

# DO WE NEED TO REMOBILIZE TRADITIONAL KNOWLEDGE AND PRACTICES IN ORDER TO MANAGE MEADOWS IN ATLANTIC PYRENEES (FRANCE)?

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**TITLE** Do we have to remobilize traditional knowledge and practices in order to manage meadows and pastures in the Atlantic Pyrenees?

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**Résumé:** Au cours des dernières années, l'accent a été mis sur la multifonctionnalité des prairies permanentes. Leur importance pour l'autonomie alimentaire des élevages et pour les écosystèmes est aujourd'hui reconnue. Cependant, de jeunes éleveurs des Pyrénées estiment ne plus avoir les connaissances pour conduire les prairies permanentes et leurs végétations spontanées qui étaient celles gérées par leurs prédécesseurs avant l'introduction de semences commerciales. Par conséquent, cette étude vise à recueillir ces savoirs faire avant qu'ils ne soient perdus à jamais. Ce travail, conduit au sein d'un groupe de recherche-action, porte sur des pratiques qui sont aujourd'hui très rarement observables dans les élevages pyrénéens. Ce recueil de savoirs a été réalisé à partir d'entretiens semi-directifs d'agriculteurs, conseillers agricoles et enseignants retraités. Leur analyse a été menée avec un logiciel d'analyse de données qualitatives (CAQDAS). Les savoirs traditionnels étaient empiriques et transmis au sein des familles depuis des générations. Ils accordaient une grande importance au respect de la diversité floristique des prairies pérennes. Ils favorisaient donc cette dernière avec une fauche tardive, une fertilisation pauvre en azote et l'utilisation de semences fermières issues des poussières de foin récupérées dans les fenils à la fin de l'hiver. La plupart de ces pratiques traditionnelles, considérées comme non transposables dans le contexte économique actuel, nous fournissent cependant des pistes de réflexion pour l'autonomie alimentaire des élevages.

**Abstract:** Over the last years, emphasis has been put on permanent meadows multifunctionality. It is now recognized that it provides ecosystem services and is helpful for feed self-sufficiency in farming systems. However, in Pyrenees young farmers expressed their distraught toward the management of the local floristic diversity characterizing natural meadows while their predecessors were used to it and had great knowledge on its dynamics before farm modernization in the sixties. Therefore, this study aimed to collect traditional knowledge relative to this topic before it was lost forever. This work, conducted within an action research group, focused on practices that are now barely observable in Pyrenean farming system. Qualitative data has been collected through semi-directed interviews of retired farmers and agricultural counsellors or teachers. It then has been analyzed with NVivo, a qualitative data analysis software (CAQDAS). Traditional knowledge was empirical and transmitted within farmers' families for generations. It implemented the management of perennial meadows on its diverse floristic composition preservation. This last one relied on late mowing, low nitrogen animal manure fertilization and on the use of farm-saved grass seeds gathered in hay dust, in the barn, at the end of the winter. Most of these traditional practices, seen as useless in nowadays economic context, provide us solution to think about for farm self-sufficiency.

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## **Table of acronyms**

CAP: common agricultural policy

CAQDAS: Computer-Aided Qualitative Data Analysis Software

GMO: genetically modified organisms

IK: Indigenous Knowledge

INRA: National Institute for Agronomic Researches

Pro-ABiodiv: meadows seeds participatory breeding project in Atlantic Pyrenees

SPid64: Action research group for participatory breeding of grass species

SR: Social Representation

TK: Traditional Knowledge

UAA: Utilized Agricultural Area

## Introduction

Green revolution brings up new way of producing, it aims to obtain the better yield and profit and thus, lead to the abandon of traditional practices which were not enough productive. However, over the last years, conventional agriculture has shown its limits to feed the world community in a sustainable way. Indeed, intensive farming is responsible for the degradation of natural resources (e.g. soil, water, diversity) and it relies on ended resources such as fertilizers and gas. Hence, there is a raising fad on alternative way of producing food closer to natural ecosystem and less dependent in external inputs. In fact, those practices, such as organic farming, are based on similar goals than traditional farming systems: being self-sufficient with very few external inputs. As a result, agronomic research focuses more and more on Indigenous knowledge: knowledge observable on indigenous communities that have conserved their traditional practices.

The specificity of the work presented here, is that it focuses on forgotten knowledge, practices not used anymore. This contrasts a lot with most of the works usually focusing on still practiced knowledge. The project is actually following a local demand, from young farmers, to collect knowledge from elders about traditional uses of grass-land. Those farmers are part of a more global project of meadows participative seeds selection. When seeds have been collected on their fields they expressed the feeling of a lack of knowledge within the young generation and an inability to maintain and take care of natural meadows, with the spontaneous vegetation as elders did before the introduction of commercial seeds. As an example of abandoned agricultural species, the use of hay dust for overseeding the grass-land.

The specificity of this work brings two main benefits over other studies. First, it aims to protect disappearing knowledge, considered as a part of their cultural heritage by the community. Secondly, since there are not yet a lot of examples of similar work it experiments an experimental methodology on this new field of social research.

The following short literature review first describes how traditional knowledge has been forgotten during the modernization of agriculture and why there is now a trend to go back to traditional systems and practices. It then gives a short presentation of TK in the Pyrenees farms. And to finish we will present the research question studied in this document.



# **I. State of the art**

## **I.1. A need for return to traditional practices**

### ***I.1.1. The green revolution in France and knowledge loss***

There are, nowadays, several issues on conventional agriculture, initially set up in order to feed a growing population after the Second World War. Indeed, literature reports many concerns on the capacity of the current food system to feed a growing population over the time even if, thanks to agronomic research, yields are increasing every year. Secondly, agriculture impacts negatively the environment through chemicals use, leaching, intensive tillage and breeding (Gliessman, 2007).

Until very late, the agricultural society rejected modernization. Mendras (1967) describes a neat opposition between agricultural and industrial societies. The industrial revolution took place in France at the eighteenth century while rural society stayed very traditional until the second half of the twentieth. Rural world is strongly linked to living ecosystem since it is based on biological cycles, which do not match with industrial mechanisms. Moreover, rural societies are described as very stuck to habits and then, opposed to change and tend to avoid as much as possible the deep swath that might be induced by introducing a new element to the traditional farming systems.

However, people got aware of the importance of agriculture after the Second World War and the famine it generates. Hence, this period marked the start of this modernization with the creation of policies and governmental action plan aiming to intensify food production in order to be self-sufficient at the national scale. Mechanization, agronomic research and specialization were the main ways toward intensification (Houée, 1980).

