# A qualitative approach to Food Loss. The case of the production of fruit in Lleida (Catalonia, Spain)

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**Abstract**: Conventional definitions of food loss and food waste consider that the phenomenon can be measured with mass or monetary units. However, the problem is that it is not easy to establish what a discarded foodstuff is. Furthermore, these definitions do not incorporate in their analyses the loss of productive resources. From political ecology and agroecology, other alternative definitions consider that the calculation should be done in terms of energy. This would allow us to include the loss of productive resources in the phenomenon. However, since the counting tools generated by the agrarian economy reduce any economic activity to mass or monetary units, these alternative definitions face a problem of quantification to a greater extent. Consequently, there is currently an open debate about what constitutes food loss; a debate that is not reaching any helpful outcome. In light of these limitations, a qualitative approach to the phenomenon can be more practical. Based on our analysis of food loss in the context of fruit production in Lleida (Catalonia, Spain) we argue that to understand the phenomenon it is more effective to analyse how food loss is produced rather than to try to quantify it.

**Keywords**: Food Loss, Food Waste, Quality requirements, Prices, Varietal change, Political Ecology

## 1. Introduction

Several researchers, social entities and public institutions have seen food loss and waste as an opportunity to fight against food poverty, destining the production not entering the agrifood circuit to the social groups suffering from it (Laakso 2017, Galli et al. 2019). Other authors consider it a partial solution to energetic constraints: as raw material to generate biogas, hydrogen or electricity (Guo et al. 2010, El-Mashad & Zhang 2010, Kathirvale et al. 2004). Nevertheless, the predominant idea regarding food loss is that it is a problem rather than a solution, be it due to ethical reasons (foodstuffs wasted in a world with structural poverty) or due to the environmental consequences of the phenomenon.

Considering this situation, at the beginning of the decade of 2010, the FAO commissioned a report on food loss and waste. Said report defined the phenomenon as '*the masses of food lost or wasted in the part of food chains leading to edible products going to human consumption*' (Gustavsson et al. 2011: 2)[1]. As a result of being commissioned by the FAO, the document and its definitions of food loss and

[1] The report distinguished between Food Loss and Food Waste. It established that Food Loss referred to the loss of food that takes place in the first stage of the agrifood circuit: from production distribution. Instead, Food Waste referred to the loss of food that takes place between the stages of distribution and consumption.

food waste enjoyed great legitimacy, becoming a reference in the field. However, not all authors and institutions accepted it. Some raised doubts and suggested nuances. Among them there was the European Union, which through its program named EU Fusions,[2] included aspects of the phenomenon that the FAO and other authors had not considered. For instance, it included in the definition food liquid waste, fish discards, and even non-edible parts of foodstuffs that could bring economic value if destined to the production of compost or biofuel (Östergren et al. 2014). In light of these and other objections, the FAO responded by nuancing its definition, which nonetheless continued to be more restrictive than that put forward by the European Union. For instance, the former excluded from the phenomenon of food loss foodstuffs like sugar, honey, salt, coffee, cocoa or alcoholic beverages, since it considered that these were not products necessary for food security (FAO 2014). Other relevant public institutions have also put forward their own definitions, which do not agree on the type of discarded material that needs to be considered food waste or food loss. Like the FAO, the Economic Research Service of the US Department of Agriculture states that only the edible part of foodstuffs needs to be considered as food waste (Buzby, Farah-Wells and Hyman 2014). However, the US Environmental Protection Agency stresses, like the EU Fusions, that the non-edible part of foodstuffs also needs to be considered food waste or food loss if it has been discarded: it is an organic material that can be recovered as compost (U.S. Environmental Protection Agency, 2016).Establishing what is considered food loss and food waste is not a banality. The interest in quantitatively monitoring this phenomenon compels us to establish an estimation system that allows for to carry out comparable statistics. To that end, it needs to specify what is considered food loss and food waste, and it needs to be universally accepted. Nevertheless, in the last years there has been a debate to establish a canonical statistical methodology. These discrepancies are translated into very dissimilar statistical calculations (Girott et al. 2015). Some research greatly overcomes the data put forward by the FAO or the EU (i.e. Soil Association, nd; Lundqvist, De Fraiture and Molden, 2008). However, others reach the conclusion that the calculations of the aforementioned institutions exaggerate the amount and value of lost food (i.e. Bellemare et al., 2017).

Most authors argue that these discrepancies are due to the different approaches to quantify the phenomenon. (Caldeira et al., 2021). Xue et al. (2017) stress that the problem can also partly be explained by the biased temporal and geographical coverage of the statistics used. Finally, Delgado, Schuster and Torero (2021) consider that we cannot forget that some methodologies are based on a microanalysis while others work with macro data: the first ones are forced to extrapolate from specific cases and therefore might no be representative; the latter do not detect unquantified inefficiencies nor the stages in which these take place.

The FAO has suggested to change the measurement unit in its 2019 report on the state of food and agriculture (SOFA): to stop using the mass calculation in favour of the monetary calculation (FAO, 2019). To consider food waste according to its economic value and not in its physical value entails a radical methodological turn, since the mass of a foodstuff usually is not related with its price, and neither is the price the same in different markets. More than solving the methodological problems regarding the quantification of food loss and food waste, this suggestion can become a new element of discordance and debate.Some authors reject the suggestion of calculating food waste and food loss based on volumen or monetary value. These authors consider that the majority of definitions of food loss do not take into account an essential element: the agricultural resources used inefficiently (Montagut & Gascón 2014, Chaboud & Daviron 2017, Gascón 2018, 2019, Gascón, Solà & Larrea,

This distinction is currently widely accepted, and the present article uses it as a starting point. However, on some occasions we cite authors that do not make this distinction and talk exclusively about food waste.

