or store manager); technical – administrative staff (farm manager, accountant or economist), veterinarian. Mention should be made of the fact that the working hours depend on the system in which the birds are raised, as well as their breed, race, age, production, etc.

Facilities and equipment used in poultry farming

Facilities and equipment differ, in keeping with the farming system they are used in:

- Sanitary filter and offices;
- Veterinarian office and pharmacy;
- Shelters for poultry, which must ensure the following microclimate conditions for the adult birds: temperature 13-18 degrees C, humidity 55-75%, light between 10-20 lx in adult chickens, air current speed 0.35-0.5 m/second, CO2 max 2500 ppm (hens), H2S max 10 ppm, NH3 max 26 ppm. In the younger categories, the surrounding temperature must range between 20-32 degrees Celsius, and the air current speed should be 0.1-0.2 m/s. The biggest danger is the accumulation of harming gas in the waste collection facility, where interventions can be carried out only by using the proper equipment.
- Lighting equipment;
- Microclimate maintenance equipment: fans, heating devices, water spraying devices;
- Incubation stations;
- Equipment for transporting the poultry inside the farm;
- Equipment for preparing and distributing feed: mills, mixers, technological trailers, feed distribution equipment;
- Drinking water facilities: well, water processing facility, pumps, adjustment pipes, various types of troughs;
- A platform for depositing and stocking waste, equipment to carry and distribute the waste on the field;
- Personal protective equipment: overalls, coat, rubber boots, apron, robe and gloves;

Chemical substances used in poultry farming

The following substances are used to disinfect rooms and equipment/machines:

- Lime powder 0.5-1 kg/m2

- quicklime (calcium oxide): limewater 20%;
- caustic soda (sodium hydroxide): it's a broad spectrum disinfectant; in concentrations of 2% it can destroy bacteria spores, viruses and parasites; it is applied by pulverizing; after disinfection, the surfaces that are touched by animals are washed, and the rooms are ventilated;
- formaldehyde: 1% solution, used for spraying or aerosols for disinfecting the shelters;
- the disinfectants used in the incubation stations and their action are presented in the following table (table 2.6.4-1)

Specification	Chlorinated	Iodinate	Phenols	Quaternary ammonium cations	Formaldehyde
Bactericide	+	+	+	+	+
Bacteriostatic	-	-	+	+	+
Fungicide	-	+	+	±±	+
Virucidal	±	+	+	±	+
Toxicity	+	-	+	+	+
Potency with organic matter	++++	++	+	+++	+

Figure 2.6.4-1 Properties of commonly used disinfectants

Note: + positive relation (affinity)l – negative relation; +- limited effect;

The treatments used against internal and external parasites, bacterial, viral and fungal diseases are administered by the veterinarian, who uses antiparasitic, antibiotic and antifungal medicines, in which the concentration of active substances varies depending on the product.

2.7 Animal husbandry – Cattle

2.7.1 Definition of cattle farming as economic sub-sector / CAEN code

CATTLE FARMING is the field that studies the biology, breed specialization, feeding, breeding, improving and selecting cattle (bovines), with a view to optimizing breeding, rearing and production technologies in order to render the activity economically effective.

CAEN Code: 0141-0142

2.7.2 Classification of cattle farming as economic sub-sector

List of fields of activity - CAEN Code 0141-0142
01. Agriculture, hunting and related services
014. Animal husbandry
0141-0142. cattle farming

2.7.3 The main components of cattle farming in Romania

Domestic cattle are a member of the of the Bos genus, which has two subspecies Bos zebu (zebu) and Bos taurus (cattle).
Cattle hold the largest share of domestic animals in the world, accounting for more than 50% of the total number of farm animals. They provide a large volume of food products, extremely important for human consumption, as well as raw materials for the processing industry. The main products are meat and milk.

Out of the total annual milk output at global level, which stands at some 550 million tons, some 91% is obtained from zeb and cows, 6% from buffalos, 1.6% from sheep and 1.4% from goats. Milk is considered a natural, complete and complex food (with more than 100 components) and constitutes the only source of food for baby mammals. It is indispensable for children and the elderly, and it is also a major source of nutrients for grown-ups.
Beef is the main source of meat for most peoples, accounting for some 30% of the total world consumption of meat. This kind of meet is easy to digest and also plays an important role in diet.
Besides the two main products, there are also other secondary products that can be obtained from cattle, which impact other economic sectors. Examples of such products are leather, dairy sub-products (skimmed milk, whey), organs, the endocrine glands, the blood.

2.7.4 Production cycles in cattle farming

The production cycle in cattle farming is influenced by the exploitation and maintenance system.
The exploitation system is defined by the totality of organizational and technological particularities that characterize a cattle farm and which influences the level of economic effectiveness, hence the profit.

Irrespective of the exploitation system used (traditional, household or industrial), the level of exploitation can be extensive, semi-intensive and intensive. The level of intensiveness grows in keeping with the level of production and profits.
Maintenance covers a whole range of technological factors, concerning the sheltering and feeding of cattle, their movement and hygiene, which have to stand at certain parameters in order to fully capitalize on the productive potential of the cattle. The maintenance system directly influences exploitation costs, and therefore the profits as well. The basic criteria taken into account when classifying cattle maintenance systems are the calendar season and the freedom of movement. By this classification, there are two types of maintenance, summer and winter maintenances, and „tied" or „free" maintenance respectively.

Operations carried out as part of the production cycle in cattle farming

The **traditional** (extensive) production cycle is the longest, because:
The number of cattle per farm is low, 1-10 heads;

- the herd is improved through empirical, phenotypic selection;
- calving takes places in the spring-summer seasons, to capitalize on cows' potential in the first stage of lactation by using green fodder; the gap between calving sessions is big, and the birth rate stands at 70-75%;
- breast rest is not paid sufficient attention, in terms of duration and specificity of feeding;
- lactating cows are fed differently, depending on the geographical area, and the local vegetal resources are used;
- shelters are built from various types of local materials; all categories of cattle, irrespective of gender and age, are kept in the same shelter;
- technical equipment is scarce, and the main operations (feeding, watering, manure evacuation, milking) are done manually.

The annual milk production per cow differs from household to household, depending on the exploitation conditions, but it usually does not exceed 3000 kg, which means that the production capacity of the biological material is not properly used. Although investment is low, the relatively low yield of milk and the difficulties in selling the milk, due to the low selling prices, make profitability low too.

The household system is widely spread across the globe, and it is used in Romania as well, by companies and private farmers who own a larger number of cows. It is characterized by a combination of elements typical of both traditional and industrial exploitation, with focus on capitalizing on the existing natural resources, while at the same time increasing the mechanization level of the technological process, which in turn leads

to a higher production of milk and therefore bigger profits. The level of exploitation can be semi-intensive or intensive.

It is characterized by:

- herds of 10 to 200 cows;
- The farms operate based on the closed production cycle system, with simple or extended breeding (in some farms there is a sort of specialization, as the young male cattle are sold to farms that specialize in cattle fattening);
- Maintenance in the tied system, because free maintenance entails big costs in terms of technical equipment;
- Feeding is carried out depending on the season;
- Technological operations are fully or partially mechanized;

Milk yield differs depending on how intensive the system is. In order to ensure a high profitability, the average annual yield per farm and per cow must exceed 3500 kg. The household system will extend in our country, because it does not entail huge investments, and the use of modern breeding, rearing, improving and exploitation technologies can ensure a high level of profitability.

