

# Flows and integration between uses in the Polyfarming system

The functioning of the Polyfarming system as a whole is based on integrating the different elements of the forest, livestock and crops. **The flows that are established within and between them**, including the production and return of materials within each one and the movement of products between elements, compensate the outputs of the system. **The products of the Polyfarming system include the final products for consumption (or outputs), such as firewood, fruits or meat; intermediate products to apply to other elements**, such as biochar, grass or forage; and **external inputs to the system** that cannot be produced in it, such as feed, seedlings or seeds.

## ■ Flows in the different elements of the Polyfarming system

The basis of the Polyfarming system is the functioning of the different elements as a whole. For this, **the flows established in each of them must be understood**, which include: (i) the **production of vegetables** (trees, pastures and crops) from solar energy, (ii) the **return of materials** within each element (both dead plant matter and animal excrement), (iii) **system outputs** (products obtained from different uses), (iv) **movement of products between elements**, as a result of putting the Polyfarming system into operation, and (v) the **external inputs to the system** which, with the Polyfarming system, are greatly reduced.

- **Forest.** In the forest there are no inputs from other elements. The main input is the **production of trees**, which is performed by CO<sub>2</sub> in the atmosphere and nutrients and water in the soil. The cycle is mainly closed internally with the return of the leaves to the ground. **Wood extraction** represents an export of biomass, which, if carried out without destroying the conditions of the system, recovers naturally. **In the Polyfarming system, there are also BRF and biochar outlets (Figure 1), large logs** for the trunk beds and **humus** from the forest floor to obtain biofertilisers, but in the model proposed they are small outputs in general.

- **Dehesa.** It is an element where the **only input derived is from the biomass production of trees** and pastures that may exist. The return of materials mainly occurs through the leaves and other plant parts that die and decompose. **The outputs of the system are very scarce**, since the calves that graze consume leaves, but deposit their excrement in the same area.

- **Pasture.** The main production of pasture accumulates in the soil. When the meadow is established, there are almost no other inputs from outside the system, **the only input is the forage** that can be given to the animals at certain times, as long as it is not from the farm. The cycle is closed by the return of the biomass consumed by the animals through excrement. If management is carried out respecting the functioning principles of the meadow (management of the herbivorous plant relationship) and all its elements (including the presence of decomposing beetles), **the system recovers naturally** from the outputs linked to the harvesting (meat, milk, etc.).



**Figure 1.** Pile of BRF, a product obtained from the forest. BRF is allowed to decompose directly in the field for several months before being applied to the garden. Photo: MJ Broncano.

- **Extensive crops.** In principle, the only input is the **seeds for sowing**, since crop fertility is maintained by the incorporation into the soil of plant remains of the species that grow in the field and the presence of legumes as nitrogen fixers. This is carried out with the use of species associations and rotations, such as those carried out with the **Fukuoka method and that of cereal crops on permanent pastures** (pasture cropping), which are described in the sheet "Combining crops in terms of time and space for greater production and the biological activity of the system". The main output is the grain of the cereals, which is used to feed the chickens, and the forage, which is normally used to feed the cows in the months when there is not enough grass in the meadow.

- **Fruit trees.** The basic input of fruit trees is **plant production from CO<sub>2</sub>**, water and nutrients from the soil, and their main output is the fruits they produce. Their combination with grasses, where there are legumes, increases the amount of nutrients available to fruit trees without additional inputs, and this is also achieved by placing wooden beds from the forest in the planting hole at the time of installation. **Different biofertilisers with invigorating and insecticidal effects** are usually applied to achieve quality fruits.

- **Garden.** The garden is an intensive element that is maintained by the contribution **of external carbon and nutrients**, since the outputs of vegetables are important. In a regenerative system, without tillage or agrochemicals, the intensive garden can be maintained with the addition of a significant amount of compost (obtained from BRF and biochar from the forest that are activated in the bed of the animals) that is then applied to crops (in many cases it is grown on compost). The main input is seedlings.

• **Cows and calves.** The diet of cows and calves is **basically obtained from the meadow**, where they also leave their excrement to maintain fertility. At certain times, the calves are taken to the dehesa or to the forest, where they mainly consume leaves and where they deposit excrement to maintain the fertility of the system. **The only notable input is the external forage** that is needed in a few months for the cows, provided that the farm is not capable of producing it itself. The main outputs are milk from cows and meat from calves.

• **Rabbits.** The diet of rabbits is completely herbivorous, so **they feed exclusively on the meadow** and do not require additional food inputs. The excrement that they release remains in the meadow itself, so that it does not impoverish its fertility, since the outputs in the form of meat are small compared to the internal cycle that is maintained.

• **Chickens.** Chickens obtain 30-40% of their diet from the meadow, so there are **important inputs into the system in the form of feed and grain**. Part of this grain can come from intensive crops, if they produce it in enough quantity. As in the case of rabbits, chicken droppings are released in the meadow itself, so that its fertility is maintained, which is not affected by the output in the form of meat.

