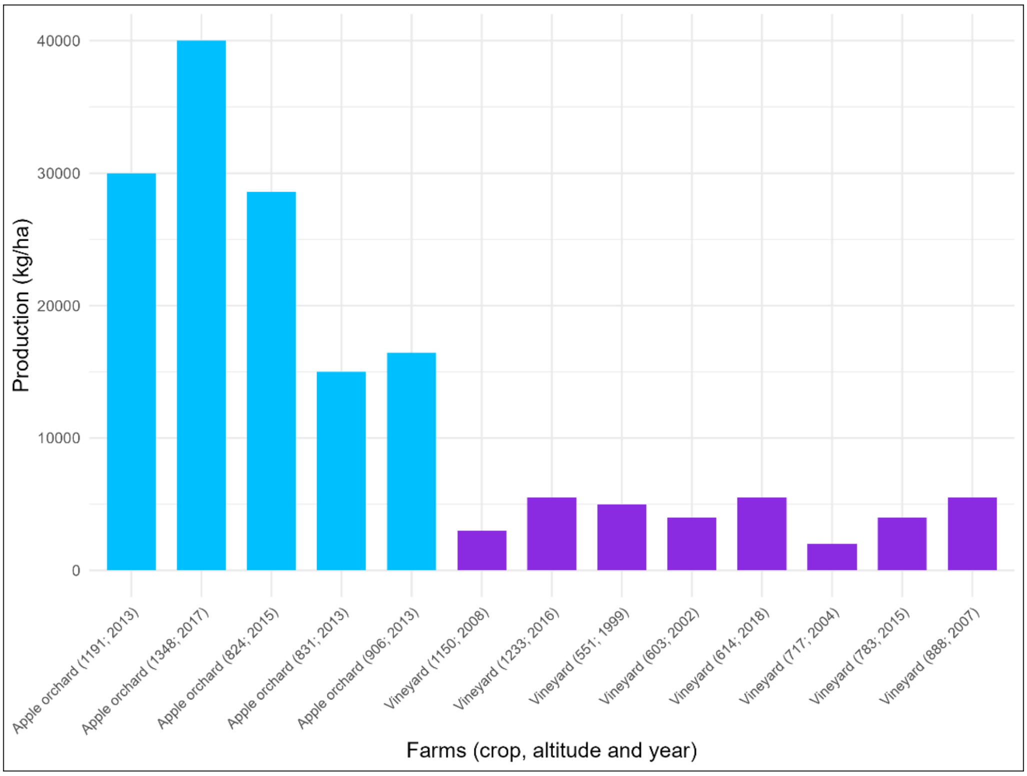

Figure 11 Production (2023) for each orchard interviewed summarized by crop, altitude and year of implementation.

As a common factor, both in terms of irrigation and the fence to protect against wildlife, it has been observed that all the farms had it. Irrigation is considered essential in intensive apple farming, which is why all farms have it. The same applies to protection measures against attacks by wild fauna, and all plantations are closed (*Figure 12*).

Figure 12 Extensive apple orchard with a synergistic fence.

Except for one case, all the remaining plots are owned by the farmer (*Figure 13*). Many (66%) are the farmer's family heritage, and the rest have been acquired to be able to develop the activity (2 in total). The acquisition prices in this case have been between 12,500 € and 15,000 € per hectare and the rental 750 € per year and hectare.

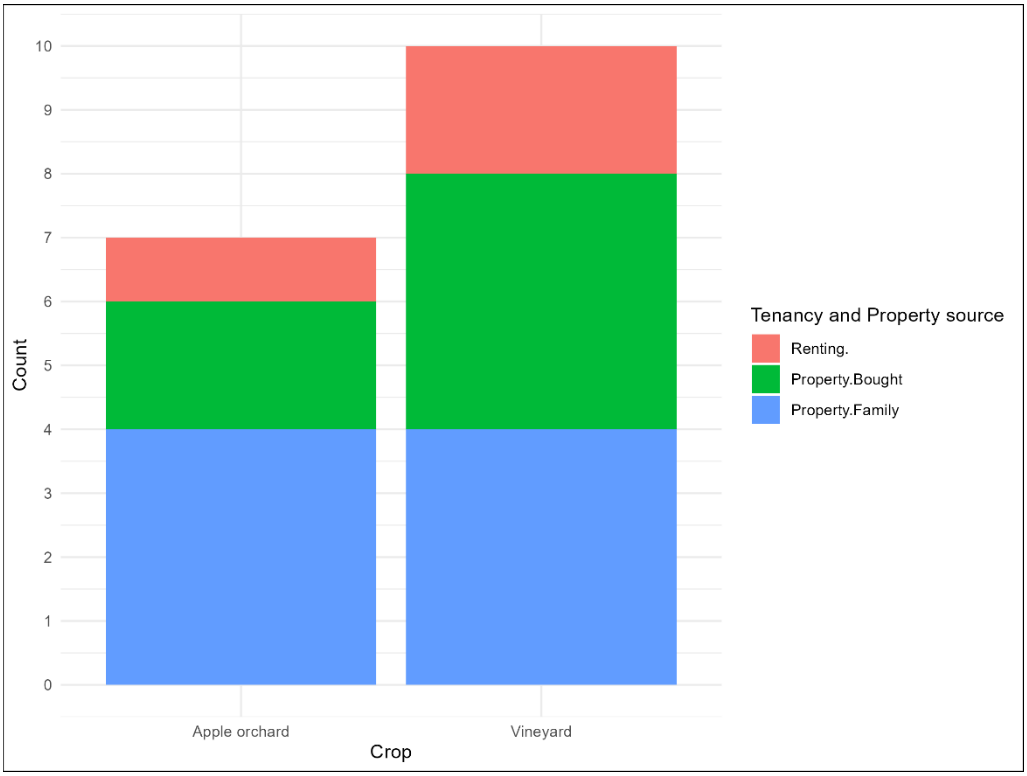

Figure 13 Comparison between type of tenancy and source of the property tenancy for both crops.