The industrial system is based on principles of concentration, specialization and integration of production, modern exploitation technologies and the intensive exploitation of a biological material that has a big genetic value, complex mechanization of all production processes, computerization and automation of some technological processes. In these farms:

- The minimum number of cows is 200, with the optimum figure exceeding 500;
- Specialization differs; some farms specialize in milk cows, and heifers are sold to farms specializing in breeding youth, and the bull calves are delivered to fattening farms, at a young age (there are also farms that use the closed production cycle);
- Breeding is organized based on the principle of spaced calving, which allows a constant production of milk throughout the year;
- Breeding bulls are used to induce genetic progress, by using semen from tested bulls and improvers;
- The targeted birth rate is 90%, with a 13 month gap between calving sessions;
- Cattle density per surface unit is high, the concentration level is also high, and exploitation is carried out per technological groups, will little attention paid to individual needs;
- In selecting the cows, proper attention is paid to their constitution, resistance to disease and fertility, which entails a higher percentage of reform in cows (30-35%);
- The land surfaces used to grow fodder are exploited intensively, in order to obtain a high percentage of energy and protein per hectare, at low costs;
- The preferred maintenance system is the free one, because of the economic effectiveness of this type of exploitation;
- Industrial exploitation require a the extensive use of technical equipment, as all work processes (fodder administration, milking, watering, waste evacuation) are mechanized or automated;
- Industrial exploitation for the production of milk requires bigger investments per cow, because of the facilities and equipment needed in the production process; the cost effectiveness, however, is also high, because labor productivity is the highest, and the milk production exceeds 6000 kg per cow per year, with a specific consumption of below one nutritional unit;
- In the farms where cows are fattened for meat, the production cycle is divided in stages: reception, distribution by lots, fattening proper (3-5 months, 2-3 series per year), finishing;

Type of staff/employees involved in the production cycle

In the small, private farms, the labor force is made up of the farmer and his family. In the large farms, with employed staff, work is organized on the basis of the principle of general serving, with works carried out in one shift, based on a work schedule. There can be specialized teams in such farms (to prepare and transport fodder or to evacuate the waste). One worker takes care of 18-30 cows, depending on how mechanized the farm is and what the yearly production of milk is. The entire activity is coordinated by the farmer or the hired manager, whose responsibility is to reach the set technical-economic targets. Depending on the size of the farm, the manager also has under their subordination the economist and the veterinarian. Breeding is organized in stages.

In industrial farms, workers are highly skilled, because hi-tech equipment and facilities are used. Work is organized in specific activities carried out by specialized teams: mechanical milking, fodder preparation and distribution, waste cleaning and evacuation, supervising the animals, producing fodder. These specialized teams carry out their activities on the basis of a clear scheduling.

Facilities and equipment used in cattle farming

Equipment differs depending on the type of farming;

- Sanitary-veterinary filter for intensive and meat cattle farms;
- Administrative offices
- Laboratory for preserving and processing semen and storing artificial insemination equipment;
- Cattle shelters: which must ensure the necessary micro-climate conditions (temperature: 10-14^{0}C, humidity: 60-75%, light 30-50 lx, air current speed up to 0.2-0.3 m/sec in winter and 0.6 m/sec in summer, CO2 max 3000 ppm, H2S max 10 ppm, NH3 max 26 ppm); shelters can be semi-open or closed with an average capacity of 100 cows, except for the traditional system;
- Waste evacuation equipment;
- Fodder and water distribution equipment;
- Lighting equipment; electrical hazard;
- Fodder silos;
- Warehouse for concentrates;
- Haystacks;
- Feed preparation and distribution equipment: mills, mixers, tractor and trailers; accident hazard;
- Milking and milk preservation equipment; danger of contracting bacterial or viral diseases;
- Cheese preparation equipment; danger when using the equipment and because of the wet floor;
- Workshop;
- Heating plant;
- Platform for storing waste;
- Electrical fence; electricity hazard when a transformer is used; batteries are used in the grazing fields; the electrical impulses felt when touching the fence are not dangerous;
- Meat farms also have a slaughterhouse and the necessary equipment (ramp, scale, etc)
- Personal protective equipment: overalls, cottoned clothes, waterproof coat, rubber boots, apron, robe, gloves;

Chemical substances used in cattle farming

The following substances are used to disinfect rooms and equipment:

- quicklime (calcium oxide): limewater 20%;
- caustic soda (sodium hydroxide): it's a broad spectrum disinfectant; in concentrations of 3% it can destroy bacteria spores, viruses and parasites; it is applied by pulverizing; after disinfection, the surfaces that are touched by animals are washed, and the rooms are ventilated;

- lime chloride: shelters are disinfected using 3% or 5% concentrations, by spraying;
- lime powder: 0.8-1 kg m2 our lime super-phosphate 100g/m2: it is applied periodically before refreshing the straw bedding; this reduces the risk of developing footrot;
- formaldehyde: 1% solution, used for spraying or aerosoles for disinfecting the shelters;
- bluestone, used together with formaldehyde to treat footrot;

The treatments used against internal and external parasites, bacterial, viral and fungal diseases are administered by the veterinarian, who uses antiparasitic, antibiotic and antifungal medicines, in which the concentration of active substances varies depending on the product.

2.8 Animal husbandry – Sheep farming

2.8.1 Definition of sheep farming as economic-subsector / CAEN Code

Sheep farming is the field that studies the biology, breed specialization, feeding, breeding, improving and selecting sheep, with a view to optimizing breeding, rearing and production technologies and rendering the economic activity effective.

CAEN Code: 0145

2.8.2 Classification of sheep farming as economic sub-sector

List of fields of activity –CAEN Code 0145
01. Agriculture, hunting and related services
014. Animal husbandry
0145. Sheep farming

2.8.3 The main components of sheep farming in Romania

Domestic sheep belong to the Ovis genus and have descended from:

- Muflon: short-tailed sheep (Brachyura): Friesian, Romanov, Heidshnuke, primitive sheep from northern Germany and Poland;
- Arkar: long-tailed sheep (Dolykura): Merino, the Romanian genuine breeds of “Țigaie”and “Țurcană” sheep, and thick-tailed sheep (Platyura) Karakul;
- Argal: Kurdiuk, Gissara, etc;

Due to the diversity of products obtained, sheep farming contributes significantly to creating the necessary amount of foodstuffs that humans need every day (milk, cheese, meat) and to the processing industry (wool, skin, fur, hormonal glands, intestines, bones, horns);
Sheep milk contains the entire range of amino acids that are essential to humans and is rich in vitamins (carotene, B complex, C, D2, E, H, K and PP), minerals (more than 40), enzymes, glycoproteic substances with antimicrobial effect, biomolecules with toning and anti-toxic effects;

Sheep meet (lamb and mutton), especially that of young sheep (lamb), is light, tasty, and it contains all the amino acids that are essential to humans.
Wool is still considered the most valuable textile fiber because it has a whole range of characteristics that cannot be found in other types of fibers. Wool and wool fabrics are easy to paint, are 12 times more resistant to acids (it is washed only with acid detergents), it’s elastic, it does not cause static electricity, is flame

retardant and easy to iron (it bears finishing and ironing operations at temperatures up to 100 degrees Celsius without getting degraded).

Karakul type of pelts are used to make coats, jackets, hats, collars. Due to pressure by green organizations who fight for banning the killing of lambs and the drop in the demand for luxury attire, the production of pelts has dropped.
Sheep skin is used in the tannery industry because it is supple, strong, thermo-resistant and it looks nice.
Besides basic products, there are also secondary products which are used in other economic sectors. For instance, organs (liver, heart, brain, spleen, tongue, diaphragm, udder, rumen, etc.) and other non-food sub products (intestines, blood, endocrine gland, bones, horns, nails)

2.8.4 Production cycles in sheep farming

In sheep farming, the production cycle is largely influenced by the farming system and the exploitation direction.
The factors that have an active role in the production cycle in animal husbandry in general, and in sheep farming in particular, are presented in the image below.