[2] The objective of the EU Fusions program is to improve research focusing on elucidating adequate strategies to prevent food waste.

2021). However, this idea is not new. In fact, the first ever definition, coined by William Kling, already considered it:

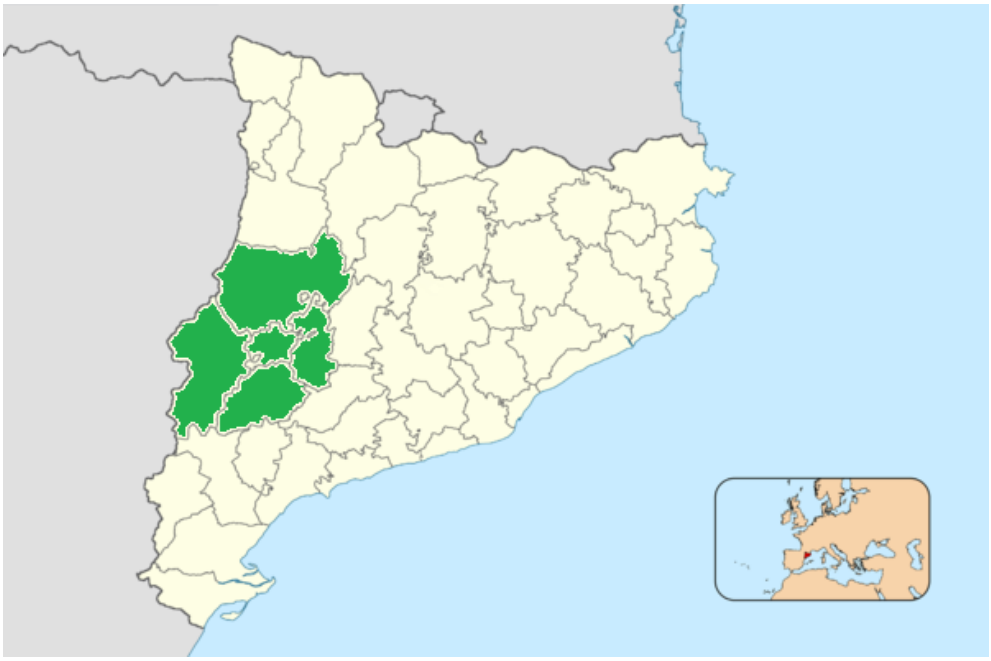
> Food waste (...) may thus be defined as a less than maximum use of *nutrients* for human consumption (...) Food waste is the destruction or deterioration of food or the use of crops, livestock and livestock products in ways which return relatively little human food value (Kling 1943: 850) (our emphasis)

This definition, created amidst the Second Word War, is substantially different from most of those elaborated in the decade of 2010. On the one hand, it includes the agricultural resources that are destroyed or underused. On the other, and as a result of the former, the definition considers that nutrients need to be the unit of measurement; that is to say, the energy rather than the mass (we have highlighted this in both definitions). If the calculation is made in nutrients/energy, it should not only include the loss of foodstuffs already produced, but also the loss of resources that produce these foodstuffs. These resources cannot be measured in mass units, and consequently in recent definitions they have become externalities: a social cost not considered by conventional accounting, which is transferred to other communities, social groups, or the future generations (Martínez-Alier 1994).

Few authors have chosen to use an energetic definition in their research (Hall et al. 2009, Cuéllar & Webber 201, Montagut & Gascón 2014, Chaboud & Daviron 2017, Gascón 2018, 2019). Such a choice is not exempt of limitations. The main one is that the conventional agricultural statistical systems present the economic activity in mass or monetary units, but the loss of resources and energy cannot be reduced to such measuring systems. Conventional definitions resolve this difficulty by not considering the loss of resources and energy. Implicitly, this means negating their existence; not because these losses do not exist, but because they cannot be measured by conventional systems of measurement (Falconí 2015).

The present article uses as a starting point the hypothesis that to quantify food waste/loss has limitations that are difficult, if not impossible, to overcome. On the one hand, the more conventional and hegemonic definitions, which consider that the phenomenon needs to be calculated based on mass units (or monetary units), are not capable to establish a common methodology. Furthermore, they cannot include in the calculation the waste of productive resources. On the other hand, the aforementioned "energetic" definitions also face the difficulty of establishing a measurement system without the existence of adequate statistical systems. We will analyse these limitations through a specific case: the production of tree fruit in the province of Lleida (Catalonia, Spain). The central region of the province of Lleida is the region of Spain with the highest production of apple and pear, and one of the most important ones regarding the production of peach. The land destined to the production of tree fruit, concentrated in the comarcas of Segrià, Pla d'Urgell, L'Urgell, Noguera, and Garrigues, occupies an area of 35.172 hectares (DARP 2019) (see Figure 1).

**Figure 1. Location map of the fruit-growing areas of the province of Lleida (Catalonia)**



Source: Own elaboration

Based on this hypothesis and in the face of the different attempts to measure the phenomenon of food waste/loss, this article argues that a qualitative approach might be more useful and adequate to analyse the processes that produce it.

