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1   For several years now, land use in France has been evolving (Agreste[1] 2007). Thus, over the period from 1992 to 2004, agricultural land has decreased from 30,099,800 to 29,222,600 hectares, while wooded and forest land has increased from 14 343.4 thousand hectares to 15 169.7 thousand hectares. At the same time, wasteland and moorland has decreased from 2,561,800 to 2,165,200 hectares.

2   The unplanned reforestation of land by spontaneous tree growth (natural tree colonization) is a reality of the natural environment that has been the subject of studies by Dérioz (1999) and Curt *et al*. (2004). According to Dérioz (1999), the transfer from moorland to forest, estimated in a survey by Teruti at 84 000 hectares per year for the period from 1992 to 1997, is most probably and essentially due to spontaneous reforestation.

3   Spontaneous tree growth has advanced over agricultural land in mountain areas and, more specifically, has colonized natural meadows that previously provided pastureland for mountain livestock (Dérioz, 1999; Curt *et al.*, 2004; Sitzia *et al.*, 2010). This has been the case, for example, in the communes of Villelongue, Artalens-Souin, Saint Pastous and Vier-Bordes, near Lourdes in the Central Pyrenees (Mottet, 2005; Mottet *et al.*, 2007). Thus the number of farms in this area has been in rapid decline in recent decades, decreasing from 121 in 1955 to only 42 in 1998.

Map 1: Location of case study site on the periphery of the Pyrenees National Park near Lourdes.
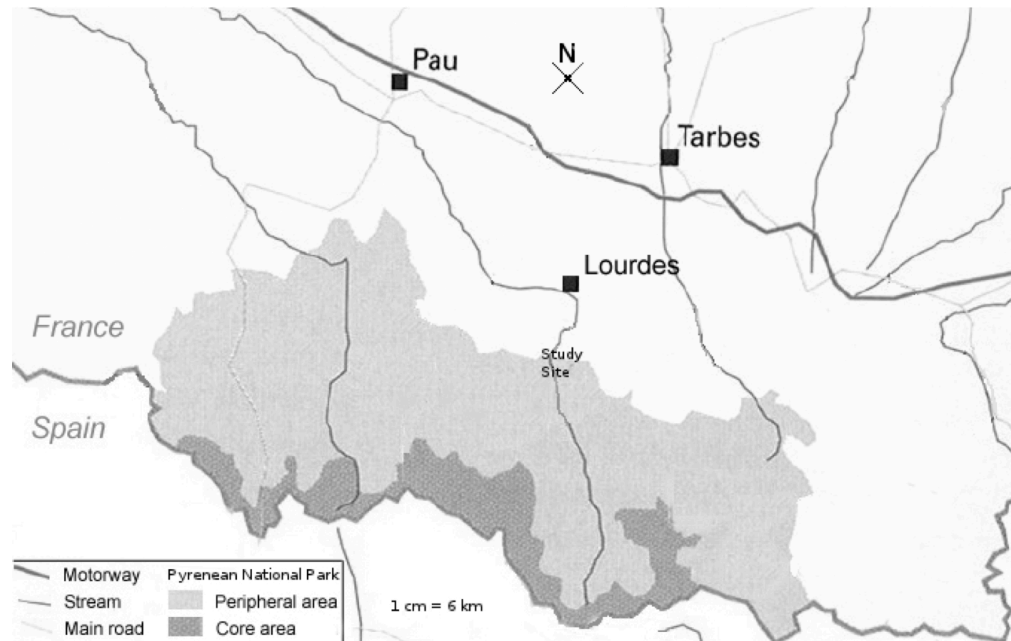
Photo 1: Forest extension in Villelongue (65) in 2002: from village to mountain pastures