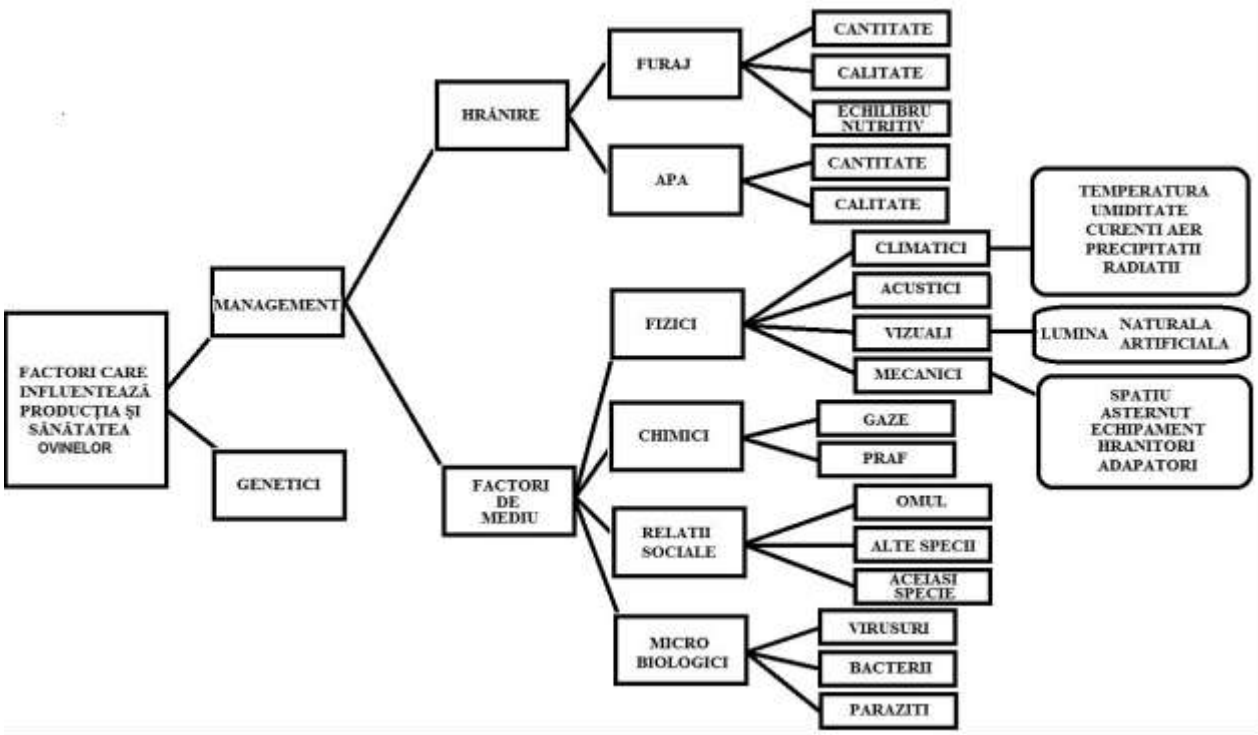

Figure 2.8.4-1 Factors that influence production in sheep farming

http://www.fao.org/docrep/s1250e/S1250E9U.GIF

The farming system can be extensive, semi-intensive and intensive.
In the extensive system, sheep are reared in pastures, from spring to autumn, and in stables during winter. The characteristic of this system is that the sheep are fed with green feed during pasturing and fodder and concentrates during winter.

The semi-intensive system entails a type of feeding in which the ratio between fibers/ green feed and concentrates is 60-70% fibers and 30-40% concentrates. Semi-intensive farming includes a wide range of technological solutions, which farmers choose depending on the surface of the pasture, the quality of the pasture, the cost of the concentrates, equipment, exploitation direction, etc.

The main principle in intensive farming is the daily feeding with portions made up of 60-70% concentrates and 30-40% fibers, in order to satisfy nutritional requirements and maintenance in stables alone, which limits movement and therefore reduces the consumption of energy for vital functions.

Operations carried out during the production cycles in sheep farming

The production cycles starts in autumn, in September-November (depending on the geographic area) when sheep breed. The gestation period lasts 5 months, and lambing takes place in spring, between February- April. This is the main breeding season, for several reasons: the effect of the light/dark ratio (1/1) with the daylight receding, lambing in late winter, when temperatures are not that low, the beneficial effect of spring pasturing and also the economic opportunity rendered by Easter celebrations. For specialized breeds, a breeding season can be set up for spring, especially in sheep reared for meat and milk. In this case, productions are capitalized on in winter.

After lambing, lambs are breastfed for a few days or up to 3-4 months, depending on the type of production desired: for a short period of time when they are raised for milk, and for a longer period of time when they are raised for meat. After weaning the lambs, the sheep are milked until August-September. It is important that weaning occurs 2-3 weeks before resuming the production cycle, for the sheep to have time to recover. The old or ill sheep are replaced by young females from the previous year. Before breeding, they are overfed in order to stimulate their bodies and prepare them for breeding.
In the case of sheep raised for meet, the same cycle is followed, but the sheep are not milked and the weaned lambs will form separate herds and will be fattened for meat.

The type of staff/employees involved in the production cycle

Employees in sheep farming have a minimum/average level of education, quite rarely higher education. In traditional farms, one employee per 250-300 sheep is enough, and in lamb fatteners, one employee per 1000 lambs. In big farms, the staff may also include guards, a driver, a worker in the fodder kitchen, an accountant. Shearers are hired as seasonal workers.

Equipment and facilities used in sheep farming
Equipment and facilities differ in keeping with the type of farming:

- *Sanitary – veterinary filter* for the facilities used for fattening sheep (in Romanian language they are called "îngrășătorii") *and intensive farms*
- sheep shelters: which must ensure the necessary micro-climate conditions (temperature: 14-18^{0}C, humidity: 65-70%, light 30-50 lx, air current speed up to 0.3-0.5 m/sec in winter and 0.6 m/sec in summer, CO2 max 3000 ppm, H2S max 10 ppm, NH3 max 26 ppm); fodder and water distribution equipment;
- lighting equipment; electricity hazard
- Feed preparation and distribution equipment: mills, mixers, tractor and trailers; accident hazard;
- Milking and storage equipment; danger of contracting bacterial or viral diseases;
- Cheese preparation equipment: equipment handling and wet floor hazards;
- Shearing equipment: a shearing equipment includes several machines which can be electrical (12-14 volts) or motioned by a flexible shaft; electrocution hazard and also danger when using the shearing device;
- Waste collection and storage platform;
- Electrical fences: electrocution hazard when electricity is received through a transformer; batteries are used on pastures; the electrical impulses felt when touching the fence art not dangerous;
- Personal protective equipment: overalls, waterproof cloak, rubber boots, apron, coat, gloves;

Chemical substances used in sheep farming

The substances used to disinfect rooms and equipment/machines are the same as those used in cattle farming. There are also treatments for internal and external parasites, bacterial, viral and fungal diseases, antibiotics, antifungal drugs;

2.9 Animal husbandry – pig farming

2.9.1 Definition of pig farming as economic sub-sector / CAEN code

PIG FARMING is the field in animal husbandry which studies the biology, breed specialization, feeding, breeding and improving the selection of pigs with a view to optimizing raising, maintenance and production techniques, and thus render the activity economically effective.
CAEN Code: 0146

2.9.2 Classification of pig farming

List of fields of activity –CAEN Code 0146
01. Agriculture, hunting and related services
014. animal husbandry
0146. pig farming

2.9.3 The main components of pig farming as economic sub-sector in Romania

The domestic pig, *Sus domesticus*, has its origins in two species of wild boars: *Sus scroafa feros* (the European wild boar) and *Sus vitatus* (the Asian wild boar).
The main production in pig farming is meat. Fat, internal organs, skin, hair, hormonal glands, bowels and bones are considered secondary products, or sub-products. As regards meat production, pig farming holds pride of place, because it ensures bio-economic conditions that are extremely favorable for this type of production. Along with an increase in the production of pork, consumers' exigencies have also grown, in the sense that now people prefer lean meat, with fine muscular fibers, tender, from young animals.