Mechanization improved farms labor efficiency, but since it was a big investment for the small traditional farms, they had to expand by taking over neighbors' farms or fields. As a result, it induces an important rural depopulation and the decline in the number of farms 160 000 per year. Secondly, agronomic research allowed a better understanding of biological cycles, especially animal and crop genetic selection and fertilization, pushing away biological performances. In order to optimize those new means of production, agricultural advisors encourage the specialization of farms. With this last restructuration arrived the use of external inputs as fertilizers, pesticides and livestock feed (Mendras, 1967).

To finish, the government through agricultural policies, agricultural counselors, agricultural trade-union and agronomic research fund are the main motors of the French agriculture

modernization. The changes induced permits to double (or more) the production; it also results in big restructuration of rural world as farms went from familial structures looking for self-sufficiency to business structures looking for profit. And last but not least, the food system moved from a local and typical production to a more globalised and standardized one (Mendras, 1967; Dumont, 1946).

### ***1.1.2. Trend to go back to traditional practices when looking for sustainability***

Nowadays, there is a raising awareness about intensive farming impact on environment. People are also more and more concerned about food quality and about their health (Pollan, 2006). Moreover, this kind of production mostly relies on limited resources as artificial fertilizers and gaz. Hence there is a bigger and bigger emphasis on more sustainable agriculture development. The study presented here focus especially on two types of “sustainable practices”: low inputs farming and organic farming.

Sofia and al. (2005) states that organic farming has always existed since traditional practices mainly relied on local resources, thus it could not use neither pesticides nor inorganic fertilizer and livestock feed was all produced in the farm. For example, in the studied area in the Pyrenees, traditional farming systems were almost self-sufficient and were optimizing manure production and crop rotation for the fertilization (Buisan, 2001; Vizcay Urrutia, 2009 ; Hourcade, Lefebvre, 1933). Organic and low input farming are then based on similar principle than traditional farming systems.

## **1.2. Research question: Do we have to remobilize traditional knowledge and practices in order to manage meadows and pastures in Atlantic Pyrenees?**

### ***1.2.1. What do we mean by traditional knowledge?***

Literature generally refers to traditional knowledge (TK), so called indigenous knowledge (IK) as the knowledge of indigenous or local communities<sup>1</sup>. It is a knowledge based on history, traditions or ways of life strongly linked to nature. It is usually transmitted through oral means from one generation to the next over centuries (cdb, 2012). Gopalam and Reddy (2006) describe two kinds of TK: still practiced knowledge and the forgotten ones. On the work presented here we studied the second kind of knowledge unlike what is very often done.

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<sup>1</sup> A local community is a group of people that share a same territory (<http://www.earthcharterinaction.org/content/categories/local%20communities%20and%20governments>).

### ***1.2.2 Toward the research question***

The need for a knowledge collection about traditional practices on meadows, built from elders' knowledge and memories, has been addressed by young ranchers within a participatory group working in research action on meadows seeds breeding. In fact, an initial project aimed to breed local variety of grassland species in order have meadows more adapted to local environmental conditions, practices and needs. During the first step of the project: selecting natural meadows and grassland for collecting seeds, young farmers expressed a mitigated attitude toward the project. In fact, they were not as much enthusiastic as researchers were expecting them to. However, these farmers expressed a real need to learn how to manage natural meadows flora as elders were doing before the green revolution. Hence, they report a loss of knowledge occurred during the Pyrenean green revolution so called locally "forage revolution" which induced a great change in meadows management through mechanization, and the use of fertilizers and selected grass varieties. As a result, traditional practices have been progressively abandoned and have not been passed on the young farmers' generation.

This work had two dimensions. First, it was conducted in order to preserve a cultural heritage: traditional knowledge and know how before we lost it forever. Secondly, it aimed to understand better how to manage local floristic composition of meadows and to better seeds selection criteria already set up by local farmers.

## **II. Materials and Methods**

### **II.1. Presentation of the overall seeds breeding project within a research action participatory group**

The traditional knowledge collecting has been conducted within a group working in action research on meadows species seeds breeding and that decided to study further the TK topic bring up by many stakeholders. As a result we cannot present the materials and methods applied without describing the participatory plant breeding project.

#### ***II.1.1. Action research: definition and benefits***

“Action research is one of the few research approaches that embrace principles of participation, reflection, empowerment, and emancipation of people and groups”, it is “sometimes called participatory action research”.

The study presented in this report has been done within a more participatory plant breeding project called pro-ABiodiv. Plants’ breeding is actually a field of agronomic research that particularly fit to action research since it is done for the local farmers’ direct profit and it cannot be carried out without their participation. Indeed, it is farmers’ needs that are, there, taken into account in the selection process, but also farmers’ knowledge: they know better than researcher the local specificities that they will have to adapt to.

#### ***II.1.2. SPid64: an interdisciplinary group***

The group SPid64 established in the department of Atlantic Pyrenees worked on this project. It is composed of local agriculture secondary school and agricultural education organisms, researchers from the INRA, the chamber of agriculture and other association and organisms working in local agriculture development.

SPid64 is animated by one participant from the chamber of agriculture and seeds breeding experiments are carried out in secondary schools. The project counts three sites of experimentation located in Atlantic Pyrenees. Searchers from INRA bring a technical support while local participants know more about local farmers’ needs and practices and about the environmental characteristics.

All the decisions concerning the project are made commonly by participants during reunions.

The traditional knowledge collection work is viewed as a prong of the original work and only a part of the group participants decided to be actively part of it. Few reunions with this shortened

group have been done. First it was important to agree on the objectives of the work. Later on, the group defines the thematic precise to study and the question research to answer through the data collected analyze.

#### ***II.1.4. A local context favoring both meadows species seed selection and traditional knowledge collection***

The whole data collection has been done in the department of Pyrenees Atlantic in the south west of France; more exactly on mountain and piedmont areas at the south of the department (figure 1). The valleys studied are: the Basse Navarre, Ossau, Labourd and Soule.