In order to illustrate our argument, first we will see the historical process that drove the farmers of Lleida to specialise in tree fruit, explaining how the agricultural cluster was created. Afterwards we will tackle the main causes of production waste, arguing that to establish a calculation of said food loss in terms of mass units also entails difficulties. Finally, we will analyse food loss by paying attention to a characteristic phenomenon of the land of Lleida: the high dynamism regarding the change of the varieties of fruit trees.

**Methodology**

Fieldwork took place among farmers, seasonal workers and technicians of collection centres of the five fruit comarcas of the province of Lleida (see Figure 1.). The research method used was the ethnographic with a deductive focus (Bernard, 2018), which aims to explore and understand social behaviour through qualitative research techniques: participant observation –joining the workers picking up the harvest– semi-structured interviews (more than 20), informal conversations and focus groups. This method allows for the analysis of the discourse of the individuals in relation to their social, historical and ideological contexts. The in-depth interviews and focus groups aimed to (re)construct the experiences of the research participants in detail (Robles, 2011). To that end, a trusting relationship was established between the researchers and the research participants. All data collected was collated in the field diary. The analysis was longitudinal, since the authors conducted several stays throughout the years. The first one lasted three months during the summer of 2016, and was followed by several shorter stays spanning up to 2019.

## 2. The production of fruit in Lleida

The agricultural landscape in Lleida changed substantially between 1940 and 1950. Even if historically land ownership was polarised between large estates and smallholdings, with time there was a transition towards medium-sized plantations. Small holdings ceased to be viable and, consequently, they ended

up disappearing. Instead, large estates relinquished part of their lands, renting or sharecropping them, due to the lack of labour and the increase of their costs (Bretón 1993, Bretón & Mateu 2000). In such a context, the agricultural production began to specialise in tree fruit.

The agricultural production of the central region of Lleida was sufficiently diversified until the mid-1950s. The irrigated land consisted mostly of vegetable gardens, while the rest was occupied by fodder, cereals, olive groves and cattle livestock. The most produced fruit was tree fruit, especially apple and peach, even though this production was relegated to the borders of the plots. Thanks to several factors, such as access to cheap labour, the increasing consumer capacity of the industrial European population, and the low exchange rate of the *peseta*, among others, farmers stopped being bound to the local markets, being able to access the national and the European ones. And this accentuated the specialisation in fruit even more.[3] By 1966 there was a significant drop of the rhythm of exports, which brought the production to almost its complete disappearance in the decade of 1970. This situation can be explained by several factors, among which the following stand out: the decrease of the agricultural production costs in Europe, the demands regarding quality and food security of the European markets, the saturation of the German market, and the duties of the European Economic Community (García Manrique 1971). Nevertheless, this did not entail a major problem for the farmers in Lleida, who continued to specialise in fruit, since at the time the Spanish market was able to absorb all the production at a good price thanks to the protection offered by customs on foreign fruit.

In 1986, thanks to the entry of Spain to the European Union, there was a restructuring of the agricultural sector due to the ending of the protection offered by customs and the incorporation of new agricultural guidelines (Majoral 2006, Clar 2017). Despite that, there was no change in the agricultural landscape of Lleida. Rather, the specialisation in fruit continued. By mid 2000s, 38.500 hectares were destined to the production of fruits such as apple, pear, and peach. Furthermore, almost all fields became irrigated (Observatori de la fruita 2019) and an extensive network of refrigerators was established (Ruíz et al. 2003). Lastly, the business concentration facilitated greater horizontal integration, producing greater land concentration, the creation of collection centres (private wholesalers and cooperatives) and the formation of larger structures of distribution. This strategy was destined to improve the competitiveness of the fruit in the European market. On the one hand, it consisted of the reduction of costs (France and Italy produced at a lower price) and, on the other, the technification of the production, the storage and the distribution to reach the increasingly stricter demands regarding quality, stock, and sanitation (Pascual et al. 2006, Langreo 2012).

Large retail chains and exporting companies led this process of transformation thanks to exporting companies, associations of shops with a single sales point, and the retail chains (supermarkets). The change in the consumption patterns of the population contributed to the abandonment of the small shops in favour of supermarkets and greengrocer's chains. As a result, most of the farmers could only articulate themselves to the market through the large retail chains and exporters, which accumulated the higher percentage of fruit sales. In this way, the dependency between producers and large retail chains and exporting companies materialised in the capacity of the latter to impose prices on the former, as well conditions on the process of production: quality control, management and technification of the plantations, varietal calendar, etc. (Farré and Sala 2014, Rossignoli and Moruzzo 2014).

Thanks to the hegemony of large retail chains and exporters within the agrifood chain, the current predominant structure of the plantations in Lleida is governed by mechanisms that homogenise the production of the small and medium sized fruit farmers. For instance, they have externalised operations and created collection centres, which act as intermediate links. In this way the production of the farmers is gathered in one place, where quality controls will be applied, and stocks will be managed. From 1980