Regarding the particular case of renting in apple orchards, it should be said that the farmer's intention was to buy a plot of land where he could plant, but he did not find the possibility of doing so due to lack of market. This situation, in the same way as in the case of vineyards, is the greatest limiting factor in terms of the establishment of new plantations, since both for purchases and long-term rentals, the land market is very stagnant. For apples it can be especially problematic since vineyards could be established without a cellar, making the implementation costs much lower, but in the case of apples, the mandatory installation of both the protective network, the fence and the irrigation system means that the investment is much greater and the usual case would be denial in the face of such a large investment if the land is not owned. This fact can be seen reflected in the origin of the plots owned, where more than half of the plantations visited are located on land that already belonged to the farmer by family legacy.

In terms of management, all the plots have an organic and certified management. This is because one of the conditions for entry into the Biolord cooperative is to carry out this type of management and, in addition, to have it certified. Thus, everyone has obtained through this route since initially the cooperative is the best way to enter the apple market and a great ease in terms of storage.

In the particular case of the vineyard there is the added characteristic of the Designations of Origin (DO). A DO is a geographical indication that guarantees the origin and quality of a product, in this case wine, which is made from certain varieties and practices previously established. A regulatory council for the designation of origin ensures compliance with the regulations, keeps a register of affiliated farmers, controls production and verifies the quality of the product. In the study area we mainly find the DO Costers del Segre. Of all the farms consulted, only three are part of it (Table 2; V3, V4 and V9) of the six that could potentially enter it (V6, V7 and V8 are inside its geographical limits). This is because although belonging to a DO brings you benefits in terms of advertising and recognition of a location and quality standards, it restricts you in terms of winemaking and practices. For this reason, farmers who want to differentiate themselves even more with their own way of making wines may see restrictions if they belong to a DO.

Table 2 Data about vineyards and apple orchards interviewed. Year indicates the year of plantation; Altitude is in meters above sea level; Surface is the total area of plantation; Irrigation indicates presence of infrastructure for irrigation (indicates that is not actually being used); Fence details the presence of protection against wildlife fauna (** no fixed installation, but mobile installed according to needs and production time); Cellar if this infrastructure is available within the farm; Tenancy refers to whether the plot is owned or rented; Property source expresses, for those that the farmers own, if they come from family ownership or whether they have had to buy them to plant; Price indicates, for those property and bought how much they costed, and for those in renting the annual price; Management type of practices applied (*** certified); "Is DO" indicates if the vineyard produces under a Denomination of Origin (DO) and; In DO if the vineyard is geographically located within an area where it could be eligible to enter the DO.*

Crop	Code	Year	Altitude (m)	Surface (ha)	Density (plant/ha)	Production (2023; kg/ha)	Irrigation	Fence	Cellar	Tenancy	Property source	Price (€/ha)	Management	Is DO	In DO
Vineyard	V1	2016	758	2.5	2,520	Semi-productive	Yes*	Yes	Yes	Property	Bought	5,000-10,000	Organic	No	No
	V2	2008	1,150	2	3,333	3,000	No	Yes	No	Property	Family	-	Conventional	No	No
	V3	2015	783	2	4,000	4,000	Yes	Yes	No	Renting	-	800	Conventional	Yes	Yes
	V4	2002	603	13	4,000	4,000	No	No	Yes	Property	Family	-	Conventional	Yes	Yes
	V5	2016	1233	2	5,000	5,500	No	Yes	No	Property	Family	-	Organic ***	No	No
	V6	1999	551	7	2,777	5,000	No	No	Yes	Property	Family	-	Conventional	No	Yes
	V7	2004	717	5.5	NA	2,000	No	Yes	Yes	Property	Bought	6,000	Regenerative	No	Yes
	V8	2018	614	6.5	4,000	Semi-productive (5,000)	Yes*	No	Yes	Property	Bought	NA	Organic***	No	Yes
	V9	2007	888	10	3,787	5,500	No	Yes**	Yes	Property	Bought	NA	Organic***	Yes	Yes
	V10	2011	1,120	0.8	2,400	Semi-productive	No	Yes	Yes	Renting	-	1,375	NA	No	No