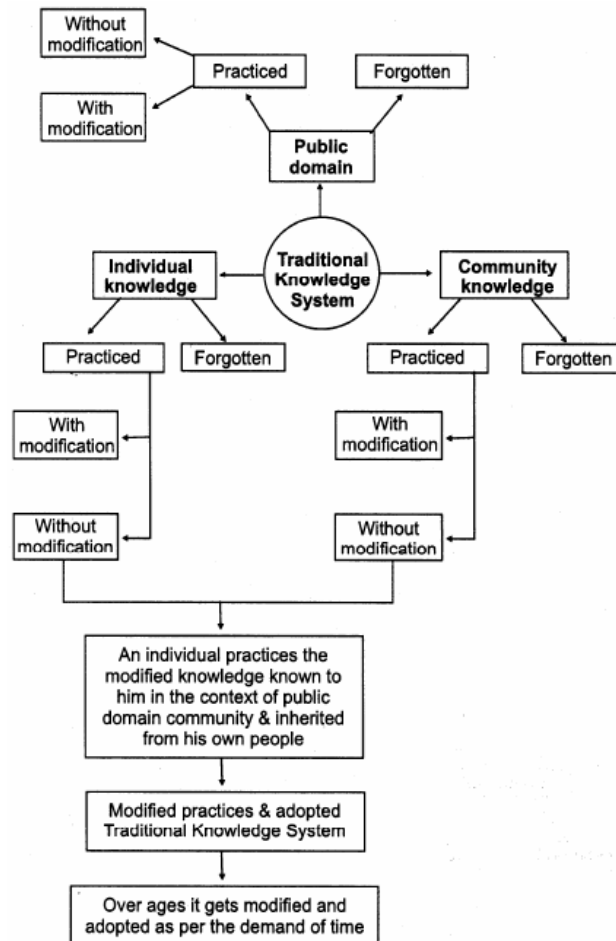
**Figure 1: study area, the department of Pyrénées Atlantiques (source: [www.cartesfrance.fr](http://www.cartesfrance.fr))**

This area, located on the Pyrenean chain and close to the Atlantic Ocean is very suitable with grazing systems. First, its uneven lands, often no mechanized, are more adapted to meadows than to crop production. Moreover, it benefits from a humid climate favouring grass development (Chambre d'Agriculture des Pyrénées atlantiques, 2012).

Another important characteristic of this area is the strong cultural identity. The PA is composed of two communities: the Pays Basque and the Béarn. Both communities, but especially the Pays Basque, are very protective toward their cultural specificities. For example they preserved their regional dialect. This specificity makes it a territory where agriculture modernization entered

with difficulties. This point is also strengthened by the fact that mountain area where very sparsely accessible and mechanized. As a result, in this area farms has been modernized very lately and it is still possible to meet people with knowledge on traditional practices.

## II.2. Collecting traditional knowledge through semi-directed interviews



**Figure 2: fram of reference to traditional knowledge (Source: Gopalam and Reddy, 2005)**

According to Gopalam and Reddy (2005), there are two kinds of TK, the one still practiced, with our without modification, and the one “forgotten” (figure 2). Only few farms, that could not be mechanized, conserved the traditional farming systems from the beginning of the twentieth; as a result we can classify the TK of this area in the second category.

Only little literature refers on studies done on this category of TK. Generally TK collections are conducted in indigenous community where traditional practices can still be observed. As a result, it was tricky to find references on how to conduct our work.

There are three different ways to collect knowledge on traditional practices: observation, interviews and literature. Since the practices we were studying were not used anymore, we could

not observe it. Thus we had only literature and interviews to carry out the study. The following chapter explains how the study has been based on those two main sources of knowledge.

**II.2.1 exploratory phase: literature reviewing and survey guide elaboration**

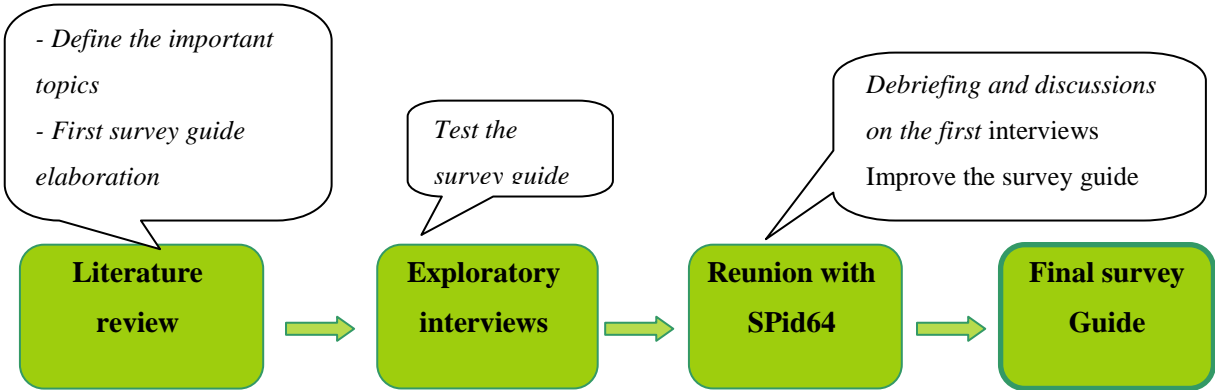
The exploratory phase consisted in setting up the study’s boundaries. It also aimed to establish the research questions through a rapid literature reviewing and exploratory interviews. Hence this phase, that lasted less than two months, was dedicated to readings, group discussions, but also field work preparation with the redaction of a survey guide and by contacting resource persons that gave us helpful advice.

- Literature reviewing

Literature reviewing had two purposes: establishing the state of the art and defining the problematic of the study (Kaufmann, 2006). In our case, literature review was also a result of the study because part of the data collection.

Local museums and universities provide us a list of works, mainly geographical, describing traditional agriculture in the Pyrenees’ mountains. We also found few papers about rural traditions in this area. Those reading gave us a better understanding of the traditional rural societies and ways of life, and a general idea of the material we could collect. It was the first step of the study leading to the redaction of a preliminary survey guide.

- Survey guide elaboration



**Figure 3: Survey guide elaboration**

As it is presented on the figure 3, a first survey guide was drafted, based on topics that stood out of the readings, on SPid64 field of interests and on some example of traditional practices remembered by the group participant and by young farmers met during the seeds collection

within the pro-Abiodiv project. We decided not to formulate complete question in the survey guide, but only thematic to treat.

Then, we tested the first survey guide during four preliminary interviews with retired farmers and agricultural counselor, seen as resource persons on this topic by the local community.

Two and a half month after the beginning of the study, we made a reunion with SPid64 in order to present the first results. Discussions were based on a literature reviews synthesis and on the four exploratory interviews gross analysis.

The main conclusions we got from the exploratory phase were that we had collected a very rich material during the first two months. Thus, we needed to sharpen the topic studied.

We decided then to focus as much as possible on meadows management and to avoid to study in details some topic as livestock and crop management, or the use of resources outside the farm.

We, as well, decided to study the period before the mechanization, so before 1960 to 1980, depending on the person interviewed age.