4   Gibon *et al.* (2010) analysed and simulated the future extension of spontaneous tree growth on this site in the Pyrenees based on the strategies adopted by farmers, particularly with respect to their mid-altitude hay fields. There has been a sort of new division of rural space with the appearance of abandoned land on terrain considered by farmers too difficult to exploit, while other land continues to be used for agricultural purposes. On the abandoned land, the common ash tree (*Fraxinus excelsior*) has spread to take over former mid-altitude meadowland. The young ash trees now form dense clumps of woodland but, as yet, no use has been made of this forest resource, despite the fact that traditionally the common ash has always been used in local farming communities, namely for energy purposes (Thiébaut, 2007). Moreover, Couture *et al.* (2008), in a study of the factors determining household energy choices, found that low-income households choose wood for heating, which, according to Cauria et al. (2009), has a positive impact on the growth of the forest-wood sector in France. Nevertheless, in an article on professional loggers, Scheppens (2005) underlines the fact that the profession shows little interest in cutting wood for domestic purposes.

5   Our aim is therefore to determine whether the exploitation of ash tree stands resulting from the spontaneous colonization of former hayfields in the Central Pyrenees is economically viable. Given that the mountain farmers still know how to collectively manage their summer grazing lands (e.g. pastoral land associations), would it not therefore be possible for local farmers to take initiatives based on the expansion of forest growth observed in the mid-altitude mountain areas of the Central Pyrenees? Is it not conceivable that this woodland, which has colonized abandoned farmland, could be used for energy purposes and thereby help maintain the local farming economy of the Pyrenees?

6   To further this aim we will evaluate the return for the woodlot owner in the form of a range of residual unit values once all the costs involved in exploiting this resource have been deducted, taking into account both the operating conditions and the selling price of the products

produced. This will enable us to determine the feasibility of exploiting this new localised and immediate source of firewood and to define the conditions for implementing this solution.

7   We will also take into account the method of marketing the wood. Woodlot owners can, for example, sell their wood as standing timber (not harvested) to a lumber merchant. The lumber merchant will then get the trees felled and cut up by professional loggers, and extracted from the forest. Another solution would involve farm/forest owners carrying out these tasks themselves and using the wood for their own domestic or agricultural heating purposes.

8   After describing the study area and explaining the methods used in the study, we present and discuss the results. We propose possible paths for sustaining the exploitation of spontaneous ash tree stands on the basis of an appropriate institutional framework and the private initiatives of local farmers.

Equipment and method

9   The ash trees plots we selected for our study, and which will be exploited for their wood, were studied by Mdawar (2009). They were former hayfields in the mid-altitude mountain areas of the Central Pyrenees, generally covering an area of less than 1 hectare each. Harvesting the wood stands appears to be a potentially viable proposition, namely for local farm households that would use it for heating, as suggested by Longuenesse (2007). Mdawar (2009) conducted stem diameter measurements on 500 plants in these plots, where the age of the trees ranges from 25 to 70 years. The survey showed that the presence of 7 to 20cm-diameter logs, for use as firewood, varies with the density of the tree stand at a given age, among other factors. Thus, at about 25 years old, and for a very high density of more than 3000 stems per hectare, 80% of the stems have a diameter greater than 7 cm and there are no stems of 20 cm or more destined for use as timber. For 35-year old trees, however, the percentage (in number of stems) of firewood varies between around 50 and 60% for a density of between 1000 and 2500 stems per hectare. Between 35 and 70 years old, ash trees are bigger but the percentage of stems less than 20 cm in diameter varies between 85 and 55% depending on the age, density but also fertility of the stand.

Photo 2: Current ash forest stand

Dynafor INRA

10   The exploitation of spontaneous-growth ash forest stands for local domestic heating purposes could be achieved through manual hewing and logging. Farm tractors, winches, and trailers with grapple arms could be used for log skidding and transport (CTBA-IDF (2005). This type

of simple operation is envisaged as soon as the physical, climatic or biological conditions of the plot indicate that its use for lumber purposes is no longer possible.

11   The selling price for firewood in the form of raw logs at the side of the forest track in 2010, in the Midi-Pyrenees region of France, was 30 € per stere (VAT included). However, since ash is in less demand than beech or oak as firewood, its price was around 25 € per stere, or 24 €, excluding VAT. The market for firewood also includes wood that has already been cut (in specified lengths), split and delivered as logs, for which the price in 2010 in Midi-Pyrénées was 52 €/stere, excluding VAT.