Crop	Code	Year	Altitude (m)	Surface (ha)	Density (plant/ha)	Production (2023; kg/ha)	Irrigation	Fence	Cellar	Tenancy	Property source	Price (€/ha)	Management	Is DO	In DO
Apple orchard	A1	2013	906	1.5	2,000	16,444	Yes	Yes	-	Property	Family	-	Organic***	-	-
	A2	2015	824	1	2,857	28,570	Yes	Yes	-	Property	Bought	15,000	Organic***	-	-
	A3	2013	831	3.5	2,886	15,000	Yes	Yes	-	Property	Family	-	Organic***	-	-
	A4	2017	1,348	1	2,000	40,000	Yes	Yes	-	Renting	-	750	Organic***	-	-
	A5	2021	1,221	0.4	750	Semi-productive	Yes	Yes	-	Property	Bought	12,500	Organic***	-	-
	A6	2013	1,191	10.5	3,571	30,000	Yes	Yes	-	Property	Family	-	Organic***	-	-
	A7	2009	824	0.8	2,315	NA	Yes	Yes	-	Property	Family	-	Organic***	-	-

3.4.2.1. Socioeconomic survey

As can be seen in (Figure 6) the vineyards vary between approximately one and twelve hectares. Of these, those with areas between 5.5 and 13 hectares represent the main activity of the farmer as an economic source, a total of four vineyards (V4, V7, V8 and V9). The reason why the farms were established is diverse and responds to both the personal motivation of the farmer and his particular situation, especially ease of access to land. Generally, everyone has a motivation towards the world of wine and the generation of a new economy in the territory to diversify activities, with winemaking in many cases non-existent in the areas where these vineyards were established. Some people are looking for a greater economic return and have done both the plantation and the cellar with a more entrepreneurial sense, but others do it as a complement to their main activity and because they see a market for the final product and, in some cases, as a more recreational purpose. Apple orchards generally do follow a more standardized model with plantations that range between one and three hectares (Figure 6). All of them are motivated by the experience carried out by Iglesias et al. (2020). Some farmers carried it out on family land as a second activity to get an extra income, but others have started this activity as their main job. Those generally did not have family land and have had to look for it and are currently in their property or on long-term lease.

In the case of vineyards there is no family winemaking background except for a couple of specific cases, but there is an interest in the world of wine. Despite the existence of these cases, where the family had been partly dedicated to the cultivation of vineyards, in none of them did the farmer who encouraged the plantation or the winemaking activity itself have training in this regard before starting the activity. Some people did seek training in this aspect, by taking regulated courses, but others have learned from experience and regular advice. The fact that winegrowing in mountainous regions is so recent became complicated for people without experience because it is a new practice in a climate where it is more difficult for the initial plant to develop. In the case of apple orchards, none of the current farmers had previous experience with the cultivation of fruit plants, they did so because it was presented to them as an activity that could work (and that was being done in other countries) and as a new way of economic development in mountainous regions. The biggest problem that farmers of both crops have agreed on is the lack of a land market through which to access new plots to cultivate. It is very difficult for them to find new areas to plant if they want to expand, or when they have wanted to find some to start farming. The owners do not want to sell, either because of the urban speculation that exists in many mountain regions or because of a lack of interest in getting rid of the family legacy. They also have a hard time considering the type of rent that a plantation of these characteristics requires, since they are used to making short rents that they generally renew annually. Farmer from A7 said toward this topic that "*there is a rental for livestock or forage, but it is very difficult to buy and rent long-term*". In some cases they also find that the heirs of the farmland in these areas are no longer in the territory and have no interest in listening to these new alternatives that are being proposed in the area. In addition, there is also this whole set of abandoned plots that are no longer suitable for direct cultivation due to the lack of generational succession in the primary sector. The most common thing is that there is no generational change and young people do not want to dedicate themselves to the primary sector with which they may have a family tradition due to all the difficulties it entails and the little economic return it currently provides. The great excess of bureaucracy is also a factor that is causing even people who have dedicated their entire lives to abandon their activity due to saturation. Farmer from V2 expressed his personal experience saying that "*the youth have left the village and the farms have ended up being taken by the few remaining old farmers. They have rented or taken everything that the others left. The small farms were not profitable, it was done for subsistence. At home they had sheep and pig farm, but ended up opening a rural tourism restaurant and stopped raising livestock. The main problem is the lack of profitability of the crops that were grown there. Many of the older people who were left have also given up on the excess bureaucracy, which they are not able to cope with. Since it had already reached a point where they did it for pleasure and because they have done it all their lives, it is not worth it for them to continue because they feel bored by the bureaucracy*". In relation to this aspect, there is also a rural exodus due to lack of opportunities; primary activity does not interest the new generations and in these areas apart from seasonal jobs related to tourism there is very little job offer. These people, who inherit family lands, maintain ownership of the farmland even if they end up living outside the territory (usually in cities) and, either rent them out in the short term or prefer to have them abandoned rather than sell them. As an addition, it is necessary to take into account the increase in the complication of access to housing that is occurring in these territories. If the person who wants to start the activity is not a resident of the place where the land is located and is considering settling in this new area, they may have many problems finding stable and affordable accommodation.

The older vineyards have seen that they have served as an example for other people to start a similar activity when they see that they have worked and that it is an emerging market in the region. Many of the farmers consulted agree that their farms can serve as an example to help keep people in the territory and that they take advantage of these family plots that they may have to generate a new activity. Or even that these people have a better vision of these activities and are more susceptible to renting or selling their plots for these plantations. They are also partly generating job offers with a certain stability for workers in the territory where the most common thing is that they only find seasonal work linked to the ski and holiday seasons.