The survey guide is divided on five sections (cf. appendix II):

- Presentation of the farming system and the farm context (geographical location, size, number of workers...)
- Livestock management
- Meadows management (fertilisation, grazing, harvest...) and meadows species (grass plants originally present in the meadows, their dynamics, etc.)
- Seeds (use of farmed-save seeds, seeds acquisition from cooperative...)
- Creation, evolution and acquisition of knowledge

The two first sections were treated very briefly during the interviews, but they were essential to understand the context. Actually, even if we chose to focus on meadows, we had to study the traditional practices within their environment in order to avoid misunderstanding and over simplification of these practices.

The section about meadows management is the more important. It broached all the actions done in the meadows, from its fertilization, to harvest and grazing. The way meadows' plants composition was controlled has also been covered in this section.

Seeds section was integrated in the survey for two main reasons: first, the way farmed-save seeds were traditionally collected and used is a very relevant topic for the seeds breeding project pro-ABiodiv and secondly we wanted to get a broaden description of the introduction of more highyield species during the Pyrenean forage revolution in the sixties.



The last section may seem out of touch with the rest of the survey. It actually aimed to define better the TK collected and the dynamics around them. It also aspired to reveal how TK are now perceived by their possessors and why they have not been passed to the actual farmers' generation.

### *Evolution of the survey guide*

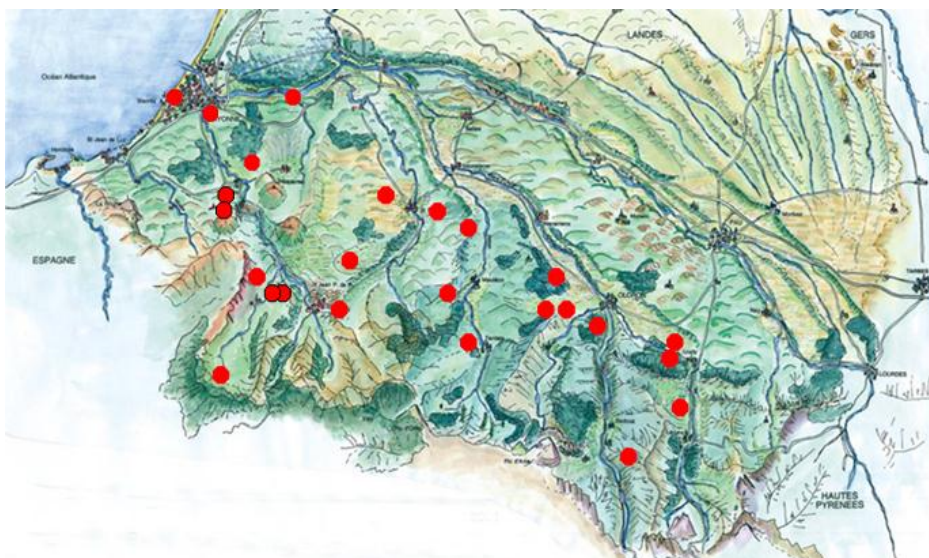
The survey guide keep evolving over the whole field work as we get to understand better the overall context

Also present the introduction paragraph used to explain the study to the people interviewed.

### **II.2.2. Choosing the population sample**

Generally, a population sample has to represent the larger population studied (Berg and Lune, 2012). However, in qualitative research, the population sample is often not established mathematically (Kaufmann, 2006). In our case, the goal of the interviews was not to represent the opinion of a larger population, but to collect testimony on traditional practices; as a result, we chose to rely on a “nonprobability sample”.

The methodology we applied is very similar to a “nonprobability sample” often called snowball method. It consist in selecting few people having the characteristics we are looking for, generally during exploratory interviews, and gathering from them the contact of other people with similar characteristics. The sample is thus built up during the field work, and it often evolve with the subject of the study as we get more and more familiar with the study. This method allows studying a population “difficult-to-reach” (Berg and Lune, 2012).



**Figure 4: Population sample in the PA (source: Landscapes' map of the department of Pyrénées Atlantiques. <http://www.cg64.fr/>)**

The figure 4 shows the 25 persons interviewed distribution in the area where the study has been carried out (see appendix III). The four first persons met, during the exploratory interviews, were

recommended by SPid64 participants. They themselves recommended other persons that would be interested to meet.

Three main priorities determined the population sample. First, we selected persons having traditional knowledge on agriculture. Hence, most of them were elders from 60 to 91 years old.

Only four persons on the 25 interviewed, were younger. They either were farming with traditional practices<sup>2</sup> or very interested in traditional practices. The second important point was that the person had to be able to express understandably: this detail is very specific to our study conducted with elders who felt sometimes more comfortable in Euskera<sup>3</sup> than in French. The third element is the location: we tried as much as possible to meet the same number of people in which valley studied. However it was not always possible because of people availabilities. As a result, many people met were in the Basse-Navarre and we did not meet anybody in the Vallée d'Asp.

Another important attribute we noticed in the sample is its composition, with a high percentage of scholars such as teachers, counselors, geographers... and little regular retired farmers. This specificity facilitated the communication during interviews. Indeed it was very tricky to collect knowledge from retired farmers who are not use to describe their activity.

To study deeper retired farmers knowledge, it would have been better to apply an ethnographic work, and then to spend few days with each farmers or farmers community and to observe their activity as well as to interview them. Nevertheless, the method we apply was faster and more convenient. It was also chosen because we had the possibility to collect a very rich material that way. Although, it is important to take into account those attributes when analyzing the data collected.

### ***II.2.3. Conducting interviews and avoiding biases***

Semi directed interviews aim to understand people's points of view, or to get the logics behind people actions or decisions. Thus, after listening to several persons, we can compare the different representation by analyzing those conversations (Kling-Eveillard and al., 2010).

Since through TK collection our purpose was to gather a diversity of traditional practices description, interviews were quite open. We tried, as much as possible, to let the person interviewed talk about the practices they knew or remembered the best. It looked like

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<sup>2</sup> Two person interviewed worked in their farm without mechanization because lands are to uneven

<sup>3</sup> The Euskera, so called Basque language, is a language spoken in the Pays Basque. It is often spoken within family and old farmers do not always know French vocabulary relative to farm activities (<http://www.eke.org/fr/culture-basque/euskara-la-langue-des-basques>).

conversation in which we were more or less choosing the leading subjects. Interviews were lasting about two hours. In that way, we were generally starting by presenting the study and the purpose of the interview and by asking a brief description of the farming system at the period studied. Then people usually started to talk by themselves about their management of the meadows. Most of the retired advisors or teachers were born and raised in local farms, thus they were describing their child farm during the interview.