2.9.4 Production cycles in pig farming

In pig farming, the production cycle is largely influenced by the farming system and the exploitation direction. The factors that influence production can be classified as: internal (breed, hybrid, gender, age, state of maintenance, health), external (feeding, environment) and human.
Raising systems can be: intensive (predominant), semi-intensive and extensive.
Production directions are for pork, mixed and fat (lard).
Raising pigs for meat entails slaughtering pigs at the age of 6 months, when they weight 90-120 kg. For mixt production (pork and fat), animals are slaughtered at 8-12 months, when their weight ranges from 140 to 160 kg. Lard is obtained from pigs older than 12 months, weighing 200-250 kg.

Operations carried out during the production cycle in pig farming
Operations are specific to the respective sectors of activity and can be carried out anytime, as pigs are raised in shelters where there is no influence from the external environmental factors.
In the intensive – industrial system, we distinguish between the following sectors of activity:

- The breeding sector where boars and sows are kept and prepared for breeding and gestation (110 days);
- The maternity sector, which includes lactating sows and piglets (30 days old);
- The youth sector, pigs are raised from the moment they are weaned up to the age of 2 months and the weight of 30 kg;
- The fattening sector hosts young pigs from 3 to 6 months and reformed adults;

- In the semi-intensive and extensive (household) systems, stationary periods are longer, except for gestation, because breeding utilization and growth intensity indexes are by 20-30% lower.

Type of staff/employees involved in the production cycle

Employees in the pig farming sector have higher or medium education if they work in intensive farms and average if they work in the household system. In intensive farms, one employee per 3000 pigs is needed, in the semi-intensive system 1 employee per 1000 pigs, and in the household system 1 per 200-250 pigs. In the intensive farms, the staff also includes an engineer, a veterinarian, an accountant, an insemination operator, a veterinarian technician, mechanics, electricians, workers in the feed kitchen, guards.

Facilities and equipment used in pig farming
Depending on the farming system, equipment differs:

- Sanitary filter and offices
- Veterinarian office and pharmacy
- *Pig shelters;* which must ensure the necessary micro-climate conditions (temperature: 15-18^{0}C, humidity: 65-70%, light 30-50 lx, air current speed 0.5-1 m/sec, CO2 max 3000 ppm, H2S max 10 ppm, NH3 max 26 ppm); for piglets, the air temperature must range between 20-32 ^{0}C and the air current speed should be 0.2-0.4 m/s; for pigs raised for meat, temperature must range from 20 to 32 degrees Celsius, and the air speed should be 0.2-0.4 m/s. The other parameters are the same. The biggest danger is the accumulation of gas in the waste collection and storage facilities, where interventions can be made only by employees who are properly equipped for that.
- *Lighting equipment;*
- *Installations for maintaining the microclimate: ventilators, air heaters, water sprayers;*
- *Equipment for preparing and distributing feeds: mills, mixers, technological trailers, fodder distribution equipment;*
- *Drinking water facility: well, water processing plant, pumps, pipes*
- *Waste evacuation facility: pumps, fold blades, ploughs;*
- *Waste depositing and storing platform, equipment to carry and distribute waste on the filed;*
- *Personal protection equipment: overalls, coat, rubber boots, apron, robe, gloves;*

Chemical substances used in pig farming
The substances used to disinfect rooms and equipment/machines are the same as those used in cattle farming. There are also treatments for internal and external parasite, bacterial, viral and fungal diseases. There is a danger of infestation with parasites (trichinosis, flees, lice, ticks). Also, humans can get bacterial (anthrax) and viral disease by getting in direct contact with the infected animal or through ingestion.

2.10 Horticulture

2.10.1 Definition of horticulture as economic sub-sector / CAEN code

Horticulture (Lat. „hortus-garden", „cultura- cultivation, cultivate") comprises several biological practical sciences, which study the morphology, biology, ecology, technology of species and varieties of fruit trees, vines, flowers and the processing of horticultural products.
CAEN CODE: 0121, 0124

2.10.2 Classification of horticulture

List of fields of activity –CAEN Code 0121, 0124 (8)
01 Agriculture, hunting and connected services
012 Cultivation of plants in permanent cultures

0121 Grapes growing (viticulture)
0124 Cultivation of seedy fruits and pomes

2.10.3 The main components of horticulture in Romania

Fruits have a complex chemical composition (sugars, vitamins, organic acids, minerals, etc.) and can be eaten fresh or preserved. They have a beneficial effect on both healthy and ill organisms (6).
The horticultural assortment includes fruit trees (apple, pear, quince, medlar, fowler's pear/rowan, plum, apricot, peach, cherry, sour cherry, almond, strawberry, blueberry, wildberry, blueberry, blackberry, buckthorn, dogwood, hazel, nut, fig, mulberry, kiwi, etc.), ornamental plants which decorate through leaves, flowers, fruits, prostrate shrubs, decorative plants, solanaceae (tomatoes, eggplants, peppers), bulb vegetables (onion, garlic, leek) root vegetables (carrot, parsley, celery, beetroot, radish, turnip, etc.), Cruciferous vegetables (headed cabbage, red cabbage, cauliflower, Brussels sprouts, kohlrabi), pod vegetables (beans, pees, okras, etc.), greens (lettuce, spinach, orach, artichoke, etc.), herbs (parcely, dill, thyme, basil, coriander, marjoram, etc.), leafy greens (nettle, patience, watercress, dandelion), aromatic plants (mint, sage, tarragon, rosemary, brotherwort, lovage, balm), Cucurbitaceous (courgette, cucumber, cantaloupe, water melon), edible mushrooms, etc, grapes, for consumption or used to make wine, cognac, etc. (1,2).

In Romania, the *Rosaceae* family accounts for 2/3 of the total number of temperate species. The largest share is held by apple trees (Malus domestica Borkh), followed by plum trees (Prunus domestica) (6).
Horticulture is very well represented in the South-Muntenia and South-East Regions. More than half of the surface covered by orchards is concentrated in the South-Muntenia and North-West Regions. In the South-Muntenia Region, the best represented are the apple and the pear, and in the South-East the apricot and the peach. According to data provided by the National Statistics Institute in a 2013 release, the area covered by apple orchards in 2012 was 51,225.7 ha, of which 1099.9 ha in the South-Muntenia Region. Out of the 100 varieties of apple cultivated in Romania, the largest share is that of Ionathan and Golden delicious (69.5%). The total area covered by apricot orchards is 2719.9 ha, and the one covered by peach orchards 1759.5 ha, of which 1371.4 ha of apricot trees and 915.8 ha of peach trees in the South-East Region (7).

Specific to these regions are the apple (seedy fruit) and the apricot (kernel fruit).
Vine growing is also a traditional field in Romania. Climate conditions in the South-East region are extremely good for table grapes (ranked first in Romania), which cover 76.2% of the total area (mainly in Vrancea county) (5). The largest areas in the country, covered by white (37.4%) and dark-colored(53.6%) grape varieties are part of the same region (2). 40 varieties of table grapes are grown in Romania, with Chsselas Dore, Afux Ali and Black Muscat predominating.
Because of economic shortcomings, many areas covered in vines (just like in the case of orchards) have been abandoned or stubbed, as they have grown old (2).

2.10.4 Production cycles in horticulture Technological particularities and the optimum execution period (seasons/months or phenological phase)

When choosing the land for setting up an orchard or a vineyard, two types of factors are taken into consideration: environmental and social-economic factors (6).