12   The logger will work for a daily turnover within a range where the maximum corresponds to that acceptable to recognised and experienced professional loggers and where the minimum corresponds to that acceptable to lumber merchants seeking to minimise their costs, taking into consideration the difficulty of operating conditions. According to the CTBA and IDF (CTBA-IDF 2005), the minimum price in 2005 was around 150 €/day (excl. VAT) for logging to 1-metre lengths and under fairly easy operating conditions[2]. The maximum found was 230 € per day in 2007 by Surini (2007). The price range from 150 to 230 €/d corresponds to a unit cost for logging of 25 to 38.3 €/stere based on an average production rate of 6 steres/day. In association with the CTBA (French Wood and Furniture Industry Technical Centre), Fibois Alsace (2007) bases its evaluation on an average yield of between 5 and 7 st/day for traditional logging using a chainsaw for cutting small-diameter logs for firewood. All these values were verified by the Midi-Pyrénées Regional Branch of the National Centre for the Development of Private Forests (Délégation Régionale Midi-Pyrénées du Centre National de la Propriété Forestière).

13   Since logging would took place on former hayfields in mid-altitude mountain areas, transporting the wood from the plots would generally be over short distances (skidding by farm tractor with a winch rather than by dragging along a track within the plot). Once the wood has been extracted from the plots, agricultural equipment would then be used (farm tractor, trailer with grapple arm) to transport it along farm tracks to the farm.

14   The unit cost of using a farm tractor (with winch and trailer with grapple arm) to remove wood from the forest for use as fuelwood was estimated in 2005 at about 7 €/stere, excl. VAT (CTBA-IDF, 2005). This cost has been confirmed for the mountain plots under consideration by the Regional Branch of the National Centre for the Development of Private Forests. Surini (2007) puts the cost a little lower, however, at around 5 €/stere, but for the skidding of logs on a gentle slope[3].

15   We will now try to determine whether the exploitation of the ash tree stands is a viable proposition on the basis of the unitary operating costs established above, but with adjustments made to the year 2010. To do this, we will use the indexes of change in production costs calculated by INSEE (2011), while using the same distribution per task given by the CTBA-IDF (2005) with respect to the traditional exploitation of logging wood (table 1).

Table 1: Readjustment of logging operating costs from 2005 (or 2007) to 2010[4]

Items	Percentage increase in depreciation	Percentage increase in running costs	Percentage increase in labour costs	Percentage increase in overall costs (sum of each increase)	Costs 2010
Logging at 150 €/d in 2005, or 25 €/stere	0.067 x 0.05	0.312 x 0.23	0.09 x 0.72	0.14	28.5 €/st or 171 €/d
Logging at 230 €/d in 2007, or 38.3 €/st	0.027 x 0.05	0.205 x 0.23	0.05 x 0.72	0.085	41.6 €/st or 250 €/d
Skidding by farm tractor and winch at 5 €/st in 2007	0.75 x 0.083 x 0.23 + 0.25 x 0.027 x 0.23	0.205 x 0.27	0.05 x 0.5	0.09622	5.5 €/st

Skidding by farm tractor and winch at 7 €/st in 2005	0.75 x 0.098 x 0.23 + 0.25 x 0.067 x 0.23	0.312 x 0.27	0.09 x 0.5	0.1499	8.1 €/st
Transport by farm tractor, trailer and grapple arm at 5 €/st in 2007	0.9 x 0.083 x 0.23 + 0.05 x 0.238 x 0.23 + 0.05 x 0.027 x 0.23	0.205 x 0.27	0.05 x 0.5	0.1006	5.5 €/st
Transport by farm tractor, trailer and grapple arm at 7 €/st in 2005	0.9 x 0.098 x 0.23 + 0.05 x 0.298 x 0.23 + 0.05 x 0.067 x 0.23	0.312 x 0.27	0.09 x 0.5	0.1537	8.1 €/st
Final cutting and splitting 11 €/st in 2005	0.067 x 0.06	0.312 x 0.06	0.09 x 0.88	0.10	12.1 €/st

Is the logging of spontaneous mountain ash tree stands viable?