We also avoided influencing the answer of people. Actually, when people do not talk spontaneously about a topic it is important to take it into account in the analysis of the interview. Moreover, people tend to be influenced by the way the question is brought up. Then questions were as neutral as possible (see appendix II). As we got deeper into the field work, questions were more and more precise because previous interviews had made us able to determine topic that were more relevant. However, it was important to keep an open-mind toward prospective new topics. As a result, the material collected is very heterogeneous: interviews were very different to each other and show a wide diversity between people and valleys.

The main difficulty we had to handle was to make people talk and describe things that do not exist anymore. The persons we met tended to talk about the present situation rather than the past. They were also often not confident in their memories. We used few techniques in order to help them in that way.

First, all along the interview we used a map of the valley studied in order to make the person drawing the fields he was describing, and the farm at the period we were focused on. Moreover, we were drawing a calendar showing annual farm activities. Those tools helped people to focus on the past and to visualize it.

The second, and most useful tool, was the use of old picture showing farm activities. We gathered those pictures both in literature and from local old farmers. Pictures were mainly showing old tools or the hay harvest. It helped a lot farmer to remember traditional practices, and thus to gather more exhaustive descriptions.

When it was possible, we finished the interviews by a walk in the meadow in order to gather more detail that the interviewee might have not thought about during the interview.

## **II.3. Qualitative content analysis**

### **II.3.1. Purposes of the analysis**

Action research dimension of the study is very visible in this step. The whole analysis has been done according to SPid64 group's expectations. The analysis work has been punctuated by two reunions with the group in order to present and discuss funding and to relocate its orientations.

Initially, the purpose of the study was to describe a diversity of traditional practices related to meadows management. Nevertheless, when the first findings from analysis -a non exhaustive synthesis of practices- had been presented to SPid64, most of the participants asked for deeper analysis explaining the logic structuring traditional farming systems.

As a result, further analyses were focusing on five main topics that appear relevant for SPid64 activities and objectives:

- meadows invasive plants management
- farm self-sufficiency for animal feeding
- farming runoff management
- Hazards<sup>4</sup> and risks management
- Application of findings within the ProABiodiv plant breeding project

### **II.3.2. Giving rigor to the analysis through coding**

Qualitative research is often accused to lack of scientific rigor. Ayache and Dumez (2011) state that searcher's subjective view and feelings shaped the theories elaborated through qualitative data analysis. Therefore, validity of results is a very common issue in this field of research.

- The CAQDAS and grounded theory methodology: a gain of rigor

Emphasis has been, more and more, put on software (CAQDAS<sup>5</sup>) for interpreting qualitative data as a way to improve the scientific quality of results. Many of these CAQDAS are based on the grounded theory, initially developed in 1967 by Glaser and Strauss in order to improve theories elaboration with a methodology more rigorous.

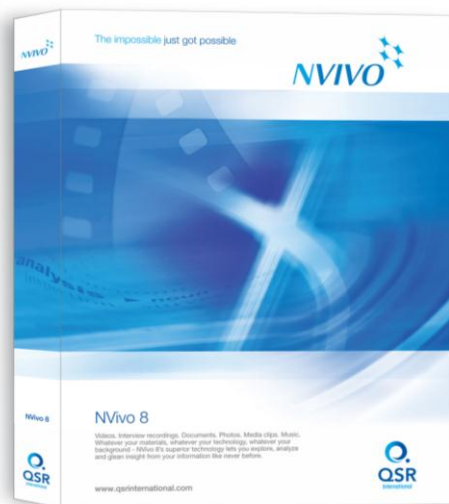
The grounded theory is rooted on observation, it aims to the "systematic discovery of the theory from the data of social research" (Glaser and Strauss, 1967).

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<sup>4</sup> The expression hazards, refers here to unexpected things - natural, economic, human... - influencing farm activities. The best example for this thematic is the climate, but there are many other.

<sup>5</sup> CAQDAS: *Computer-Aided Qualitative Data Analysis Software*

Generally, the purpose of data interpretation is to get an understanding of the meanings of raw data gathered through observation and interview. The grounded theory is based on data coding, process through which theorization can rise. The coding consists in establishing categories, so-called noodle, in which can fit piece of the original material. Each noodle gets a title that should describe as well as possible its meaning. The process of coding, by cutting and classifying raw data, aims to enable theory and meanings to emerge automatically from the material and to limit the influence of searcher subjectivity (Giordano, 2003; Ayache and Dumez, 2011). The interpretative approach (Miles and Huberman, 1994) we relied on, make us enable to interpret data collected through interviews and observation converted into texts. Hence, in order to be analyzed, interviews were recorded and transcribed, but kept anonymous.



We then relied on the CAQDAS NVivo (see figure 5), which characteristics reflect what have been said previously. We chose to use this software first because data had been collect in accordance with the grounded theory requirements. Secondly, it provides a relative validity to the results. And, since it is more and more used within the social research community, it was interesting to test its methodological functionalities.

**Figure 5: Nvivo, a qualitative data analysis computer softwer produced by QSR international. Source: NVivo getting started,**

**2008. (www.qsrinternational.com)**

It is, at this point of the methodology description, important to specify that the software is an helpful tool for arranging data, and studying the noodles obtained through the coding process, but finding are only emerging through searcher reflexion, and not from the software.

- Linear and transversal interview analysis

Interview interpretation has been conduced in two steps. The linear analysis brings a complete understanding of each interview within its proper context: location, age, activity, background, etc. of the interviewee. This step is major in the interpretation: according to Kaufman (2006) the interviewee always has to be relocated when analysing the material. Therefore, each interview had been read and coded individually.

The second step was the transversal analysis, in which we compared noodles established during linear analysis.

Both step led to a deep understanding of underlying principles about the research question described on the I.2 Those principles are the main production of the study, they are presented in the following chapter of this document.

### III. Results

#### III.1. traditional farming systems in Atlantic Pyrenees

This section of results is both based on interviews and literature review. It aimed to describe traditional farming systems in a way that make understandable results of the study.

##### III.1.1. Farms productions

###### - Husbandry

First of all, Pyrenean farms were mainly dedicated to animals breeding. In fact, it is the activity that most value mountain areas and local rainy climate (Hourcade, 1970; Vizcay Urrutia, 2009). Livestock was composed of sheep and cows principally, goats in some valley and few horses and pigs. In Labourd (south of Atlantic Pyrenees) herd of a local pony breed, the pottok, were leaved half wild in moor lands. According to Hourcade (1970), until the First Worl War sheep



production was only for meat and not present in all valleys. Afterwards it became more common with the installation of milk cooperatives buying sheep milk to farmers for Roquefort production. Atlantic Pyrenees became then one of the main French sheep milk areas of production (Labatut, 2009). All the farms were breeding a local cow the blond of Pyrennees, so called *béarnaise* (figure 6). They were raised to be milked, for meat production and for animal draught, as well

**Figure 6:** The local cow: the *béarnaise* (source: H. Proix, Bilhères sur Ossau) as horses.

Generally farms had less than a hundred, a dozen of cows and few horses and pigs.