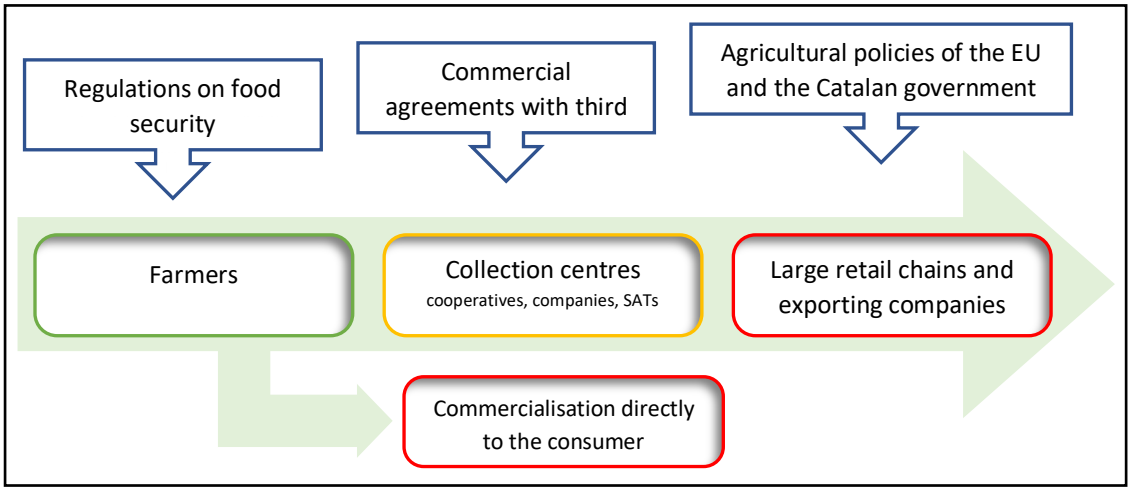
[3] There is an abundant bibliography paying attention to the topic of the specialisation in the production of fruit and its consequences in the rural structure in the fields of Lleida. For more information, see Lluch & Seró (1970), García Manrique (1971), Sabartés (1994), Bretón (2000) and Díaz et al. (2013).

onwards there appeared three different types of collection centres in the fields of Lleida: cooperatives of commercialisation, organised by partners who were at the same time producers; private companies; and a mixed structure, the Sociedades Agrarias de Transformación (Agricultural Societies of Transformation, SAT).[4]

At the beginning of the decade of 2010, these collection centres concentrated 80% of the fruit produced in Lleida (Mallada & Colom 2010). In the productive structure the role of these collection centres consisted in supporting the production and commercialisation processes, as well as transmitting to the farmers the demands established by large retail chains and exporters.

The power inequalities within the cluster constituted by conventional and integrated farmers, collection centres and large retail chains have consequences in the accumulation of food loss in the fields of Lleida. Furthermore, there are other agents exerting influence over the phenomenon, among which we include the public institutions through their agricultural and food security policies, as well as the opening of markets.

**Figure 2. Fruit cluster of integrated and conventional farming in Lleida: agents influencing food loss**




*Source: prepared by the authors.*

## 3. The loss of production

The predominant model of production in the fields of Lleida favours not to consume a substantial part of the produced edible fruit. The aim of the present article is to analyse the waste of resources in order to test the definitions of food loss based on the quantification of the phenomenon through the calculation of mass. To this end, first we will analyse the two main factors generating the loss of the production in the fields of fruit trees in Lleida: the quality required by large retail chains and exporting companies, and the prices that these impose upon the farmers.

### Quality and appearance

The conventional system of commercialisation prioritizes the presence (calibre, texture, colour and shape), rather than its nutritional value or organoleptic properties, as key value of the quality of the fruit. Shape irregularities affecting the fruit's visual perception are not accepted, even if they do not

[4] The Sociedades Agrarias de Transformación (SAT) are civil societies with an economic and social end, destined to the production, transformation and commercialisation of agriculture and livestock products. In order to establish a SAT at least three people are needed. In Lleida the most prevalent SAT's are family oriented.

affect its nutritional qualities. These demands, imposed by large retail chains and exporting companies, are based on requirements that aim to standardise the production that enters the agrifood circuit (Gorenstein 1998, Prieto et al. 2008).

Rather than a caprice, these requirements are the result, on the one hand, of the logistic structure of the large retail chains and exporters. In this way, in order to properly control the storehouse, large retail chains and exporters need a homogeneous rhythm of post-harvest ripening. For instance, if the fruit is sensitive, as in the case of specific varieties of pears and stone fruits, the harvest is put in boxes with alveoli of the same size. On the other hand, the aforementioned requirements are the result of the sales systems, since in greengrocer's chains and supermarkets, the choice of products and the preparation of the baskets has been effectively externalised to consumers. When the appearance of the fruit is heterogeneous, consumers choose the most visually appealing and leave the rest, which ends up accumulating until they are rotten. In summary, the hegemonic situation of the logistic, control, storage, and sales system of the large retail chains and exporters facilitates the transferring of part of the running costs of the system to the prior stages of production and collecting. And farmers have become aware of these requirements as the agrifood chain has been progressively controlled by the large retail chains and exporting companies.

These requirements are controlled through three different filters before reaching the point of sale. The first one takes place in the very own plantations: the farmers give instructions to the labourers about the visual quality of the fruit at the beginning of the harvest. Accordingly, the latter withdraw, or simply do not pick up, those fruits that have been damaged by fungus or insects, those that are rotten or those that have not reached ripening while still on the tree. The harvesters also do the same with those fruits which do not fulfil the visual and size requirements, even if they are edible. The fruit that is too ripe or with small scraping, which could become blackened with time, are again not collected, since they would not be able to endure the transportation and storage processes before reaching the point of sale. This situation contrasts with that prevailing in the decade of 1950, where these fruits were easily sold in the local markets.