16   A fuelwood merchant who sells ash wood cut and delivered at 52 €/st excl. VAT, taking into account cutting (cutting to length and log splitting) and transport costs, expects to obtain saw logs, brought to a roadside location, at a maximum price of 24 €/st excl. VAT, which was the roadside selling price for 2010. Forest owners can, however, carry out this work themselves.

Exploitation by professional loggers in a "standing timber" market

17   We first begin with an approach based on the "standing timber" or "stumpage" market in which wood is sold standing in the forest to a logging merchant by the forest owner, who therefore does not carry out any logging operations himself. The logging merchant will take delivery of the wood on the edge of the woodlot and will pay the owner if there is any residual value after he has paid for the wood to be cut and extracted. Felling, logging and skidding operations will be carried out by a sub-contractor commissioned by the logging merchant. The logging merchant will take into account both the operating costs to bring the wood to the forest track at the edge of the woodlot, and the selling price (24 €/st excl. VAT) in calculating the amount to pay the owner.

18   Based on the costs we adopted for this study, and with reference to table 1, the logger will work in 2010 for a turnover varying between 171 and 250 €/d, with an average of about 210 €/d taking into account the increase in costs between 2005 (or 2007) and 2010[5] (table 1). This corresponds to logging costs of 28.5 to 41.6 €/st, based on an average production of 6 st/day. The re-adjusted unit cost in 2010 for skidding by farm tractor and winch is in the range of 5.5 to 8.1 €/st (excl. VAT) for the woodlots in question. The forest roadside price for cut logs will therefore exceed the selling price of 24 €/stere excl. VAT.

19   Under these conditions, with logging and skidding operations sub-contracted to professionals, the forest owners will not be able to obtain a positive residual value for their wood.

Exploitation by farmers to satisfy their own needs

20   Farmers could therefore decide to exploit their woodlots themselves (logging, skidding, transport by trailer, cutting and splitting) using forest equipment, given that the operating costs would be less than those charged by professionals. We estimate the reduction in costs based on the fact that a farmer who is also the forest owner does not have charges as high as those of a professional logger in carrying out the various operations involved in exploiting the woodlot: the farmer will have already paid his social security contributions.

21   We will apply a reduction percentage based on two studies. The first (Soulères, 1998) indicates that social security contributions in 1998 accounted for about 65% of salary. Similarly, data from the Agricultural Social Insurance Mutual Benefit Association (Mutualité Sociale Agricole) suggested a figure of 60% in 2010 for the mountain areas of France. The second study (Barel, 2002), revealed the following distribution of costs for a complete traditional forest logging operation (with manual logging and cutting, skidding with winches, and transport by trailer with grapple arm): 64% in labour, 24% in running costs, and about 12% in depreciation costs (expressed in relation to total operating costs of a professional). In other words, social security contributions in a traditional forest exploitation system represent about 38% (0.60 x 0.64) overall of the total cost. It is therefore possible to differentiate by cost item based on the distribution of the costs of harvesting and producing logs provided by the CTBA-IDF (2005). Logging costs will be reduced by 43%, skidding and transport costs by 30%, and those of cutting and splitting by 53%. Thus, labour represents 72% of the total cost per stere of logs, while for skidding or transport of logs, labour represents 50% of total cost per stere. In addition, labour represents 88 % of the total cost of a stere cut into logs (CTBA-IDF, 2005).

22   The total cost of using professional loggers to exploit the forest resource varies between 51.6 and 69.9 €/st excl. VAT, as shown in table 1. The farmers who carry out all forestry operations themselves will have a total cost varying from 29.7 to 40.8 €/st excl. VAT, as shown in table 2.