###### - Cultures

In the Pyrenean Valleys studied, about 90% of the UAA (utilized agricultural area) was in meadows and only 10% of crops (Hourcade, 1970; Buisan, 2001). Farms' UAA was very low,

about 10 ha per farm, and then they generally had about only 1 to 2 ha of cultures. As a result crop production was mainly for family and livestock consumption. Farms were self-sufficient. Principal crops were: grains as corn and wheat or barley and potatoes. They had a biennale crop rotation including corn and wheat, with an intercrop of crimson clover and turnip in winter time between the wheat and the corn (cf. figure 7). Farmers were either sowing the intercrop after wheat harvest (case 2), or under corn in august (case 1). Intercrops, locally called *crimson clover* and *rave*, were very important for the animal feeding system. Thus it will be more described later on (III.2.1.2.1).



Figure 7: Biennale crop rotation. (Source: H. Proix)

**III.1.2. Farms structural organization**

Since the resources in the bottoms of valleys were limited in the valley of Ossau, Aspe part of the low Navarre, farms were built on three levels: 1. the farmstead on the bottom of the valley 2. the *borde*<sup>6</sup>: barns built on the piedmont areas and 3.the mountain pastures. Few months a year, the entire family was living in the *bordes* area, cultivating its fields. According to Hourcade (1970), many herds are almost nomadic on these valleys, moving from one level to another.

On the other valleys, instead of the *bordes* livestock was grazing moor lands before to go to mountain pasture and in some case like in Labourd there was no mountain pasture. Moor lands are familiarly called *Touyas*\*.*Touya* was also an important resource producing litter composed of ferns and gorses.

**III.1.3. Farm modernization**

In the valleys studied, since 1960 with the green revolution, cultures were dropped out, and meadows replaced ancient fields. Moreover, several *bordes* have been abandoned or taken over by landless farmers establishing their farm their. Since this moment farm relied more and more

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<sup>6</sup> *Borde* from *bordea* in euskera, which means house. The *bordes* also means to entire agricultural area where the barn was built (field plus meadows next to the barn).



on external inputs and start to buy feed. But some traditional practices and land used are still visible as the transhumances, or fern harvest on moorlands (figures 8 and 9).



**Figure 8: traditional transhumance, still observable in Bilhère en Ossau (Source H. Proix)**



**Figure 9: Fern Harvest in Banca (Source: H. Proix)**

### **III.2. Traditional practices on meadows management**

In order to understand the practices on meadows management we had first to understand the farming system management. In a first part we describe how farming system were managed toward a self-sufficiency for animal feed. A second part focuses on meadows management.

#### ***III.2.1. Maintaining farms self-sufficiency through family patrimony preservation and searching the balance between the use and regeneration of its resources***

The previous description of traditional Pyrenean farms highlights the fact they had very small utilized agricultural area (UAA). However, they were self sufficient for animal feeding and a high percentage of crop production was used for family auto consumption. Therefore, it must be relevant to work on the following question: how natural resources and lands were managed in order to fulfil this self sufficiency requirement?



On the one hand, the fact that nothing was wasted is omnipresent in the interviews. In fact, “*nothing was lost*” and “*we mustn’t leave any leftover*” in order to offset the lack of cultivable lands. Farming practices were based on the research of the balance between resource use and regeneration. Thus, we can assume it was regarded as a renewable element of the farming system. Dust harvested in hay barn was, for instance, used as seeds for meadows renewing: “*we ourselves recycle farm-saved seed gathered over here*”. This recycling principle is completely absent in contemporary farming systems strongly relying on external inputs as seeds, feed and fertilizers.

On the other hand, interviews describe “*a very strong tradition to conserve family patrimony and especially the “House<sup>7</sup>” (Etxe)*”.

The family patrimony is a good received from ascendancy inheritance (Lamy, 1993).

Interviews often present Pyrenean TK as practices that insured farms sustainability, notably through the farm patrimony preservation. Indeed, the *Etxe* was usually transmitted from the parents to the eldest son or daughter, who thus gets the responsibility to take care of it for coming generations. Concern for the farm patrimony and local resource management are generally mentioned together, “*Today we are more in an age of wasting, of a lack of rigor in taking care than in the past*”.

#### III.2.1.1 grass and rough forage was the basis for animal feeding

Grass, as hay or directly pastured by animals was the main feeding source for livestock. Hay was a rare resource, thus it was reserved for animal in production: “*hay was kept for labour cows, with a calf, or for sheep milking feeding their lamb*”. Since grassland areas were limited, it was not possible to produce enough hay to feed the whole herd during winter, as a result “*hay storage was not big enough for keeping livestock all the time in the barn*”. Therefore, hay was a limiting factor for farms; but it was also very important element because “*livestock was the family livelihood; we first had to take care of the livestock*”. As a result, hay harvest was done late in the season in order to produce hay in quantity. This first cut producing rough hay, how was animal feeding maintained rich enough in winter time?

If hay quality was not the prime criteria determining the date for cutting, it was still a concern and it was kept at a correct level thanks to some haying practices, especially manual work and

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<sup>7</sup> « House » : « Maison » in french and *Etxe* in Euskera, refers to both the family habitat and the entity composed by all the family members. It is a structuring concept of Basque culture; generally the *etxe* and its inhabitants share the same name (Etchegoyhen, 2011).

care for hay drying. Furthermore, hay was complemented by richer nutrients as second or third cut of hay<sup>8</sup>, forage crop or grains.

#### *III.2.1.1.1. Producing big quantities of hay rather than a high quality hay*

Meadows management aimed to produce enough hay to feed farms' livestock. Then, quantity produced prevailed over hay quality: « *rather than hay nutrients value, people were looking for hay quantity. They were waiting the meadows reach a sufficient grass volume for mowing it. (...) Actually, cows were big hay consumers and had to be fed, thus often hay produced in farm was not high quality hay. It was harvested very late in the season* ». The practice now called late mowing by agronomists was the main mean to produce enough hay for farms' livestock: hay was harvested late in season in order to let the vegetation reach its maximum volume. Furthermore, all grasslands were mowed at least once a year, even the less accessible and hay loss was avoided as much as possible; « *children gathered hay left with rakes, because we must not waste anything* ».