The second filter takes place in the collection centres and is made by the cooperatives and the companies, which have the power of withdrawing the fruit considered inadequate for not presenting the required quality. They are strict with the farmers as a result of their role as inspectors granted to them by the large retail chains and exporting companies. This inspection is initiated in the very fields. The need to ensure a high percentage of adequate fruits leads the collection centres to control, or try to control, the productive process.

The third filter is the responsibility of the large retail chains and exporting companies, and it is implemented on the supply from the collection centres. The quality of the product that reaches the storehouse of the large distributors usually fulfils their requirements due to the contractual relations that exist between the former and the collection centres, since the latter are afraid of losing the opportunity to provide for the former. Consequently, usually the collection centre will pressure the farmer rather than negotiate with the large chains and exporters.

The fruit that is withdrawn due to not fulfilling the visual and ripening requirements does not necessarily leave the agrifood circuit, since there is a market for this type of production: the industry of juices and purees. In principle, except the fruit that is rotten or wormy, all the production not accepted in the fresh fruit channels could be destined to this industry. In practice, however, this is not the case: only 6% of the production is destined to juice or puree (Mallada & Colom 2010). There are two factors that can explain why most of the rejected fruit is not destined to this industry. The first one is that not all fruit varieties are accepted, as for instance the fresh peach. Even though by the end of 2010 it was the most solicited variety, it was rejected by the industry due to the colour of its juice, which is red and, therefore, does not coincide with the criteria established by the large distributors, which want it to be yellow. Since this type of fruit did not fulfil the required criteria it encountered quite a lot of obstacles to enter

the secondary market. Instead, those farmers cultivating yellow varieties of peach have a greater chance to destine it to the production of juice, even if not to the circuit of fresh fruit. The second factor is the price.

**Price**

The hegemony held by large retail chains and exporting companies does not only materialise in their capacity to impose conditions over quality to the farmers, but also to dictate the buying price of their production. Several factors need to be taken into account to understand the power of the large retail chains and exporters over the prices of the production, such as the increase in the fruit production in the European Union through the incentive scheme of the Common Agricultural Policy, the expansion to eastern European countries with a powerful agricultural network such as Poland, and the signing of commercial agreements with countries of the South due to their lower costs of production, which allow them to introduce fruit to the European markets at a more competitive price. All these factors allow for large retail chains and exporters to increase their profit margins at the expense of the farmers'. In the case of the tree fruit produced in Lleida, the percentual difference between the production price and the end-consumer price was around 450% by the end of the decade of 2010 (COAG 2020). On the contrary, production costs continue to increase. In such conditions, to maintain a balance between income and expenditure is the second factor of tension which farmers face, together with the homogeneity requirements of the production. In fact, it is not rare for the price offered by large retail chains and exporters to be lower than the cost of production (Miarnau 2006, Iglesias & Casals 2011).

This tension between the selling price and the production costs is reflected on food loss. It is due to this tension that most part of the rejected production in the fresh fruit circuit is not destined to the industry of purees and juices. During our fieldwork, while the buying price of the peach to farmers fluctuated between 0.25 and 0.18 euros/kg depending on quality and month of the year, the price offered for the peach destined to industry was of only 0.03 euros/kg. According to the collection centres, this low price is the result of the abundance of the product in the international market, which makes its supply much higher than its demand.

Several farmers have mentioned that the labour costs of harvesting the fruit destined to industry are the same as those incurred when picking up fruit for the fresh circuit. Consequently, it is more profitable for the farmers to not pick up the produce in the field, since the price does not cover the costs of the labour force required to pick it up. As a result, the fruit is abandoned on the fields and smashed, turning it into compost for the next season. In other words, there is a direct relationship between the price set by large retail and food loss (Janousek, Markey and Roseland 2018). Given current prices, picking second-rate fruit is not economically viable.

**Difficulties in quantifying the loss of production:**

It might seem as if quantifying the fruit lost or withdrawn in a plantation or in the facility centres is an easy process without technical difficulties; one would simply need to add the volumes of rejected fruit. However, it is not that simple. The problem lies in establishing what can be considered lost fruit.

On the one hand, farmers assume as ruined products those which do not conform to the visual quality demands of the market, even though they are aware that in the market structure prevailing one or two generations ago, such fruit was commercialised. This brings farmers to minimise their calculations regarding the fruit which could be consumed but that is instead wasted in their plantations, which they establish between 5 and 10%. During our fieldwork we joined the gangs of day labourers working in the harvesting process. Regarding pear, for instance, we could observe that only 1 or 2% of the fruit was rejected and thrown to the floor due to being ruined. Of the rest, approximately half was destined to the production of juices and purees after being picked up. Of these, 10% was destined to this industry due to not reaching the minimum calibre, 35% due to not presenting the desired shape, and a 5% due to other defects (colouring, damaged skin, hits...). However, as already mentioned, many a time the

farmers decide not to pick up these types of fruits destined to the industry as a result of their profit and loss calculations. According to statistics of the Generalitat de Catalunya, in 2018 less than 20% of the harvested pear was destined to the industry (DARP 2019). If half of the production does not enter the commercial chain of the fresh fruit, and only 20% is destined to the elaboration of juice and purees, this means that 30% is lost in the plantations. This is a much higher percentage than that calculated by the farmers.