A. THE APPLE (*Malus domestica Borkh*), is part of the *Rosaceae* family, the *Pomoidae* sub-family.

The apple is quite pretentious when it comes to humidity and soil, it can be affected by a large number of pests and diseases and requires extensive maintenance works.

1. **Choosing the land**. The soil in an apple orchard must be fertile, irrigable, slightly elevated and prone to mechanical works.

2. **Preparing the soil** by means of: clearing/stubbing (using bulldozers), levelling, planting legumes and plants for 1-2 years (they enrich the soil) and deep turning of the soil (plough, scrounger; May-August or July – September), chemical and organic fertilization, calcareous amendments (incorporated in the soil preparation works);
3. **Planting operations**: the planting material is obtained in nurseries. Apple trees are planted manually or mechanically, in holes, in autumn, early winter or even spring. Depending on the situation, organic fertilizers should be placed straight into the holes. In preparation for planting, the roots are trimmed, mudded, and after it was planted, the tree is watered and hilled;
4. **Soil maintenance and weed combatting operations**: in young plantations, mechanical weeding out, weed killing and intercalations. Equipment used: miller, disc harrow or cultivator. In the fruit set stage, working the soil, using weed killers and planting perennial gramineous weeds (*Festuca rubra, Lolium perene, Tifolium repens, etc.),* used to mulch the soil after mowing (the vegetal material is left ont he soil, it has a beneficial effect on the soil, reduces weeding and soil erosion). Herbicides used: Gesatop 50 WP, Caragarde A 50, Lasso (applied pre-emergently, in autumn or spring), Gramoxone, Roundup, Fusilade, Galant, Targa (pre-emergent application);
5. **Cuttings to form the crown and ensuring the young fruit bearing branches:** in Romanian language they are called "tăieri în uscat"
   Carried out since leaf-falling till bud-sprouting (autumn – spring) and green cuttings (in Romanian language they are called "taieri in verde") which are recommended for apricot, cherry, peach, sour cherry, which are carried out in the vegetation stage (more precisely after the fruits have fallen). In the latter case, cuttings can be of several types: to form the crown (operation that starts in the nursery and is then carried out in the orchard every several years), for fruiting (operations are carried out on the semi-skeleton and on 1-3 year old branches, to ensure a proper production of fruit), to maintain the crown, to correct it (when cuttings were not done correctly or when no cuttings were done at all), to regenerate the trees (in case of old trees). The cuttings carried out for maintenance, fruiting or correction are done every year. Cuttings can be done: semi-mechanically (pneumatic scissors), and in the countries where this sub-sectors is very well developed, cutting machines are used (bar mower, disc bar);
6. **Fertilization in the established orchards** – there are several types of fertilizing operations, depending on the soil, level of precipitations and production. Fertilization with nitrogen-based fertilizers (ammonium nitrate, ammonium sulphate, ureea) is very important for the young orchards, where apple trees are still growing, but phosphorus-based fertilizers (super-phosphate) and potassium – based fertilizers (potassium chloride) are needed for fruit bearing orchards. Also useful are complex foliar fertilizers (N,P,K + micro-elements), which are applied during the vegetation phase, since petal dropping until harvesting (treatment stops one week before harvesting proper) as well as green fertilizers (leguminous plants), which are incorporated into the soil. In the plantations that are not irrigated, nitrogen is administered in fractions (1/3 of the total quantity at a time), in autumn, spring and summer before buds start differentiating (June), while organic fertilizers, phosphorus and potassium are administered in autumn. In the irrigate orchards, in the other hand, approximately 1/3 of the quantity of phosphorus and potassium is administered in June;
7. **Irrigation:** compulsory in orchards with weak graft-bearings (in Romanian language they are called "portaltoi de vigoare slabă"). The orchard is watered in several stages (after de-budding, after fruits start falling, before and after harvesting). Soil and air humidity are extremely important (60-65% of the field capacity).
8. **Norming the load** through: fruiting cuttings (for a balanced load), chemical singling (with hormone-based products Rodofix, Geramid, Dirigol-N, Frutix), insecticides such as Severin, manual fruit singling (June-early July);
9. **Phytosanitary works:** varieties that are resistant to mildew and apple scab are used. Diseases and pests are combatted in winter (2 treatments) with the following chemical products: Ococcalux 3 EC, Carbetox, Oleocarbetox, a mixture of sulphur and calcium (in Romanian language it is called "zeamă sulfocalcică"), barium polysulphide 45 PU (against lice, green fly eggs, mildew, the disease called in Romanian language "rapan", leaf rot, apple worm cocoons, etc.), and 10-12 treatment sessions during vegetation, using: Carbetox 37 EC, Captadin 50 U, Onefug 50 PU, Vondozeb, Bayleton 25 WP,

Nimrod, Apollo 50 SC, Thiodan, Rubigan 12 EC, Score 250 SC, Topsin M 70, Systhane MZ, Benlate, Delan, Euparen, Nisorun 10 EC, Decis 2.5 EC, Zolone 30 PM, Karate 2.5 EC, Omite 57 E, Kilaval 40 EC, Delan 75 WP

10. **Fruit harvesting:** manual. Summer apples are harvested in July-August, autumn apples in

B. THE APRICOT TREE (*Armeniaca vulgaris Lam*), is part of the *Rosaceae* family, the *Prunoidae* sub-family.

Apricot orchards are rather sensible when it comes to vegetation factors and nutritious elements. They behave well in times of draught (but with a big consumption of water), are very sensitive to disease and pests and require lots of complex treatments (8-10);

1. Planting: autumn, spring or in winter windows;
2. Maintenance works: crown forming cuttings, maintenance cuttings, fruiting cuttings (February – March), in green (June or after harvesting, recommended for apricots, peaches and cherries) and regeneration cuttings.
3. Soil works and phytosanitary treatments: ploughing in autumn, stirring in spring, disking in summer, mineral-organic fertilization, grassing (prevents the premature demise of trees), herbiciding with Gramoxone, Starone, Dual 500 EC, Basta, Roundup, Fusilade, Targa, Gallant, Gool, Nabu EC, Focus Ultra (as indicated in the prospects). Treatments against diseases (moniliasis, mildew, neturia inaequalis also called the scab of apricot also named the black spot of apricot - in Romanian language it is named “rapan”, alternariosis, etc.) and pests (hairy caterpillar, San Jose lice, acari, moths, leaf lice, etc.) with a fungicide mix made of metallic copper and neutralized copper (in Romanian language it is named “zeama bordeleza”), Captadin 50 PU, Turdacupral, Sumialpha + Sumilex 50 WP, Runilan 50 WP + Fastac 10 EC, Dithane M 45+Karate 2,5 EC, Merpan 50 WP + Nurrele D, Vandozeb 80+Sumialpha, Topsin M 70 + Alphaguard, Captan 50+Decis 2,5, Derosal 60 + Fastac 10 (2 treatments during vegetative rest, after fruiting cutting, 3 upon entering the vegetation stage and 5-6 during vegetation);
4. **Irrigation:** 4-6 times (spring, before de-budding; after blooming; before and after harvesting, *July – August; autumn)*
5. **Norming the load** – after the petals fall, manually or chemically (Ethrel);
6. **Harvesting** is done manually, in stages, in full maturity (in the case of fresh fruit for consumption). The fruits that are used in other industries can be harvested by shaking, when they reach maturity or over-maturity (5,6);

C. VINES (*Vitis vinifera*), of the *Vitaceae* family;
The main agro-phytotechnical measures taken to set up and maintain vines:

1. **Preparing the soil:** to plant vines by removing all vegetation, levelling, chemical and organic fertilizing, along with trenching (in autumn, when planting takes place in spring or in May-June at the latest when the vines are planted in autumn); this operation is carried out with a plough (PBD60 or PBD80); levelling (tractor + reverse bulldozer blade), marking out (establishing the planting spot) is done in autumn (autumn planting) or at the end of winter (spring planting);
2. **Preparing the vines for planting**: shaping the roots and cords, mudding to increase the adherence between root and soil (a mix of manure + yellow clay + water), paraffining (paraffin + resin + bitumen) the cords and part of the parent stock (when there is no hilling);
3. **Planting the vines obtained in nurseries**: in holes done manually or mechanically, concomitantly with fertilizing and followed by watering, in spring or autumn (not so often);
4. **Maintenance after planting**
   1st year: soil maintenance (mechanical or manual tilling) to destroy weeds and crust, autumn ploughing, sprouting control (if necessary, intervening by removing aggregates of soil just to reach underneath the garth and then the aggregate of soil is rebuilt, when pests appear, chemical intervetion is required), copcitul (removing shoots from the parent stocks and the roots from the stocks), in summer, June and August, weeding and tying the vines, filling the gaps, in autumn, spring

(with grafts) or in summer, august (with vines grown in pots); treatments against diseases and pests, hilling, in autumn, as a means of protection against frosting;
2nd year: manual unhilling with a shovel, in spring, in March, removing the unnecessary shoots, the removing of the tips of the buds which is the so called in Romanian language "cărnitul lăstarilor" (August), preparing and installing the espaliers or other means to support the vines, to which operations for the 1st year are also added;
3rd year: cuttings to form the above-ground part and the trunk (3-5 years after planting), works in the vegetation stage, to which those specific to the 2nd year are also added (4);

1. **Maintenance of fruiting vines:**

- Cuttings, cand be done manually, semi-mechanically and mechanically and are done for fruiting (annual; late winter – early spring), regeneration (to revive the old vineyards), special (vines affected by climate factor) and leading the chords. Cuttings are done in the physiological rest period (dry cuttings) and during the vegetation period (green cuttings);
  - *Circling* is the operation whereby chords are tied to the support system (espaliers, props, etc.); it is carried out during the sprout swelling period, after fruiting cutting
  - *Operations carried out in the vegetation period are:* weeding (after the sprouts emerge), tying the shoots (2-4 times, in summer), thinning the shoots at the base of the leaves (rarely, along with tying), removing the tips of the buds (in Romanian "carnitul" (in the second half of August – first part of September; with scissors, scythe) and, occasionally, topping (manually, before blooming), partial unleaving (removing old leaves, 2-3 weeks before ripening), supplementary pollination. In table grapes, the following operations must be carried out: ring incision (with special scissors; 15 June – 15 July), singling and shortening inflorescences (after tying) and grapes, putting the grapes into bags (rarely, when grapes start maturing);
  - *Filling the gaps (in spring or autumn)* through marcotting, extending the chords (aerial marcotting), planting the vines fortified in pots or grafted (1-2 years) in holes;
  - *Soil operations:* the spring ploughing (March – April) with a special vine plough connected to a star-shaped brake (plus the equipment needed to spread nitrogen based fertilizers), deep stirring (after the spring ploughing, manually, with a shovel, or mechanically using a detector plough), manual shoveling along the rows and mechanical between the rows (during the vegetation period) using the cultivator, the disk (soft soils) or the miller (hard soil), mulching the soil (polyethylene foil, leaves, straws in between the rows). In autumn (after the leaves have fallen): ploughing and fertilizing (organic and chemical with phosphorus and potassium). Periodical works: deep stirring of the soil, in autumn, after harvesting (with a subsoiler and plough with chisel type organs);
  - Phyto-sanitary protection. Combating weeds with the help of pre-emergent (Gesatop 50 WP, Caragard Combi A 50, Dual 500 EC, Lasso, Goal 2 E, Simadon 50 PU etc) and post-emergent (Agil 100 EC, Roundup, Gramoxone, Dominator, Ronstar 25 EC, Targa 10 EC, Glifotim, Fusilade Super, Touchdown, Basta, Gallant ș.a.) (1, 2) herbicides.
  - Combating diseases such as mildew, rot (with Derosal, Topsin, Rovral, Ronilan, Sumilex etc), viroses, bacterioses and pests such as moths, phylloxera (with Sevin 85 WP, Decis 2.5 CE, Karate 25 CE, Carbetox 37 CE ș.a.), acarienii (Mitak, Zolone, Neoron 500 EC etc.).
  - **Grape harvesting;** Table grapes are harvested between July 15 and October 15; they are sorted (the grapes that do not have the required quality are removed), packed and shipped in optimum conditions. Wine grapes are harvested starting 10-15 before they get fully ripen and harvesting ends within 10-15 days after this phase. Harvesting is manual, and for shipping, Sulphur dioxide is used to protect the grapes (2,3).

Type of staff/employees involved in the production cycle

Most of those who work in agriculture are part of a vulnerable social category (permanent or seasonal workers). Very few farmers have basic education, most of them only have practical experience, and the capacity to absorb European funds in the rural environment is still very low.

Equipment used in horticulture (machines, tools)
The main types of equipment used in horticulture are:

- Machines used to work the land: bulldozers with log extractors, ploughs, land plow and grating device (in Romanian language calld "scormonitor"), miller, disk harrow, cultivator, plow used for opening / broaching (also named in English "broach" and in Romanian "plug balansier de desfundare"), tractor plus reverse blade, cultivator plough aggregated with a star-shape harrow, detector plough, subsolier, plough + chisel type organs;
- Tools used in semi-mechanized cuttings: pneumatic scissors;
- Cutting tools: scissors, saw, budding knife, vine knife;
- Manual tools used to work the land: shovels, pickaxes, hammer picks;
- Maintenance equipment and tools, machines for dusting and spraying (carried and operated by people, mounted on cars, tractor);
- Tools needed for preparing solutions: buckets, barrels, funnels, gages;
- Mobile steel reinforced stairs with opening limitation devices;
- baskets/panniers or vibrating shakers (for fruit that can be shaken);
- protective equipment: googles, gloves, cap/hood, proper footwear and clothes;

Chemical products used in horticulture

- *chemical fertilizers* used to improve the soil's nutritive balance: nitrogen-based fertilizers (ammonium nitrate, ammonium sulphate, urea), complex foliar fertilizers, phosphorus fertilizers (superphosphate) and potassium (potassium salt);
- *herbicides* to combat weeds: Gesatop 50 WP, Caragarde A 50, Lasso, Gramoxone, Roundup, Galant, Starone, Dual 500 EC, Nabu EC, Focus Ultra, Goal 2 E, Simadon 50 PU, Agil 100 EC, Dominator, Ronstar 25 EC, Targa 10 EC, Glifotim, Fusilade Super, Touchdown, etc,
- *chemical treatments to combat diseases and pests:* Ococcalux 3 EC, Oleocarbetox, a mixture of sulphur and calcium (in Romanian language it is called "zeamă sulfocalcică", barium polisulphide 45 PU, Carbetox 37 EC, Onefug 50 PU, Vondozeb, Bayleton 25 WP, Nimrod, Apollo 50 SC, Thiodan, Rubigan 12 EC, Score 250 SC, Topsin M 70, Systhane MZ, Benlate, Delan, Euparen, Nisorun 10 EC, Decis 2.5 EC, Zolone 30 PM, Karate 2.5 EC, Omite 57 E, Kilaval 40 EC, Delan 75 WP, a fungicide mix made of metallic copper and neutralized copper (in Romanian language it is named "zeama bordeleza"), Captadin 50 PU, Turdacupral, Sumialpha + Sumilex 50 WP, Runilan 50 WP + Fastac 10 EC, Dithane M 45 + Karate 2,5 EC, Merpan 50 WP + Nurrele D, Vandozeb 80+Sumialpha, Topsin M 70 + Alphaguard, Captan 50+Decis 2,5, Derosal 60 + Fastac 10, Derosal, Topsin, Mitak, Zolone, Neoron 500 EC ș.a.;
- *homonal products to balance the amount of fruit in a tree:* Rodofix, Geramid, Dirigol-N, Frutix.