Table 2: Operating costs and residual standing timber values in €/stere (excl. VAT) according to type of operator (professional logger or farmer)

Exploitation operation Cost and residual value Type of operator	Logging (in 1m lengths) Cost €/st	Skidding by winch, transport by trailer and grapple arm Cost €/st	Cutting to size (cutting to 0.50 cm and splitting) Cost €/st	Residual value (in €/st) returned to forest owner
Logging, skidding, cutting to size, transport by a professional Logging, skidding, cutting to size, transport by the farmer	28.5 to 41.6 16.3 to 23.7	11 to 16.2 7.7 to 11.4	12.1 5.7	Nil to negative 11.2 to 22.3

23   The exploitation of woodlots by farmers for their own use or for residents close to their farms, whether operating conditions are difficult or relatively easy, can therefore realise a high maximum residual value, net of costs, in the range of 11.2 to 22.3 €/stere, with an average value of about 16.8 €/stere.

Social conditions for developing the use of spontaneous forest stands on former agricultural land for energy purposes

24   The exploitation of forest stands resulting from spontaneous tree growth on abandoned agricultural land formerly used for hay meadows in the Central Pyrenees thus seems to be part of a domestic forest economy. The owners of the ash tree stands, however, are not generally just forest owners. They were, and are, also livestock farmers (Mottet, 2005). The way they manage their woodlots will not therefore be determined solely in terms of the forest economy, but also the farm economy or, more generally, the local economy as a whole.

25   In the local area, the farmer is often confronted with the arrival of urban dwellers in search of secondary homes: the number of townspeople who have purchased a barn to renovate or accommodation as a second home in the communes[6] of Villelongue, Artalens-Souin, Saint Pastous and Vier-Bordes is increasing, while the number of farms in this area is in sharp decline, dropping from 121 in 1955 to 42 in 1998 (Mottet, 2005). It would therefore seem that the local economy is evolving: agriculture is declining but there is still a hard core of farmers, with individual or collective projects for managing their land (Mottet, 2005; Mottet

et al., 2007; Gibon *et al.*, 2010). Tourism, through the growth of second homes, is increasing, to a point where there is now a new source of revenue from the sale of land and farm buildings.

26   The conditions accompanying this new economy are now becoming more visible: on the one hand, abandoned agricultural land, spontaneous tree growth, particularly ash, and an increasingly closed landscape, and on the other, a growing tourism economy seeking a more open landscape and services which before were not needed, such as the delivery of farm produce or firewood to second home owners. The exploitation of ash tree stands by local farmer owners to supply fuelwood to residents living in the proximity of the woodlots, an activity that is just beginning in the commune of Villelongue, will help further define this new economy, contribute to its growth and ultimately help sustain the stock rearing economy of mountain areas.

27   It would seem then that for abandoned agricultural land with similar reforestation conditions to those of the former hay fields of the mid-altitude mountain areas in our study area, it is now possible to envisage a local development project with a clear aim. The project could be based on a local and inter-commune institutional arrangement involving cooperation between several of the communes concerned, the Coopération Forestière (Association of Forestry Cooperatives), the Pyrenees National Park, and the Midi-Pyrénées Regional branch of the Centre National de la Propriété Forestière. This institutional initiative could help prepare and implement a Development Plan for upland areas that could also be coordinated with a Plan d'Approvisionnement Territorial (French government initiative to promote the development of local woodland areas for energy purposes) or a Charte Forestière de Territoire (government initiative to promote the local and regional planning and sustainable development of forests) (Rey-Giraud G. *et al.*, 2007; Dupire, 2010; Fédération des Communes Forestières[7], 2011), and would be coherent and perfectly in keeping with the objective of promoting the exploitation of spontaneous forest stands for local energy purposes.

28   Thus an appropriate route could be mapped out for using ash forest stands for local energy purposes if they are found to be unsuitable for timber production. More fundamentally, a plan could also be implemented to estimate this potential resource in the area concerned. A special survey could be conducted among local woodlot owners to determine the distribution of spontaneous ash tree growth and the intentions of the owners regarding these lots. It would also be possible to encourage owners to group together to jointly purchase the special equipment needed to exploit their woodlots for the production of firewood. Assistance could also be offered for acquiring the necessary forest equipment, giving priority to those farmers who group together to develop this activity. Measures could also be proposed to help farmers and local authorities in purchasing wood-burning furnaces as part of a project to heat a public building.