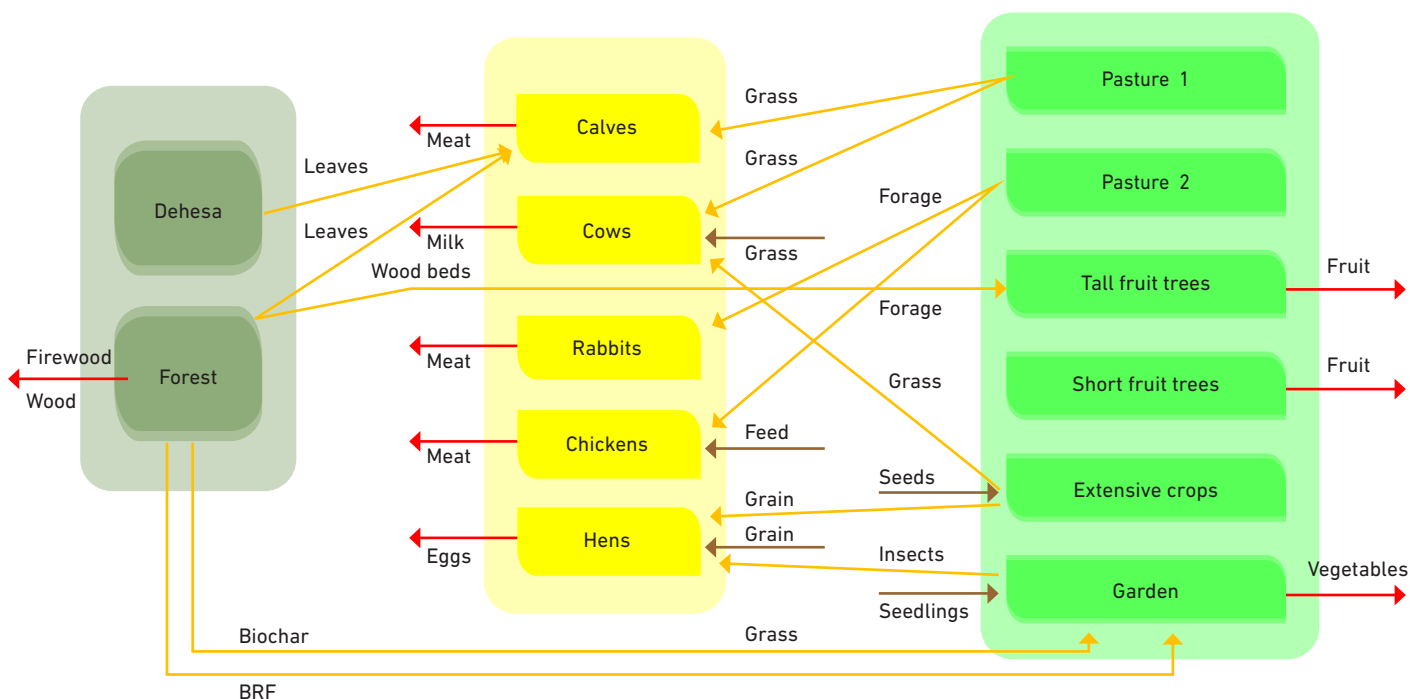
• **Hens.** Hens spend part of the time in the garden, where they consume insects and grass. However, **their main food is grain**, which represents the main input in this case. Their output is the eggs produced.

## Integration between uses: circulation of products in the Polyfarming system

To understand **how the Polyfarming system works as a whole**, integrating the different uses, it is necessary to identify the products that are introduced (**inputs**), and those that leave the system (**outputs**) or that **move between the different elements** (Figure 2). The products are the result of the use of a certain element, either as a final product for consumption or as an intermediate product to be applied to another element, or external inputs to the system that cannot be produced in it. In a model farm with the elements described in the "Characterisation of the different elements of the Polyfarming system" sheet, these products could be summarised as follows:

- The **final products (outputs)** of the system include: firewood, wood, fruits, vegetables, meat, milk and eggs.
- **Intermediate products** that move between different elements include: grass, forage, grain, leaves, biochar, BRF and wood beds.
- Finally, there are a series of **products from outside the system (inputs)**: seeds, seedlings, feed, forage and grain, the last two in case the internal production of the system is not sufficient as a whole.

The origin or destination of these products from the different elements identified in the Polyfarming system is represented in **Figure 3**, where the three main uses at the farm level are separated: forestry, agriculture and livestock.



**Figure 2.** Circulation of products between the different elements of the Polyfarming system. Final products or outputs, red arrow; intermediate products between elements, orange arrow; products coming from outside or inputs, brown arrow. Uses: forestry (dark green), agricultural (light green) and livestock (yellow).