Definitions:
Cuttings: operations (in dry or in green) by means of which branches/vines are removed/shortened, with the aim of directing/regulating the growth and fruiting (striking a balance between growth and fruiting);
Marcotting : a method used to obtain or multiply parent stocks (1 year-old shoots/sprouts or branches);
Grafting: the joining, based on compatibility, of the parent stock (plant with radicular system plus fragment of stock) with the graft (the part that will grow the aerial part);
Thinning-out: removing or shorting copili or shoots/sprouts
***The operation which is called in Romanian language "Cărnitul"*:** cutting sprots 20-30 cm above the last wire of the espalier;
Topping: removing the top of the shoots / sprouts
Ring incision: the operation by means of which part of the bark is removed (ring shaped) after blooming;
Bagging the grapes: grapes are introduced into paper bags (extra-early and early varieties, and the grapes that are sensitive to sun and get stained by over exposure);

2.11 Forestry (Silviculture)

2.11.1 Definition of silviculture as economic sub-sector / CAEN code

Forestry - Silviculture (from the Latin *silva-silvae* -forest and *cultura-culturae* – culture) is the science and practice of creating, managing, using, preserving and repairing forests and associated resources (trees, shrubbery, sub-shrubs), with the aim of ensuring goods and services for the population.

CAEN CODE: 0210

2.11.2 Sub-sector classification

List of fields of activity – CAEN Code 0210 (8)
02 Forestry and forest exploitation
021 Forestry and associated activities
0210 Forestry and associated activities

2.11.3 The main components of forestry as economic sub-sector in Romania

In Europe, forestry is defined as "the applied science of guiding forest ecosystems towards meeting the needs of society (products and services) in a sustainable and ecoogical manner."
Forestry has two components: *Silvology* or *Silvobiology* (incorporating both the understanding of natural forest ecosystems and the design of silvicultural systems) and Silvotechnics (methods of preserving, repairing and exploiting forests) (6);
According to data provided by the National Statistics Institute, in 2014, forests in Romania covered an area of 6387282 hectares (97.6% of the national forest area), registering a 0.1% growth as compared to the year 2009), as a result of introducing into the estate degraded land and forest meadows (in keeping with Law no.46 of 2008 on the forest area.

The forest area is made up of coniferous (29.9%) and deciduous forests (70.1%). (4,6)
Species of national deciduous trees: the beech tree (*Fagus sylvatica L.*), the durmast (*Quercus petraea* (Matt. Liebl or *Quercus sessiliflora* Salisb.), the pedunculate oak tree (*Quercus robur* L. or *Quercus pedunculata* Ehrl.), the Hungarian or Italian oak (*Q. frainetto* Ten), the Turkey or Austrian oak *(Q. cerris* L.), the silver oak *(Q. pedunculiflora* K. Koch), the fluffy oak *(Q. pubescens* Wild), the field/Norway maple *(Acer platanoides* L.) and the sycamore maple (*Acer pseudoplatanus* L), the sweet cherry tree (*Prunus avium* L.), the common ash (*Fraxinus excelsior) – in the hilly and mountain areas* – the narrow-leafed ash (*Fraxinus angustifolia* Vahl), the small-leaved lime (*Tilia cordata* Mill), the silver lime (*Tilia tomentosa* Moench.*)*and the big-leaved lime (*Tilia platyphylos* Scop.), the field elm (*Ulmus minor* Mill), the mountain elm (*Ulmus glabra* Huds.), the black alder (*Alnus glutinosa* Gaertn), the white alder (*Alnus incana* Moench.*)*, the edible chestnut (*Castanea sativa* Mill.), the while poplar (*Populus alba* L.*),* the European aspen (*Populus tremula* L), the black poplar (*Populus nigra* L.*) Populus x canadensis cv. „Robusta" Populus x canadensis cv. „Serotina"*, *Populus x canadensis „Marilandica"*, *Populus x canadensis cv. „Regenerata"* (5).
Species of local coniferous trees : the Scots pine (*Pinus sylvestris* L.), the European larch (*Larix decidua* Mill.), the Norway spruce (*Picea abies* L. Karst), the silver fir (*Abies alba* Mill).
Species of exotic deciduous trees (brought from other countries): the red oak (*Quercus rubra* L.*),* the black locust (*Robinia pseudacacia* L.), the eastern white pine (*Pinus strobus* L.)(5).
Of all deciduous species, the beech tree covers the largest area (31.5%), followed by oaq family of trees (17.9%), durmast (10.65), pedunculate oak (2.2), acacia, Acerineae also calles the Juss Tree, ash, cherry trees (15.7%), lime trees, poplars and willow trees (5%).
Coniferous species cover 29.9% (22.7% spruce, 4.8 fir, 1.8% pine, 0.6% European larch, etc.)

Forests cover a significant area in the Central Region (36.5%) and 19.3% of the total forest area, they help develop the wood processing industry, which is an economic resource for populations living in mountain areas. On the other hand, the South-East and South-Muntenia regions rank among the last in terms of areas covered by forests (11,10).
Dominating in the Central Region are deciduous forests, which cover 55% of the surface, followed closely by coniferous forests. The region ranks first in terms of lumber production and second in terms of harvested wood. Also, the exploitation of forestry waste for energy purposes has developed significantly in the past years. (9).

Wooden species selected as prototypes for deciduous and coniferous forests are the beech and the spruce. Both species have the largest shares at national level, especially in the Central Region, where forests cover the largest part of the forest area.
The process flow for obtaining seedlings and for setting up a new species is classical (old). Treatments are mainly applied in nurseries. Weeds and pests are combated using chemical or mechanical methods, applied to the soil, seeds or vegetation.
It seems that one of the major problems facing our country is tree regeneration, which can affect biodiversity and can lead to some forests depreciating and even disappearing.

2.11.4 Production cycles in silviculture

Technological specificities and the optimum execution period (seasons/months or development stage)
A. The Norway spruce (*Picea abies* L), part of the *Pinaceae* family, forms pure or mixed brush (mixed with other coniferous or deciduous trees), prefers the cold and moist areas, it is not very pretentious about the soil, has shallow roots and is a shadow species.
The factors that affect the spruce in a negative way are abiotic (frost, snow, wind, drought) and biotic (insects, bacteria, xylophagous fungi and animals that destroy the bark or the buds).
The setting up of spruce cultures can be done by means of natural regeneration, direct seeding or seedling planting.

1. **Operations carried out in solaria to obtain seedling**
   - cone harvesting (abundant fructification takes place every 3-4 years) between October and late January, extraction, seed storing (in optimum conditions, seeds can be preserved up to 4 years) to generate seedling (through seeds).
   - Preparing the soil by means of breaking up and turning the soil (destroying the weedy vegetation and preparing the soil) cultivating the soil to make it loosen and mellow and combat weeds, organo-mineral fertilization (by means of soil incorporation or in fractions after springing and in June – nitrogen) and rolling on dry soil, already seeded or just for grinding it. Mineral fertilizers are: ammonium nitrate, ammonium sulphate, super phosphate and potassium salt.
   - Ditch seeding, *in spring (early May)*, scissor singling, one month after springing (in the first year, along with weeding), combating fusariosis with fungicides, watering and shadowing after springing, weeding, seedling fortification (removing the protective foil, removing watering and nitrogen fertilization from the flow), replicating and planting the seedlings at the age of 2-3 years).
   - Planting takes place in spring, in holes that are made manually (using shovels and spades) or mechanically. Nude rooted seedlings are used for this end (4,7).