On the other hand, it is common to assume that the fruit rejected due to the effect of pests does not fall into the category of food loss. However, smallholdings, based on the use of domestic labour force, usually take better care of their plantations and, consequently, are less affected by pests. In this sense, should we not consider the fruit rejected due to the effects of pests, resulting from not applying a more efficient production model, as food loss? In the same way, the use of nets would allow for the reduction of the amount of ruined fruit due to hailing and scarring. However, nets are usually not applied: it is a costly and risky economic investment due to the low price of the fruit.[5] Should we consider, then, that this type of fruit has been wasted? Or does it fall into the category of the 'normal' percentage of loss caused by natural reasons?

## 4. The loss of productive resources

Our analysis of the loss of productive resources focuses on the dynamism of the change of the varieties of fruit trees. Varietal change is a continuous process. No one remembers anymore the varieties with which the specialization in fruit in Lleida started (apple Belleza de Roma, pear Blanca de Aranjuez...). The predominant peach varieties in the decade of 1960 and 1970, such as Agosto, Sundanell or Torres, have been substituted by Catherino, Summer Lady, or different hybrids of Baby Gold. Many of these did not even exist in that time. The Llimonera pear, dominant until recently, is receding in favour of Conference or Williams pear. This dynamism does not only affect the varieties, but also the type of fruit. In this way, between 2005 and 2017, 8.200 hectares of apple trees and pear trees were uprooted and substituted by stone fruit trees such as peach trees, nectarine trees, and Saturn peach trees (Segre 2018). Furthermore, while in the mid-1990s the production of stone fruit in Lleida did not reach the annual 150.000 tonnes, today it reaches approximately 400.000 tonnes. Instead, the production of pear has decreased from more than 350.000 tonnes to less than 150.000 tonnes, while the production of apple has diminished from 350.000 to less than 200.000 (Observatori de la fruita 2019).

The objective of the varietal and fruit change is to improve the articulation of the plantations to a saturated market, but it entails the constant grafting and uprooting of trees still in their full productive capacity.

### Fruit and varietal change as an imposition of the market

Farmers and managers of collection centres, as well as the technical literature to which these managers have access, identify several causes explaining the dynamism of the varietal change. According to their objectives, these causes can be divided in two different groups. On the one hand, those resulting from the need to be articulated in the market: to the changing tastes of the consumers, to the logistical needs of the large retail chains and exporters, and to the demands regarding food security made by public

[5] Nets are a technology that allows for the reduction of the negative effects of hailing and scarring due to the wind. Nevertheless, both the material and the labour force needed to implement it are expensive (around 15.000 euros/hectare) and risky, considering that the farmers do not know the price at which they will sell their fruit during the following harvests. To that we need to add the role of the crop insurance. Due to the conditions of these insurances, whose policies are subsidised by the State, and the low prices of the fruit, it is more profitable for the farmers to claim the compensation due to hailing than to defend the harvest in front of the inclemency of the weather.

institutions. On the other, those destined to reduce production costs: specifically, the costs of the labour force.

Farmers and technicians of collection centres point out two tendencies: fast varietal changes in the case of stone fruit, and a reduction of the land destined to seed fruits. Furthermore, they identify the changing taste of the consumers as one of the main reasons for these tendencies. On some occasions, this is the result of the appearance of tastier varieties. Some other times, it is simply due to visual attraction, even if their organoleptic qualities are inferior. Another factor is the appearance of hybrid varieties which are easier to consume or to prepare; for instance, the boom of the Saturn peach was due to the fact that its flattened shape allows for a cleaner bite (Iglesias 2013). Finally, we need to take into account the desire of consumers to access fruit beyond in-season. To extend the fruits' season, adopting early or late varieties, which obtain better prices, drives farmers to varietal change.

On occasions, the changes in consumers' taste has been attributed to the capacity of large distributors to impose trends (Montagut & Dogliotte 2006, Ploeg 2010). The objective would be to increase sales (increasing, for instance, the fruit season) and to resolve technical and logistical problems. When we talked about this topic with the farmers, the case of the peach is persistent. Until the decade of 1980, all the peach produced in Lleida was yellow. It was sold in nearby markets, but its principal client was the canning industry, which elaborated what in Spanish is called peach '*en almíbar*.'[6] As time went by, the consumption of *almíbares* decreased, and the European market opened, followed by those in other continents. Unfortunately, the yellow peach posed technical problems: its skin is very sensitive to mechanical handling and to transport. Any small hit affects it, the spot quickly blackening. As a result, exporters and supermarkets began to demand red peach instead.

Requirements of homogenisation and ease regarding the storage, classification and transport imposed by the large retail chains and exporters force farmers to adopt new technological packages which include varieties adapted to the new logistical and technical needs. To this we need to add the competition of third countries: those which have been entering the European Community, and those with which new commercial agreements are being established. Varieties which were competitive stop being so due to the fact that they are produced in other places at lower costs, or because they inundate the market during the same months. Farmers are thus forced to adapt their plantations by looking for small cracks in the market: varieties that are cultivated when there is still a small supply of fruit, or with characteristics that make them attractive to the consumers.

As we were saying, to reduce production costs is also a factor that can explain the varietal change. The technological development of new varieties in Europe does not only intent to cover the logistical needs of the large retail chains and exporters or to reduce the use of chemical synthesis regarding the control of pests. Considering that in Europe the labour force is costly and the access to technology relatively easy, to favour a competitive rural network in a global market entails the technification of the plantations and the reduction of the labour force. But not all varieties allow this. The interest lies in developing varieties requiring less clearing, which diminishes the investment in pruning, or varieties with a shorter ripening process, which allows for the reduction of the number of times the harvesters need to go through the fields to pick up the fruit (Miarnau 2009). Again, the case of the peach is paradigmatic. From the decade of 1990 there has been interest in trees with less volume and height so that the fruit can be picked up without the use of ladders. This accelerates the harvesting process and thus reduces the number of working hours (Montserrat et al. 2004).