However hay quality was not necessarily overlooked. Actually, criteria of quality were different from nowadays' one. « *Nutrients values, they did not know it* », people were observing the animal behaviour to determine the hay quality: « *good hay was not too rough, it had to be eaten by animals, not too old neither* ». The hay odour also indicates its quality. In the interviews, people often linked it with other elements presented to be influent in hay quality as: the plant stage when it has been mowed, tedding\*, the meadow's plant composition... Hay smell is also, often implicitly, linked with presence of grass seeds in hay. Emphasis is often put on these criteria when comparing traditional and current agricultural practices. Indeed, several subjects maintain that had a better quality before farms mechanization, but on this topic there are diverging points of views expressed. On the one hand, some people say hay when was harvested manually it was not shook out and damaged as it is now, hence it lost less leaves and seeds: « *grass was not damaged like it is nowadays with hay tedding\*. Because nowadays, hay tedding are so brutal that it is damaging a lot* ». In the interviews, people often say that hay smell differently since the mechanization, because tools led to the fall of grass seeds. On the other hand, hay was cleaner before farms' mechanization: « *sometimes machines trend to remove soil (...) dirty hay is bad for animals* ». Nevertheless, some people say machines enable to mow bigger surface with less time and sooner in the season. According to them grass is then cut down at its optimal stage and hay has a better quality. To conclude, these points of view strongly depend on quality criteria that evolved with farm mechanization and intensification.

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<sup>8</sup> In French, second and third cut of hay are called *regain*, this term refers to hay with of better quality than the first cut.

Interviews are relating over and over again two priorities for hay quality: a good hay “*is a hay harvested at the best grass stage, and dried in very good conditions*”.

- “*the hay has to be harvested at the best grass stage*”

Period of haying were changing according to location, climate and years. The first cut was usually done from the end of June to mid July. Late mowing was not only done in purpose, it was also linked to climatic constraints, since at the period studied there were no reliable meteorological predictions: “*we did not mow too early because the weather was not favorable, because here springs are rainy*”. In fact, in the Pyrenees, June and July are the most favorable moments for haying. Mowing was also done early in the morning or on the evening. Subjects asked specify it was done that way in order to avoid hot temperatures and because flies were bothering labor cows during the day. However, this schedule was also advantageous for hay quality by preserving the plant integrity since it is easier to cut a wet grass and because hay



fragile species as clover and ribwort plantain\* must not be shook out in warm weather.

**Figure 10: animal-drawn mower.**  
(Photo from H. Proix in Suhescun, France)

Until the half of the twenties, meadows were mowed with the scythe (figure 11), from the thirties with animal-drawn mower (figure 10) and from the fifties with mowing machines.



Before farms mechanization, every meadow was mowed, non mechanized lands were mowed with the scythe but they had been abandoned little by little. Surface mowed were smaller than today, there hardly reached 50 acres. In fact, mechanization and weather forecast enable farmers to cut bigger surface without risking to wet the hay.

**Figure 11: Sycthe.** (source: H. Proix in Bilhère France)

- “And dried in very good conditions”

Tedding was determining for hay quality, hence it was done with concern: “*hays had to be very dried, crisp. Nowadays we don’t wait enough for it to be “crisp”, we are getting embittered*”. Hay quality was depended on its level of dehydration. Hay was manipulated with racks before farms acquired animal- drawn hay tedding. With those tools, hay got dried in two to three days when the weather was good. Hay was laid on the soil few hours after mowing and turned over



**Figure 12: the *argueto* (euskera) was used to carry hay over men's head (photo A. Dascon)**

several times a day. At night, it was put in windrows or in piles in order to avoid humidity, “*when we had dew we made piles with the hay. We made it by hands, with racks*”. Hay was laid on the soil again on the next morning after soil had been dried by the sun. When it was raining, big two to three meters piles were built with drying hay around a central post. It was left several weeks drying in the pile. When it got dry enough, hay was

brought in the hay barn with a chariot (figure 13), a sledge (figure 14) or carried directly by men (figure 12).



**Figure 14: hay sledge drawn by a mule (Photo A. Dascon)**



**Figure 13: Hay chariot had to be filled in a specific way in order to be well balanced (photo A. Dascon)**

Hay harvest is, in most of the interviews, described with great details, this attest of the concern farmers had to full the hay barn for winter.

- Hay quality affected its uses and storage

Roughest hays and sheep leftovers were used for cows feeding. One retired counsellor interviewed also said that missed hays were given to horses. Thus, it seems farmers were carefully looking at hay quality. Animal species did not all have the same importance for the farm’s subsistence, often sheep was very important; it received better care than cows or horses.

However this logic was not general at the territory studied, but only in valleys where sheep production was important.

Loose hay was stored in hay-barns. It was piled-up in lays; hay harvested first was at the bottom of the pile. Hay barns were small and narrow; indeed hay had to be packed down every day during harvest in order to optimize the space available. Moreover, there were often several piles in one hay barn made with different quality of hay: sheep hay, cows hay and second cut hay.

To conclude, late mowing was a very common practice in the Pyrenees and aimed to produce enough hay to feed livestock. According to elders producing rough hay at the first cut was not an issue because it was balanced with the high quality of the second cut hay: “*we didn't care if cows hay was not good. The hay from the second cut was guarded for sheep; it was for sheep milk production*”.

#### *III.2.1.1.2. producing a high quality hay in the second cut and winter sheep grazing*

Interviews raise two local specificities that gave a big importance to *regain* in traditional Pyrenean farming systems: 1. In Pyrenees, flora's second growth leafy and able to regenerate after a dry period. It gives high quality to *regains*. 2. the climate, rainy in spring, foster late mowing for the first cut and thus, local fodder systems rely more on the quality of *regains* than on first cut hay. Hence, *regain* is described as a “holy” fodder: “*the regain had a big importance because it's a grass much smoother and tastier for sheep*”.

Sheep and cows herd management were quite different to each other; in winter time, cows were mainly feed with hay while sheep were grazing every days, unless the weather was very bad. Farm producing sheep milk also feed sheep with *regain*. This hay is richer and it was considered as a supplementation and directly related to milk production success. Thus, it was given in low quantity to female sheep in production in order to supplement grazing. Even in farm without milk production *regain* had a comparable purpose: it was given to suckling animals.

#### III.2.1.2. Give the greatest value to local resource and safeguard the farm patrimony

Lands use was thought at best in order to, first, produce enough feed for animals and secondly to preserve soil potential homogeneous over the years. Two levers are presented in interviews: first of all, every fields, even the less accessible or the steepest, were cultivated, “*we cultivated every field even if we had to do it by hand, with the scythe. Because farms were small, families large and we had to survive*”. Cultivable lands surface was thus the limiting factor. The second lever presented is the crop management, using all crop residues to supplement hay and employing catch crop\* within a biennial crop rotation.