2. **Direct seeding** is done in spring, in beds, underneath back logs or in the shade of plants, by means of superficial soil moving and by covering the seeds using special rakes.
3. **Natural growth (regeneration).** Both species (the spruce and the beech) have a great capacity of natural regeneration, and that is why it is easy to set them up both in the areas covered by forest and outside it.
4. **Brush maintenance:**
   - The operation called in Romanian language “descoplesiri” for maintaining the seeds (after direct seeding or planting), by removing the invading vegetation around the beds, and to avoid the pressure

such vegetation might put on seedlings when snow falls (the operation is carried out before blossoming or in autumn).

- Removals (the woody vegetation that affects seedlings is removed during periods of intense circulation in the circulating vessels);
- Cleaning (removing branches) – the growth and quality of the seedling is improved, operations can be carried out early, even in the twig and rod stages, in order to ensure a good natural lopping.
- Singling (strong in young, weak in old trees) – operations that ensure a good growth of the trees and which are done gradually in pure brushes; they start at the age of 25-30 and are then carried out regularly; otherwise, there is a lack of balance between the length and the width of the trees, and they can be easily felled down by wind or snow (such operations should be avoided on areas with high elevation angles). In case of mixes, the beech, the elm, the ash and the maple are preserved at a share of 20% (a role in enhancing strength and productivity).
- Hygiene works; artificial looping (removing the knobs, the dry branches, in brushes of class I, II of production, in late autumn or early spring, manually, with a hand saw or machines), works on the brink of the massif and creating access ways for harvesting wood (all stages), and also removing greedy sprouts from the body of the trees (the lower part).

5. Forestry regimes and treatments: cutting (convenient, no difficulties; regeneration problems occur on the sunny versants; no problems on the shadowed versants and on averagely inclined terrain), on large surfaces, in pure brushes, followed by artificial or natural regeneration; cuttings on the brink of the massif (against the wind, successive cutting should be avoided), progressive cutting, regulated wood with progressive cutting (if the share of spruce in the mix is low) and the gardened wood (in the alpine plane or spruce trees on cliffs) (2,5).

B. The Beech (*Fagus sylvaticaL),* is part of the *Fagaceae family.* It has both a cultural and an economic role; it's a good mix species, a shade tree, it prefers warmer climate, a moist soil and grows soft sprouts (from adventive buds); the ideal mix in our country is beech with spruce or fir. It is sensitive to late frosting, winter frost, it has a good resistance to wind and is not affected by too many diseases (caused by fungi such as *Phytophtora, Asterosporium*) or leaf/wood pests (*Ocneria, Rhynchaeus, Lymantria, Cerambyx* etc) and mast (*Carpocapsa spp*.).

Beech cultures are usually installed by means of natural regeneration, but also through direct seeding, in nests, or through seedling planting in autumn, 3-4 before cutting the marked trees.

1. Beech planting in nurseries (when direct seeding or natural regeneration is not possible);

The main operations carried out in nurseries:

- Harvesting (*October-November)* and maintaining the mast (the beech fructifies every year after the age of 60 years and it reaches maximum fructification at 4-7 years);
- Preparing and disinfecting the soil using formalin (1%) and treating the soil and the mast with insecto-fungicides;
- Seeding the mast in ditches during the fall season, after harvesting and before frosting (in case of shaved cutting or when there is no natural regeneration) or during the spring season (February – March), by shading the culture in the first year and in the second if necessary.
- Planting seedlings (2 years) after treatment with a 1% fungicide mix made of metallic copper and neutralized copper (in Romanian language it is named "zeama bordeleza") (against attacks by *Phytophtora omnivora*) (2, 4, 7).

2. Brush maintenance

- Clearings in young plantations (only if necessary);
- Singling (brushes are removed if regeneration follows); the first operation of this type is carried out when the tree is in the pole stage, then every 10-12 and 20 years respectively (when the brushes go pass 100 years)

3. Forestry regimes and treatments: the simple grove (the beech tree is under 20 years, exploitation takes place at the end of winter, in warm areas, cutting is carried out in two cycles), the compound grove (characterized by rapid regeneration, a reserve in the old groves; the disadvantage is given by large coverage), the regular grove (successive cuttings, after seeding or cutting for seeding) is the most indicated, as it is followed by the operation called in Romanian language "receparea semintisului" (in early spring), (2,5).

Type of staff/employees who carry out the production cycle

The population working in forestry (alongside agriculture and pisciculture) significantly exceeds the European average (4.7%) (13). According to data provided by the National Statistics Institute, out of the employed population, 23.3% are people qualified to work in those three sub-sectors (forestry, agriculture, pisciculture) (14).

Equipment used in forestry (machines, tools)

- special knife for harvesting cones, scissors for singling seedlings in nurseries;
- hedging knives, special scissors, axes;
- Manual tools (shovels, pickaxes, special rakes) or machines used for working the land, seeding and harvesting;
- Cleaning can be done with axes, saws and portable mechanical machines;
- The protection equipment depends on the type of activity that is carried out; for instance, in cutting operations, workers must wear helmet, gloves, goggles, earplugs, protective trousers, boots)

Chemical products used in forestry

The chemical products used as fertilizers and against weeds, diseases, pests and animals, are:

- Lontrel 3000 (EC), used against weeds (thistles, Sonchus arvensis –also called in Romanian language "susai") applied post-emergently, and Kerb 50W (WP), applied pre and post emergently, against monocotyledonous weeds, for pines, in nurseries (3);
- Decis 2.5 EC, Sinotarox 5G, Krate 2.5 EC, Karate Zeon, Supersect 10 EC, Novodor TM, Mospilan 20 SP, Atracurv, Atratyp, Atratyp Plus, Lamdex 5EC , etc., insecticides used against specific pests: *Hylobius abietis* (the large pine weevil), *Ips typographus* (the European spruce bark beetle), *Pityogenes chalcographus* (the six toothed spruce bark beetle), *Lymantria monacha* (the nun moth) etc. (1);
- Pantera 40 EC or Rango, post-emergent application, against annual and permanent monocotyledonous weeds, in deciduous nurseries (3)
- Dithan M-45, Dithane Neotec 75 WG, Vondozeb (WP), Vondozeb 75 DG (EG), fungicides used against Fusariosis, application on soil and seedlings, and Folpan 80 WDG (WG) against seedlings loss in solariums;
- Small trees are protected against animals with the help of repellents (taste and smell badly). Simple repellents: Wam Extra (deer, wild pigs, rabbits), Versus Extra (deer, rabbits), in coniferous and deciduous forests, when the saplings are 0.5-1.5 m tall; compound repellent, Cervacol Extra (RB) against deer (when the saplings are 0.5-1.5 m tall), (3);
- nitrate fertilizers (ammonium nitrite, ammonium sulphite), phosphorus fertilizers (superphosphate) and potassium fertilizers (potassium salt), organic fertilizers (manure, compost, etc.)

Definitions:

- "forest area" includes all forests and lands used for forestation, which meet culture, production or forest management needs, ponds, brook beads, as well as non-productive pieces of land included in the Forest Management" (10)
- The operation which is called in Romanian "Descoplesiri" – the surface cutting of weeds and placing them around seedlings, in order to delay the occurance of another generation of weeds.
- The razor sharp operation (called in Romanian language "taieri rase") – fully extracting the old brushes by means of a single cutting and artificial forest regeneration.

- "Singling" – maintenance – guiding works for brushes, carried out periodically;
- 'Artificial levelling' – cutting the dry or partially dry branches, with the aim of improving the quality of the trees.
- "regimes" – silvotechnical systems (wood, compound grove, etc.) with reference to measures and means of setting up/ re-setting up and managing brushes, in order to regenerate the cultivated forest.