

Costs and key points of producing and applying BRF

There are mainly three types of costs for the production and application of BRF: (1) **costs of obtaining the base material**, which are branches <7 cm in diameter; (2) **shredding costs**, which includes the use of a shredder and transportation to the location of the pile of branches; and (3) **field application costs**, which includes transporting the BRF from the crushing zone to the field and distributing it in the field.



Figure 1. Decomposition process of BRF in the forest. Photo: J. Luis Ordóñez.

Quantification of production and application costs of BRF

The quantification of BRF production and application (Figure 1) is based on calculating three different types of costs:

1. **Cost of obtaining the BRF base material.**
2. **Cost of crushing BRF.**
3. **Cost of placing BRF on the field.**

Next, we will describe the different alternatives analysed for each of these processes, indicating the costs they represent and their variability (Table 1).

1. Cost of obtaining the BRF base material. This cost includes **cutting the branches** that will be used as raw material. All the necessary materials for felling (chainsaw, etc.) are already available on the farm, otherwise the corresponding costs will have to be included. **Branches of <7 cm are obtained from the traditional forestry cuttings that are made in the agro-silvo-pastoral farms.** So, its cost can be considered **0**, since it is work included in obtaining wood or firewood.

2. Cost of crushing BRF. This cost includes crushing the branch biomass using a shredder. It is considered that the farm has **a shredder**, otherwise the cost of hiring it would have to be counted. In principle, the shredder is taken to the place

where the branches are and not the other way around, since transporting the volume of branches would be much more expensive than transporting the BRF directly. Approximately 10 m³ of branches are needed to obtain 1 m³ of BRF. **The cost of crushing is that of two people working for approximately 1-2 hours:** one drags the branches to the crusher and the other introduces them. If the branches are large (5-7 cm) it takes longer than if they are smaller (2-4 cm).

3. Cost of placing BRF on the field. This cost includes transporting the BRF from the crushing area to the field and distributing it on the ground.

- In the case of **transport**, the cost **depends on the time spent loading the trailer and moving the BRF to the application area.** In the farm where the Polyfarming system is implemented, the trailer has a capacity of 2 m³, so it only takes one trip to transport all the BRF obtained from 10 m³ of branches. It is considered that the farm has a jeep with a trailer, otherwise it is necessary to include the **costs of renting it.** If the BRF is left in the field for a year before transporting it (one of the possible options), then it is still more compact and more BRF can fit on the trailer.

- Regarding the application, **it is essential that the vehicle**

arrives right next to the field, so that transporting the BRF with a wheelbarrow to the application area is very quick. A pile is mounted near the facilities that require it, which the chicks and the garden area.

- In the case of the **chick litter**, the BRF is placed directly in a very short time, so the **cost** is practically **0**.
- In the case of the **vegetable garden**, the BRF is placed in the irrigation ditches. In the trenches of 15 cm x 20 cm section (0.03 m²), the hose is placed and the top is covered with BRF. Approximately 0.5 m³ of BRF is placed on each 70 m long line, like those at Planeses. One worker takes approximately 0.75 hours to apply BRF to one of these lines.

■ Considerations on the optimal strategy for producing and applying BRF

The **key points** to consider in the production and application of BRF are the following:

- In BRF production, it is essential to **place the shredder close to where the freshly cut branches are**.
- The crushing of the branches depends on their size: **when they are large (5-7 cm), much higher yields are obtained** than if the branches are small (2-4 cm).
- The BRF can be transported to the farm once it has been crushed or, more advisable, **leave it in the forest for a few months** and then transport it to the area of the farm where it will be applied.

From these considerations, we can establish a **series of simple calculations to estimate the total costs** of applying BRF in agricultural farms. These calculations are based on 1 m³ of BRF. **The overall cost is the sum of three costs:**

$$C_{\text{total}} = C_{\text{obtaining}} + C_{\text{crushing}} + C_{\text{placing}}$$

Obtaining the BRF base material:

$$C_{\text{obtaining}} = 0 \text{ (<7 cm branches are obtained from forest harvesting)}$$

Crushing del BRF:

$$C_{\text{crushing}} = 10 \text{ m}^3 \text{ branches} \times 1 \text{ m}^3 \text{ BRF} / 10 \text{ m}^3 \text{ branches} \times 2 \text{ h} / 1 \text{ m}^3 \text{ BRF} \times \text{Salary} / \text{h} \text{ (shredding with 2 workers)}$$

Placing the BRF, the sum of two costs:

$$C_{\text{transport}} = N \text{ h (depends on the distance from the crusher to the field)} \times \text{Salary} / \text{hour (load and transport of BRF)}$$

$$C_{\text{application (1)}} = 0 \text{ (application in the chick litter)}$$

$$C_{\text{application (2)}} = 0.5 \text{ m}^3 \text{ BRF} \times 0.75 \text{ horas/m}^3 \times \text{Salary/hour (application in the orchard, in a 70 m-long line)}$$

Parameter	Unit	Value used	Variability and causes
Shredding time of 10 m ³ of branches	hour	2	Two people take 1 h when the branches are large (5-7 cm), if they are small (2-4 cm) they take twice as long
Quantity of BRF obtained from 10 m ³ of branches	m ³	1	When it is left in the field for a year it ends up occupying a smaller volume
BRF trailer loading time	hour	0.5	It varies with trailer size
Trailer transfer time	hour	-	It depends on the distance
Time of application of BRF in the chick litter	hour	0	A small amount of BRF is added and this does not take very long
Amount of BRF applied to the orchard (per 70-m line)	m ³ BRF/ line	0.5	It may fluctuate slightly depending on how deep the trench is
BRF application time	hour/line 70 m	0.75	It may vary depending on where the BRF stack is

Table 1. Parameters used to calculate the costs of producing and applying BRF, indicating the values used in Polyfarming and the possible variability that can occur in these values.