In relation to the greatest effects that farmers of both crops have on the development of the activity, the most common and serious are late spring frosts and wildlife. Regarding the first, there are preventive measures that can be applied on specific days when frost occurs that can compromise production, such as candles or sprinkler systems. Farmer from A1 expressed that "*there are years when we lose flowers due to spring frosts which can affect up to 20 % of production. And this not only causes trees to produce less one year, but it also unbalances them with the issue of alternation, so the following years we also have problems directly related to that frost*". Although protective measures, the most important thing is the location of the plot and it would be essential to be able to base ourselves on a study (such as the one proposed by Busquets et al. (2024) to find those where this risk can be minimized. Unfortunately, and as mentioned above, access to the land is very complicated and therefore this task of choosing specific plots is very difficult. Regarding wildlife, plantations, both vineyards and apple orchards, are usually found with some type of fence, either electric or fixed (more common in apple orchards), to protect the plants. Wildlife can not only directly affect the harvest, but they can also damage the plants themselves. Farmer from V3 expressed that "*What stands out the most are the problems with wildlife because they are becoming more and more noticeable, especially in years when there is no rain".* Also, farmer from V2 had serious problems with wildlife: "*three years ago we lost 30 % of our harvest to wild boar attacks in a couple of days*". Each farm must carefully study its particular conditions and the possible animals with which it may have problems in order to adapt the fence and ensure that it will be useful. On the other hand, as these are activities that have recently been introduced in the territory and have a relatively low presence in most regions, there is a lack of specialized labor. Farmers have noticed this in the first place, finding people who work more regularly for the annual maintenance of the farm, but they do end up finding workers who they can train and keep for years. When this becomes more problematic is when handfull of people is needed for pruning or thinning, which are tasks that require good prior knowledge and that cannot be taught at the time. Both vineyard and apple orchards have to end up getting to hire brigades that come from areas of the national territory where these activities are usually carried out and pay the additional cost of travel and, in some cases, stay for all these workers.

Vineyard farmers who have enough production and are interested in working with distributors encounter obstacles due to the distance they have to the supply and sales centers. There is also a lack of a cooperative structure that would allow for mitigating costs, such as having common machinery available or, more importantly, a winery where all production can be processed. Apple orchards, on the other hand, needs an irrigation structure that may not be easily accessible. Mountainous regions generally do not have irrigation because it has not been necessary and alternative routes such as ponds or wells must be sought.

As for subsidies, few of the people interviewed have been able to benefit from any help to start their activity. In this cases all where only available for machinery and only one could access for estructural costs. In the particular case of vineyards, some where able to obtain subsidies to partially pay for the cellar.

For some years now, mountain regions in the study area have worked to encourage the products generated in their territory through a whole set of initiatives to group them and improve their visualization, as well as to reach potential consumers. In this sense, all producers can access these tools to improve their advertising. In the case of apples, there is also a cooperative through which the entire product is marketed and an image is generated that represents them all together, managing to differentiate themselves from the competition.

The experience of part of the owners of wine-growing activities in mountainous regions is that it is a viable business despite its difficulties if a minimum surface area is achieved. Farmer from V8 expressed that "*Professionally, a farmer can't do anything with less than three hectares and one should never consider a farm to only produce grapes. If a farmer is going to make wine, he must have training to do it well or some tutelage of a professional person who can advise during the process*". Others consider that it depends a lot on the personal situation of the person who wants to start the activity. The costs (and difficulties) of accessing land added to the construction of the cellar are too high if a newly introduced person have to start from scratch and without experience in managing a wine business. The biggest practical limiting factor is the difficulty of accessing cultivable areas, but this can partially be solved thanks to the fact that a business aimed at wine production can subsist with relatively small plantation areas in relation to other types of crops (such as sweet fruit, which need a better economy of scale structure). The fact that winegrowing in mountainous regions is so recent becomes complicated for people without experience because it is a new practice in a climate where it is more difficult for the initial plant to develop. Before starting, the farmer should know well the entire business model that wants to implement so that it works correctly and be clear about the direction to be followed. Some farms have advocated for smaller plantation areas but offering an enotourism experience on the same farm that provide them the majority of the income. With this type of model, a smaller area is needed for generating a primary activity, even though is more linked to tourism in the local area. Others seek more business through greater wine production and commersialisation. In this model, it is necessary to see at what point the volume of commercialization is sufficient for the local territory to not be able to absorb it and it is necessary to look for national and international alternatives. This involves an economic and immaterial investment of time that is difficult to measure but farmers dedicated to it find it very necessary. It involves moving to fairs, looking for contacts within the wine world and a lot of networking activity. At first, it was difficult for them to see the usefulness but ultimately it turned out to be essential for them to find sales channels that did not exist in their territory. At the present moment, the differentiation and interest in mountain wine can be seen in the fact that the various farms visited do not usually have an accumulation of stock from one year to the next. The most common case is that they manage to sell everything they produce. Distribution in most cases is local, to restaurants, shops and direct sales in the territory where the wine is produced with some occasional shipments and distribution channels to large national population centers (especially Barcelona) and, in the case of the largest vineyards, also international. The distribution is usually done by the farmer himself whenever it is for local distribution and they then make use of shipping companies for national and international.