There are several agents driving the varietal change. First, the collection centres, through their technicians, due to their need to be articulated to the large retail chains and exporters. Second,

[6] Peach '*en almíbar*' used to be a very popular dessert in Spain. The peach *en almíbar* is made by cooking the peach at a very slow flame in a syrup called *almíbar*, made with water and sugar. Afterwards it is canned with its own juice for later consumption. The *almíbar* can also be done with other fruits, such as pineapple or pear.

specialised magazines targeting the farmers, which inform them of the new hybrid varieties and their opportunities and limitations in the market. Finally, the Generalitat de Catalunya –the Catalan autonomic government– through the Institut de Recerca i Tecnologia Agroalimentàries (Research and Agri-food Technology Institute) –a public company promoting research with the aim of contributing to the modernisation and the competitiveness of the Catalan agricultural sector– and through the Departament d'Agricultura, Ramaderia, Pesca i Alimentació (Department of Agriculture, Farming, Fishing and Food) –which manages the agricultural policies of the Generalitat and, among others, channels resources and aid to the farmers.

A peach tree or a nectarine tree can live for up to 20 years, even though they lose productive capacity from 15 years onwards. In Lleida, it is estimated that their life expectancy is of 14 years (Miarnau 2009). Instead, the life cycle of an apple tree is much longer: 50 years. However, it is estimated that in the fields of Lleida their life expectancy is of only 15 years, reaching their productive maturity after five or six years (Millán 2009). In this way, the dynamism in the varietal change and in the type of fruit entails that usually the full life cycle of the trees is not used. Generally, the varietal change is made through grafting. In this case, the tree can be one or two seasons without producing, and the cost is relatively low. On other occasions, the trees need to be uprooted. The acquisition cost of the saplings is high: in the case of apple, the saplings for a hectare of land cost between 4.500 and 5.500 euros in 2019, depending on the variety. To this we need to add the costs of labour force and the teams, as well as the loss incurred by that hectare not being productive until the trees reach their maturity.

However, this dynamism in the varieties and the type of fruit trees does not only increase production costs; it also entails a loss of productive resources, which can be considered food loss. To understand the varietal change as food loss implies entering the debate of its definition: ¿what is food loss? As we have seen, the definitions established by the FAO or the EU Fusions Program, which are restrictive and based on the calculation of lost volume, would not accept this as food loss. However, from a political ecology perspective, which analyses the energetic and nutrient costs, this should be counted as food loss. In this sense, the uprooting of trees still in their productive cycle, as well as the time lapse until the new sapling gives fruit, are considered an energetic squandering and, therefore, food loss.

**Fruit and varietal change as a strategy of the farmer**

So far, we have analysed the varietal change as an imposition of the hegemonic agents of the agrifood chain. But even though this pressure is univocal, the response of the farmers is not. Varietal change is also a productive strategy.

The agrarian technicians that drive the varietal change are aware of the risk that it entails (Iglesias 2004, 2013). However, farmers are much more aware of it. It is a high investment, of which the results will not be known until two years later. What will be the situation of the market at that time? The farmer needs to make decisions imagining a very changing future. The main variables that they identify are the taste of the consumers, the emergence of new competitive markets, and the access to new markets which might require a specific logistic process. The climatic and edaphic conditions of the land might also not be the most adequate for the new hybrids, about which farmers do not have any practical experience.

The varietal change is not only risky; in addition, farmers do not encounter a hegemonic discourse establishing what to do at each moment (which is the most adequate variety, when should the change be made, etc.). This transforms the varietal change in a strategy that depends on factors such as the market to which the production is destined, the age of the trees at the time a new variety appears, or the innovative or conservative spirit of each farmer. However, the most relevant one is the operating model, which depends on the type of labour force and, to a lesser extent, the property regime.

Part of the estates in Lleida work with domestic labour force. However, most of them have progressively turned to hired labour force. Nevertheless, not all day labourers have the same skills and knowledge about the profession. The farmer oscillates between two needs. On the one hand, to maintain the salaries

as low as possible in order to reduce production costs in a context where large retail chains and exporters retain most of the profit margin (Torres et al. 2013). On the other, to access labourers who know the trade and, if possible, the plantation and the working ways imposed by the farmer (Mata & González 2017); that is to say, to count on qualified labour force which can start working without the need of previous training. The use of either domestic or hired labour force depends on two factors. The first one is the existence of generational renewal; the medium age of the farmers of Lleida is increasingly higher (Díaz et al. 2013). The second, and the most salient, is the size of the plantations.

There exist two extreme production models. The first one is related to the medium-sized and large plantations (larger than 40 hectares), more or less technified and with a labour force composed of hired day labourers. In both cases, the strategy is to obtain the highest quantity of fruit at the lowest cost per hour and worker. The amount of fruit harvested to destine to industry is quite small, since the price of the fruit does not compensate the cost of the labour force needed to harvest it. However, what concerns us now is that the care of the fruit trees (the pruning, grafting, etc.) carried out in these plantations is not the most adequate, which has consequences over their production.