Conclusion

29   Given the spread of spontaneous forest growth in mountain areas, we have attempted to define the conditions for exploiting this potential resource for energy purposes by examining a mid-altitude area in the Central Pyrenees where ash tree stands have colonized abandoned agricultural land formerly used for hay making. We calculated the costs of extracting the wood and cutting the logs to size for fuelwood on the basis of already existing studies. We checked the relevance of our findings by referring to experiments conducted in the Alps (FIBRA, 2010). Our study suggests that exploiting the spontaneous ash tree stands to obtain wood for heating purposes could be an interesting proposition. These resources represent a clear development potential that is localised and can be realised immediately. Initiatives in this direction could be encouraged within the context of a number of existing government programmes (Plan d'Approvisionnement Territorial, Plan de Développement de Massif, Charte Forestière de Territoire).

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Notes

1 Agreste, 2007. *L'utilisation du territoire en 2005 et en 2006*, Teruti-Lucas, 192, SCEES.

2 Logging production rate is in fact about 8 st/d for an 8-hour day.

3 Less than 15% slope instead of 30%.

4 Sources: CTBA-IDF (2005), Surini (2007) and INSEE (2011), IPAMPA agricultural equipment indexes and SMIC (minimum wage) index. From 2005 to 2010, depreciation costs for logging equipment increased by 6.7% (Insee, 2011), costs that represent 5% of overall logging costs according to CTBA-IDF (2005). The cost items "depreciation of logging" and "cutting and splitting" correspond to the Insee category "equipment and small tools"; the cost item "skidding by winch" was broken down into "depreciation on tractor" (for 75%) and "equipment and small tools" items of Insee (for 25%); the item "transport by trailer with grapple arm" was broken down into "depreciation on tractor" (for 90%), trailer (for 0.05%) and the "equipment and small tools" item of INSEE (for 0.05%); the change in the item "running costs" corresponds to the change in the "energy" item of INSEE; the change in the "labour costs" item corresponds to the change in "minimum hourly wage" provided by INSEE.

5 The range of values used is a little larger than that of FIBRA (2010), which suggests the average daily wage desired by logging contractors is between 200 and 220 €/d. The average level, however, remains the same, at 210 €/day.

6 The number of secondary homes in Saint Pastous rose from 5 in 1968 to 44 in 2004, in the commune of Viers-Borde, the number rose from 2 to 56. The commune of Villelongue had 92 secondary homes in 2007 out of a total of 252 housing units. In Artalens-Souin, in 2008, there were 44 secondary homes out of a total of 100 housing units.

7 Fédération des Communes Forestières, 2011.

À propos des auteurs

Bernard Elyakime
INRA-ENSATelyakime@toulouse.inra.fr
Laurent Larrieu
INRA-ENSAT et CNPF-Délégation Régionale Midi-Pyrénées du Centre National de la Propriété Forestière, Toulouse
Alain Cabanettes
INRA-ENSAT
Laurent Burnel
INRA-ENSAT

Abstract

With the agricultural economy of the Central Pyrenees in steady decline, natural forest stands are colonising abandoned agricultural meadows. The present study seeks to define the economic conditions for a new fuel-wood local economy based on these extensions of the forest cover. Farmer/forest owners are capable of exploiting this resource, involving logging, hauling and cutting the wood to size, to meet their own heating needs. In this way, owners could thus recuperate a maximum unit value estimated at 11.2 to 22.3 € per stere (1 cubic metre), or an average value of 16.8 € per stere after deduction of all costs. An economy based on wood energy, using wood from spontaneously generated forest growth on private land, is therefore possible. A development policy for such an activity could be envisaged with appropriate initiatives to stimulate the owners of land where spontaneous ash reforestation has occurred to harvest this potential resource.

Keywords : mountain, forest, agriculture, spontaneous reforestation, public policy, wood energy

Notes de la rédaction

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