The experience of apple farmers who dedicate themselves entirely to it is that it is very difficult to start the activity and maintain the crop, both due to its management and the profitability that is currently being extracted from it. Farmer from A2 said that "t*here is a very clear problem with the lack of experience in this type of exploitation in mountainous regions and it requires a high knowledge to be constantly productive*". The viability of the exploitation depends largely on acquiring the sufficient learning and efficiency when working with apple trees. The tree must be controlled very well so that it reaches the expected and necessary levels of caliber and production, as well as in alternation. The weather conditions can induce the trees to enter rest cycles from one year to the next causing the production in the following year to not be as expected and, in some cases, insufficiently low. In this sense, spring frosts can be especially devastating if they affect the peak of flowering. There is at least one year registered in the period of 2013 to 2024 in which all the production from the apple orchard was lost due to late spring frost affecting the flowering period. Farmers tried both candles and sprinking to fight against this problem. Candles are really expensive. If they are needed several nights (around more than three to five), their cost may not offset the profits from production. To reduce costs, farmers using candles tend to stay all night awake only lighting the candles when the temperatures drop enough for frosts to happen and blowing them out when the flowers are safe. Sprinkling, on the other hand, needs to be added to the structure costs, as it is complementary to the irrigation system. It wastes a lot of water, so the farmer has to make sure that he has enough of this resource to carry out the protective system. It also doesn't work as well as candles, but its cheaper if enough water is available and it may be programmed to work automatically. In addition, much of the machinery is not adapted to the slope with which they have to work in these environments and the tasks can be very time-consuming if they have to be carried out manually or with machines not specialized.

Finally, in the case of apples, the option of extensive cultivation should be mentioned. In the study area, only one has been located, which is also small in size (0.4 ha), dedicated to the production of cider. Although there is still no economic information available on the development of this activity, it is considered an alternative to intensive cultivation. The implementation costs are lower (although it must be taken into account if it is processed and requires facilities to manage the product) and the handling tasks as well. The farmer interviewed whom develops this activity (A7) expressed that "*if you want to implement an extensive orchard (wide planting frames, more vigorous plants, without mesh) you should go for processed products to make it viable. You can use the vast majority of the volume and it does not require as many treatments or flower selection*".

As a summary of the two activities, the following points stand out. The major initial obstacle to starting the activity is access to land and the price to buy a plot with good characteristics for woody crops. This is mainly due to the lack of a purchase and sale market available in mountainous regions despite the large number of plots that exist where these plantations would be possible. Renting is equally difficult when it is proposed in the long term with the owner (15 - 25 years) and it may not be preferable for the person who wants to start the activity due to the large investment required. This factor means that the choice of the most suitable plots following the methodology proposed in Busquets et al. (2024) may not be possible because the location of the plantation will end up depending on where we find an owner willing to sell at a fair price. It is necessary to pay attention to this point by the new person who wants to start the activity since trying to find a plot where late spring frosts are especially minimized can be key to the good development of the activity. Once the plots are found, the type of acativity must be considered. Vineyards have a lower implementation cost as long as the construction of a cellar is not taken into account. An operation intended for the sale of grapes to third parties is not considered viable, so in this first case the farmer will have to look for a place to vinify the production and, if he wishes, mature the wine. The enotourism activity that can be related will be smaller than vineyards with a cellar on the farm but will greatly reduce the implementation costs and the farmer can look for alternative ways to encourage it. If it is obtained by building a winery, either from scratch or taking advantage of an existing construction, the costs will increase considerably but the farmer will gain in quality of service and will be able to take advantage of the opportunity to create a space where to develop enotourism. This can be the main source of income and the point from which much of the marketing takes place, but significant dissemination work will need to be done to reach the necessary volume of consumers. Regarding the vineyard management tasks, these are enough for the person to have to dedicate themselves almost entirely to it (even if they have a second activity) or need to hire someone to do it. The farmer will have to take into account that at specific times they will probably need specialized help (green pruning) and non-specialized (harvest). Currently, the marketing and selling price of wine produced in mountainous regions is not a problem thanks to the differentiation from other common production regions. In this sense, it will be necessary to see the temporal evolution of the price of this product as well as the capacity of the territory to absorb it if the farms constantly increase. For the apple part, the implementation costs are between vineyards without a winery and vineyards with a winery. The intensive plantation model is very well defined and the existence of the cooperative facilitates the implementation part thanks to the experience of the members and the advisory team that it has behind it. However, it will be necessary to ensure the possibility of installing sufficient irrigation equipment to maintain productive trees. Managing the farm is the most complicated part since it requires a lot of knowledge and dedication, which can be complicated for one person if tries to achieve an economy of scale so that the activity is profitable. The marketing part in this case does not generate any problems either. On the one hand, the cooperative structure can be used, making it much easier, but if the farmer is looking for a greater economic return because the plantation is small, it can look for more local sales channels that, according to the experience of the people interviewed, are currently available. However, it is necessary to take into account the time commitment that this requires and the fact that it will be necessary to have a cold room or space to store the product safely during the time it takes to market. As a general thought, farmer from A2 said that "*At an economic level it may not work out, it is very difficult to make a profit. Especially if the farmer does not have previous knowledge of apple production in the mountains. We planted varieties for which there was not much information about productivity, growth, or how they functioned in mountainous regions. The experience lived is very important*".