The second model of production is characterised by smaller and family-owned plantations. Even though their numbers are diminishing due to difficulties regarding generational renewal and land concentration, these plantations take better care of their trees. To work with a domestic labour force has two main advantages regarding food loss. First, the more specialised labour force implies a better knowledge of the plantation, an increase in the quality of the harvest and a higher interest in obtaining a good performance. Second, this type of labour force follows a logic that is more linked to the property than to remuneration, in contrast to the economic logic of modern plantations. As a result, family-oriented agriculture can survive in different conditions than capitalistic enterprises, sometimes working under conditions where the latter would become bankrupt. For instance, in the domestic economy the value of the resources lies not only on obtaining benefits but also on the reproduction of the domestic group. In this way, while in the capitalist model salaries are considered running costs, in the rural economy work is a benefit. Consequently, the latter has the capacity to make the most of the available labour force, in contrast to the capitalist model, which counts it as a negative output (Shanin 1973, Chayanov 1986, Ploeg 2013). Thus, the rural model takes better care of the fruit trees and takes better advantage of the resources. For instance, in Lleida this is a reality that is well-known in practice, and it is common to hear that those farmers who work with domestic labour take better care of the fruits and, as a result, control pests more efficiently.

Those small plantations in which domestic labour forces is predominant are usually more resistant to varietal change; instead, the larger ones, highly technified and dependant on hired labour force, are not. Lluís is a conventional farmer who combines the use of domestic labour with hiring day labourers during the harvest. Occasionally he is hired by large estates to carry out maintenance tasks. During our fieldwork he was grafting in a plantation: the trees were only five years old. He considered that this practice was an atrocity, mentioning that he would never carry it out in his own plantation. However, large estates have other strategies: the new variety can entail a better articulation in the German market where all the production is destined, or a reduction in the labour force needed during the harvesting process.

We have also noticed that the tenancy regime of the land has a small influence on the varietal change. In Lleida, more than half of the land destined to fruit is cultivated through rental contracts, and a little bit less than half belong to the farmer (Observatori de la fruita 2019). We have observed that those plantations which belong to the farmers who cultivate them tend to undergo slower processes of varietal change. This is due to the fact that ownership diminishes production costs, which allows the farmers to sustain the reduction of the market price of old varieties.

## 5. Conclusions

To defend what we have called an 'energetic' definition of food loss requires us to consider the inefficiency of the usage of the productive resources (Montagut & Gascón 2014, Gascón 2018, 2019). This position, even if shared only by a minority, has received certain support throughout the last decade (Hall et al. 2009, Cuéllar & Webber 2010, Chaboud & Daviron 2017). However, such a definition complicates the process of calculating food loss: the counting tools generated by the agricultural economy reduce any economic activity to mass or monetary units. But we have to accept that conventional accounting systems do not reflect all agricultural economic processes. In fact, they tend to fall in the trap of assessing what they can measure, instead of measuring what needs to be assessed (Martínez-Alier 2002).

In the case of the fruit in Lleida, we have seen the need to consider non-quantifiable processes in order to study the phenomenon of food loss through the dynamism of the varietal change. Varietal change not only increases the investment costs of the plantations. It also entails the loss of productive resources. Sometimes, trees that are still productive are uprooted in order to be substituted by saplings of new species, which will take years to bear fruit. In the best-case scenario, varieties are changed through scions, which also leave the trees unproductive for one or two harvests.

Furthermore, to try and calculate the lost production also faces practical difficulties. The authors that look into this phenomenon based on the definitions of the FAO or the European Union, which consider as food loss only the production that is quantifiable in mass units, admit that to establish statistics is difficult, since there is no consensus on how to make these calculations (Stuart 2009, Parfitt et al. 2010). Even though since the end of the last decade the regional studies tackling this issue have multiplied (Griffin et al. 2009, Nahman & Lange 2013, Reynolds et al. 2016), it does not seem these have provided conclusive results, or at least universally accepted ones. In fact, a debate has been started about how to establish an agreed system of quantification, where authors only seem to agree on one point: that all the rest do not make the calculations correctly (Koester 2013, Östergren et al. 2014, Bellemare et al. 2017, Chaboud & Daviron 2017).

The case of fruit production in Lleida provides an example of the idea that to quantify the already produced food loss is almost impossible. Frequently, to determine what is food loss is a subjective decision. For instance, in principle the fruit that is withdrawn from the agrifood circuit due to being rotten as a result of hailing or pests cannot be considered food loss, since this fruit is not adequate for its consumption due to health and/or organoleptic reasons. However, there are certain agricultural practices that can reduce these problems, such as the use of nets or a greater investment in the harvesting process. In this sense, the productive structure of the plantation also has consequences over the effect of pests: those plantations based on domestic labour force take better care of the trees and are consequently less affected by pests. Then, do we have to consider ruined fruit, which can no longer be consumed, as wasted food or as the natural percentage of harvest loss?

Due to the difficulties in trying to establish what constitutes food loss and the impossibility to establish quantitative calculations regarding the wasted productive resources, we argue that a qualitative approach can be more effective when trying to understand the phenomenon. Practically, it might be more helpful to analyse how food loss is produced rather than to try to quantify the volume of loss that it entails.

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## 7. Informed consent

The data obtained from informants were qualitative in nature. Informants were informed verbally, and their consent was also obtained verbally. They were also informed that their names would be anonymised in the publications resulting from the research. The research didn't involve any intervention. For this reason, the research has not required the approval of an independent ethics committee.

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