3.4.2.2. Economic survey

The costs of implementing the structure for vineyards (Table 3) range from 8,700 € to 11,850 € per hectare including installation services and, in one case, 7,000 € per hectare of structure excluding these services. As for the planting, if this is carried out by the farmer himself, the costs of the plants have ranged from 4,800 to 6,000 € per hectare and climb to 6,700 € to 15,220 € per hectare if services are contracted to carry out this task. Overall, the fixed costs of implementation range from 13,700 € (case without costs for planting services) to 27,000 € (case with all services and extrapolating from small plots) per hectare. It should be noted that the most expensive cost, 27,000 € per hectare, comes from an extrapolation of two small plots (0.24 and 0.37 hectares respectively) and that if it were a single unit the costs would most likely have been lower. In any case, this measure allows us to visualize the point to which prices can climb if there is no single homogeneous unit to carry out the plantation and this must be carried out in several small ones. All the structure costs represented in Table 3 do not take into account, due to lack of data, the costs related to the installation of irrigation or protective fencing. Fencing, however, is estimated by the experience of sources consulted during the interviews for both vineyards and apples to be around 5,000 € per hectare. The highest cost associated with the vineyards comes from the winery. When the estate already had a building where the winemaking activity could be accommodated, the costs of preparing the space and purchasing all the material and machinery necessary to start the activity have been between 70,000 € and 150,000 €. If, on the other hand, it has been necessary to prepare the land and build a warehouse because there was no type of structure that could be used previously, the costs increase to 270,000 € to 565,000 €. Finally, to be able to maintain and work the farm, all farmers have machinery (tractor and implements) that in some cases, the tractor, was already available to other family farms. These latter farms have only had to acquire the necessary accessories at a cost of estimated of 13,000 €. Farmers who have had to buy everything have allocated between 22,000 € and 26,000 € for second-hand equipment up to 34,000 € and 39,000 € for those who have bought everything new. The type of accessories acquired by each farm varies depending on the needs of the plot but generally consists of inter-vines, brush cutters, atomizers and crushers, among others.

Apple orchards have higher base implementation costs (Table 4) than vineyards which are around 60,000 € (with part of the installation carried out by the owner) and 65,000 € per hectare with all the services included. This agglomeration takes into account all the support material for the plants, as well as the apple trees themselves (which are around 12,000 € to 15,000 € per hectare), the irrigation system, the protective mesh and the fence. In some cases, the land has been necessary to prepare prior to the planting tasks with an additional cost of 10,000 € and 22,000 €. Regarding agricultural machinery, for the acquisition of tractors and accessories farmers had to allocate between 15,800 € and

44,700 € taking into account that it was used machinery and 88,000 € acquiring everything new.

Comparing vineyards and the apple orchards, it can be seen how the structural and planting fixed costs of both (Table 3 and Table 4) differ greatly, ranging from 13,700 € to 27,000 € per hectare for the first to 60,000 € to 65,000 € per hectare for the second. This is largely due to the costs associated with the protection structure for the apple trees (Figure 14), mainly for hail. Also, all apple trees need irrigation and these costs are not contemplated, nor do they initially seem necessary, in the vineyards due to lack of information on the matter. However, it should be noted that thanks to the cooperative structure of apple plantations (with an annual associated cost of around 750 € per hectare), there is no need to have an infrastructure for the maintenance or shipping of the fruit produced during the marketing period. In the case of vineyards, many owners do obtain the means to build a winery, which considerably increases the costs of the operation.

Figure 14 Apple orchard protective structure.

Table 3 Fixed costs for vineyards. Surface is the total area of plantation; Structure includes the entire vine support system on trellis (not including irrigation); Obs. stand for observations about each cost; Plantation refers to the vines; Other costs are earthworks and plot adaptation; Cellar represents the costs, if not indicated in the observations, of the construction of the building, the installations and all the necessary machinery; Tractor and tools for the machinery used in the vineyard.

Crop	Code	Surface (ha)	Structure (€/ha)	Obs.	Plantation (€/ha)	Obs.	Other costs (€)	Obs.	Cellar (€)	Obs.	Tractor and tools (€)	Obs.
Vineyard	V1	2.5	8,700	Material + service	5,000	Plants	25,000	Leverage of a plot of 0.7 ha	270,000		39,000	
	V2	2	7,000	Material	9,000	Plants + service	NA		NA		22,000	Used
	V3	2	NA		4,800	Plants	NA		NA		NA	
	V4	13	NA		NA		NA		70,000	Existing building	13,000	Only tools
	V5	2	NA		6,700	Plants + service	20,000	Land preparation and stone removal	NA		37,000	
	V6	7	10,000	Material + service	NA		NA		NA		NA	
	V7	5.5	10,000	Material + service	5,000	Plants	NA		150,000	Existing building	34,000	
	V8	6.5	NA		NA		NA		565,000		26,000	Used
	V9	10	8,000	Material + service	6,000	Plants	NA		NA		NA	
	V10	0.8	11,850	Material + service	15,220	Plants + service	NA		NA		NA	

Table 4 Fixed costs for apple orchards. Surface is the total area of plantation; Structure includes the entire apple support system, irrigation, fence and, in some cases, installation services; Obs. stand for observations about each cost; Plantation refers to the apple plants; Other costs are earthworks and plot adaptation and; Tractor and tools for the machinery used in the apple orchard.

Crop	Code	Surface (ha)	Structure (€/ha)	Obs.	Plantation (€/ha)	Obs.	Other costs (€)	Obs.	Tractor and tools (€)	Obs.
Apple orchard	A1	1.5	65,000	Material + plants + service	NA		22,000	Land preparation	37,000	Used
	A2	1	45,000	Material	15,000	Plants	NA		44,700	Used
	A3	3.5	60,000	Material + plants + service	NA		NA		88,000	
	A4	1	50,000	Material + service	12,000	Plants	10,000	Land preparation	15,800	Used

Regarding the production of bottles (Table 5) in vineyards we found minimums of 2,500 bottles and maximums of 5,500 bottles per hectare with an average of 3,600 bottles. Its cost when outsourced to other wineries (without taking into account those associated with transport rental and fuel) is between 2.5 € and 5.5 € per bottle. If, on the other hand, the winemaking is carried out with the farmer's own means, the costs are reduced to 1.35 € to 2 € per bottle. This cost per bottle only includes the materials of the bottle, cork, label, without being able to consider expenses related to electricity, advisory services and other related ones due to lack of information. Generally, each of the wine brands has several references with different prices for each one. In order to summarize this information, which in some cases is very complex due to the large number of references available, Table 5 presents an average selling price per bottle for each brand. As a result, an average price varying between 10 € and 20 € per bottle has been observed, with minimums of 9.5 € and maximums of 30 € per bottle.

Table 5 Bottle production information and profit for vineyards. Surface is the total area of plantation; Bottles represent the amount of wine bottle produced by unit of surface; Cost is the mean cost per bottle (externalized for those farmers without cellar) and; Bottle price the mean selling price of bottles for each brand.*

Crop	Code	Surface (ha)	Bottles (quantity/ha)	Cost (€/bottle)	Bottle price (€/bottle)
Vineyard	V2	3.5	2,500	3.5*	15
	V3	2	3,000	2.5*	10
	V4	13	4,100	1.35	11
	V5	2	3,800	5.5*	20
	V6	7	5,500	NA	10
	V7	5.5	3,000	1.5	20
	V8	6.5	2,150	2	14
	V9	10	5,000	NA	18

The profits of apple orchards come from the sale of apples. Data obtained in terms of production, in total and classified according to size (*Table 6*), and of the selling prices (*Table 7*) are presented below. The interest in production is focused on apples of size A, which are those of the size found in any supermarket and for which a higher price is obtained per unit of weight. This size represents the majority of the production of the farms (generally around 70 %) and the selling price varies depending on the buyer. If the farm is within the cooperative, the selling price of size A is 1.3 € per kilogram and increases to 2 € or 3 € per kilogram if sold to food stores or directly to the market respectively (outside of the cooperative). Although the latter two provide more profits for each fruit, the fact of not using the cooperative structure implies that the farmer must have their own means of storage (cold storage) and marketing. The B caliber (approximately 20 % of production) precedes the A caliber in quality and shape, so its selling price to the cooperative is lower, standing at 0.6 € per kilogram. If the farmer wants to sell directly to stores or directly on the market, the prices can be very variable. As it is a slightly smaller fruit or with brands, the quality should not be different from that of the A caliber, so it is possible that in these marketing channels (especially selling directly in the market) it can be made at the same price as these. In stores it may be more difficult to maintain the price but according to the sources consulted, in any case it would be higher than that paied by the cooperative. Finally, the C caliber (10 % of production) is made up of apples that are smaller than the B and also have malformations. In the cooperative these fruits are destined for the production of juices and ciders externally (an external company is hired). If the farmer wants to do it his own way, he has to look for a way to make some of these processed products since their direct marketing is very difficult due to the characteristics of these fruits.

Table 6 Apple production information and profit for apple orchards. Surface is the total area of plantation; Production is the total amount of apples produced per hectare in 2023; Production A, B or C represents the part of the production for each caliber (are estimated with an average from other farms as original data was not available).*

Crop	Code	Surface (ha)	Production (kg/ha)	Production A (kg/ha)	Production B (kg/ha)	Production C (kg/ha)
Apple orchard	A1	1.5	16,444	11,675	3,124	1,644
	A2	1	28,570	27,999	286	286
	A3	3.5	15,000	10,650*	2,850*	1,500*
	A4	1	40,000	28,400*	7,600*	4,000*
	A6	10.5	30,000	21,300*	5,700*	3,000*

Table 7 Selling prices for apples depending on its calibre and the buyer.

Caliber	Price (€/kg)	Buyer
A	1.3	Cooperative
B	0.6	Cooperative
C	0.4	Cooperative
A	2.0	Shop
A	3.0	Farmers market (direct sales)

Although the survey created to collect economic data has been very extensive and detailed (Annex III. Economic survey – Vineyard and Annex IV. Economic survey – Apple orchard), with the aim of being able to separate as much as possible all the costs and benefits related to the development of the activity, for the both case of study the data provided has been very dispersed and not very accurate in terms of the proposed sections. The problem that has been found in this aspect is the general lack of professionalization that exists in many farms. As these are second activities and very small plots, farmers do not have as exhaustive control as well-established companies could with respect to the expenses involved in the maintenance and management of the farm. It has been possible to obtain more information with respect to the implementation costs (Table 3 and Table 4), as it involves the investment to start the activity, but the origin of this data has not been the same for everyone. This is more visible with vineyards where the information has been more dispersed than in the case of apples, where having a cooperative structure behind it and a demonstration project, the study on the implementation costs was more unified, as well as the exploitation model.

None of the owners visited was able to fill in with certainty all the sections raised in the economic survey mentioned above and what has been obtained from everyone have been approximations, which have been summarized and provided in different tables in order to visualize the ranges of magnitude that one could expect to implement either of the two plantations.

Unfortunately, there has been a lack of much information regarding the management and maintenance of the farms. The farmers have not been able to provide very detailed information on the costs and hours dedicated to a good part of the tasks as they have not kept accurate accounting in this regard. Not for lack of interest, but for a more practical aspect; They dedicate many hours to it and take great care of their farms, but they generally do it in a more passionate and, in some cases, recreational way than in a business way. In addition, in the moments of greatest work they have help from family or close people to carry out these tasks, such as the harvest, and they do it to the extent they can and adapting to this situation. It has been possible to extract, according to the experience of the farmers and their criteria, that at least one person is needed with full dedication all year round (although with some moments of less work, especially in winter) to carry out the activity. At the moments of green pruning, removal of flowers in the case of apples and other specific ones, extra help from specialized personnel is necessary as these are tasks that must be done in a very short period of time and therefore a contract is necessary. The most common case in vineyards is that the farmer has a person as an assistant with whom he collaborates to carry out all the annual tasks. Apple plantations, on the other hand, tend to be managed solely by the farmer who owns them and with occasional hiring of specialists to carry out the specialized tasks mentioned above. This is not the case for plantations that exceed two hectares, where in these cases the owner does need to have staff hired all year round for the maintenance of the farm.

3.4.3. Legislation review

This section discusses the problems that could be encountered in implementing the activity if a change in land use from forestry to agriculture is proposed to encourage a mosaic landscape in areas with high forest continuity. It should be noted that this analysis has been carried out by consulting the regulations that apply to the study area (Ley 6/1988, Ley 21/2013 and Ley 43/2003) and that it is likely to be different in other countries, but it can give an idea of the legal obstacles that could be encountered and the characteristics needen when carrying out this type of activity.

Farmer from V1, whom recovered some abandoned plots from a forest which previously where of agricultural use said that "*It is expensive to recover an agricultural use in an area where forest has been established because not only do one have to remove the trees and roots, but in many cases the terraces also have to be restored*".

In recent years, the forest area in Catalonia (Spain) has increased by a large number of hectares. Although the forestry legislation (dating from 1988;) aims to avoid the reduction of the existing forest area and to promote its expansion to stop the development of erosion processes, currently, despite adhering to the law, the need to establish objectives compatible with the initial one and that integrate new aspects of multifunctionality is evident. These must be aimed at the mosaic compartmentalization of the forest surface, avoiding large continuous forest masses in order to hinder the spread of large catastrophic fires, they must favor mechanized agriculture adapted to current times and, in general, help and promote the restructuring of the social balance of the territory, even if this implies a certain setback in this continuous increase in hectares of forest surface.

According to the legislation, the process is understood as a transformation of unclassified forest land into land suitable for developing an agricultural activity. Legally, it is therefore basically a matter of change of land use; when land classified as forest becomes agricultural. According to current legislation, forest land is defined as that which can be included within the following conditions:

- Rustic land populated with tree or shrub species, bushes and grasses
- Lands located on the edges of forests that are necessary for their protection
- Lands that, due to their characteristics, are suitable for afforestation or reforestation
- Natural regeneration meadows, wetlands, flats previously populated without the corresponding authorization
- Forest tracks and paths
- Temporarily, agricultural land that circumstantially and with a minimum duration of the species' turn is the object of forestry exploitation with fast-growing species

On the other hand, according to current legislation, the following are not considered forest land:

- Land legally classified as urban or planned urbanizable
- Surfaces populated with isolated trees or linear plantations
- Surfaces intended for the cultivation of ornamental trees
- Agricultural land

In order to make this land use change, any of the land that is considered forest will have to go through a series of processes regulated by legislation. The fastest way is for this action to be framed is within the forest management instruments of Catalonia (Technical Forest Management and Improvement Plan). If initially the land use change is not included within the plan mentioned above, a modification of the same can be requested to obtain authorization. If this path cannot be followed, authorization from the administration will have to be requested through the territorial services, which will be responsible for determining the required technical and economic suitability. In either case, a positive report from the local entity will be required, in this case the City Council, and an environmental impact assessment. If the City Council does not issue this report or considers that the changes are incompatible with the urban planning approach, it will not be approved and therefore will be unfeasible on that plot. Clearings may be incompatible when the land is classified in the urban planning plan with forest keys and does not have agricultural uses allowed.

At the time of writing this deliverable, clearings of less than one hectare, and clearings of one to ten deforested hectares (coverage of tree species less than 20 %) that are not in any of the following cases, may directly request authorization from the administration without having to previously carry out an environmental impact assessment:

- Areas with a level of water erosion > 10 t/ha*year
- Areas where natural or semi-natural vegetation occupies less than 5 % of the surface in a circle of one kilometer.
- Clearings that, being presented in fractions, reach the previous thresholds by accumulating the magnitudes or dimensions of each of the projects considered.
- Breaks that may significantly affect, directly or indirectly, Natura 2000 protected areas.

The rest of the land use changes must be subject to an environmental assessment before authorization by the administrative body. The following projects will therefore be subject to an ordinary environmental impact assessment:

- More than 10 ha in the Natura 2000 Network.
- More than 50 ha outside the Natura 2000 Network.
- Those included in the scope of application of the simplified environmental assessment, as well as those that, being presented in fractions, reach the