*III.2.1.2.1. Use as much as possible meadows additional resources, which are not already used for human consumption*

### **Using crop residue as animal feed**

Culture and their uses are poorly described by interviews since these ones were focusing on meadows. Still, we could note that crop: potatoes, wheat, and corn were mainly food crop. It was mostly use for human consumption, only a small part was used for animals feeding. However, all crop residues were used for animal feeding. Straw was roughage given to non productive animals. Corn heads and leave made richer labor cows' diet in summer. Thus, there were no wastes produced in traditional farms.

### **Feed crops\*: optimize field lands and preserve their fertility**

Many subjects put emphasis on the inter crop crimson clover-turnip. Indeed, they were greatly increasing yearly cultivable surface.

#### *- The crimson clover*

The *crimson clover* was very helpful during the “hunger gap<sup>9</sup>” at the end of the winter. It was grazed by sheep and/or fed green to labor cows in May. One retired farmer in Ossau also describes mares grazing the *crimson clover* in this valley where there was no sheep production. As a result, we can assume crimson clover was saved for animal in production and that producers saw it as a rich nutrient.

#### *- The turnip*

Turnip was harvested daily, cleaned up and cut down in pieces with a machine. Then it was given to feed cows, complementing straw and hay. In some farms it was also directly grazed by sheep. Some people state it has a high nutritional quality when others think it bettered forage, even rough, ingestion. During the Pyrenean forage revolution, turnip has been substituted by other vegetable as cabbages, beets or rapeseeds. Agricultural counselors and schools enhanced these “new” vegetables nutrients content and moreover, turnip cropping was very time consuming for farmers.

Thus, the intercrop crimson clover – turnip were abandoned in favor of other vegetable and ray-grass for several reasons: work simplification and productivity research, the introduction of feed as external input and bloat issue related to leguminous consumption.

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<sup>9</sup> Hunger gap : period of the year preceding harvest and in which food resources peter out (CIRAD-GRET, 2002).

To conclude, feed crops were part of animal feed in winter time. Furthermore, they ensured farm patrimony preservation: on the one hand it allows not overuse the meadow and, on the other hand, by fertilizing field with green manure and covering soil in winter time.

#### *III.2.1.2.2. local resource was wider than farm's lands*

The utilised agricultural land only represented, half of total farms lands. In fact, moor lands and mountain pastures were part of the rotational grazing.

These resources were not directly expressed in survey guide but it was impossible to study grazing system without taking it into account. Sheep were grazing on meadows throughout the winter. In spring, meadows were reserved for grass growth in order to produce hay; in this purpose sheep were leaving the meadows from the first of May according to most of the interviewee.

Moor land and mountain pasture first enable to free meadows for hay production. Generally, herds were following a tour established since centuries: they were first grazing in moor land before to climb to mountain pasture. In autumn, they were going backward to farm pastures. In some valley, there was no use of mountain pasture, thus herds stay the whole summer in moor lands. In both case, labour cows were grazing in moor land the whole summer. As a result, using those areas expended farms' surface in order to produce hay and to reduce meadows' trampling by animals grazing.

Secondly, litter in barns was made with fern or *touya* flora harvested in moor lands. This use of lands had two consequences: 1. reserve straw produced in farms for animals feeding, participating that way in farm self-sufficiency. 2. Cutting in moor lands avoided it to become shrubby. It also avoided natural disasters as forest fires or avalanches.

#### *III.2.1.2.3. Livestock size evolving according to yearly forage production*

Farms were self-sufficient for animal feeding, but they also were very sensitive to hazards elements influencing farms feed production from one year to another. How were farms managing to adapt to these changes and to stay self-sufficient every year?

*“I've seen difficult winters, farmers could not make ends meet because they did not have enough hay [...] they preferred to sell animals”* rather than to damage meadows with over grazing. Many times cow has been described as an income livestock, which sell helped to adjust to a lack of forage. Selling an animal was thus re adapt farm needs to annual forage production. It was also avoiding overgrazing. This topic will be developed later on meadows management description.



Furthermore, before farms' modernization, animals were much less productive than nowadays with genetic selection. Hence, farms needs were lower and farm self-sufficiency for feeding more accessible.

### *III.2.1.2.3. field and pasture fertilisation based on local material*

Until the fifties, no artificial fertilizers were used in Pyrenean farms. Lands were only fertilized with manure and lime locally produced, *“before we spread manure and it was all. Artificial fertilizers arrived from 55 or something like that”*.

Lime was locally produced with lime kiln\*, it is an activity well described in several interview, *“there were plenty of lime kiln here, so this practice was quite casual, it appears to me we limed lands much more than we do now”*. Indeed, limey soils are quite observable in the territory studied, then it was an abundant resource, *“we have places with limestone, so there were lime kiln”*. However, this activity has been abandoned by the end of the nineteenth century and if many interview mentioned it, people did not give much detail on it. Furthermore, people tend to call liming the application of slags\* that occurred from the end of the Second World War. This practice will be described with more details later on.

Interviewees often enhance the importance animal manure had in traditional farming systems: *“people have always been looking for animal manure since time immemorial”*. Hence, herd management aimed to avoid manure loss. Cows lived in stables several months a year not only in order to limit over grazing but to produce manure. Even when they were grazing, animals came back to their stall during the warmer parts of the day, *“they kept animal inside in order to produce manure for meadows”*. Farmyards' floor were also covered with a coarse litter to gather a maximum of animals manure, *“we free cows on the morning and we left them several minutes in the farmyard to gather the manure and not to drop it on the road, for neighbors [...] some farmers even spread litter on the road front of their house, that way cows passing their were participating too to the farm's manure elaboration”*. Meadows were also fertilized directly thanks to sheep grazing: *“sheep were parked in a claitate<sup>10</sup> and that were removed every two days; they managed to fertilize one this way”*.

Several interviews enhance the contrast between the manure importance in traditional farming systems and the fact that nowadays it is more considered as a waste: *“on the seventies, manure*

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<sup>10</sup> Paddock in Euskera



*was yet seen as a waste [...] it was not anymore a farm production*". Nevertheless, they assume fertilization purposes have changed: manure aimed to maintain soil fertility while now, fertilizer target a maximal soil productivity : *"we want to make soil producing as fast as possible, we fertilize it for a short term, we do not feed the soil, keep it in live... Nitrogen aim to a rapid plant growth"*. Thus artificial fertilizers break agricultural practices sustainability because first, it is a limited resource and secondly they do not maintain soil fertility.

### **III.2.2. Maintain the meadows permanent through a well balanced floral composition**

In most of the case studied, meadows were permanent: *"why they were not resown? It was not imaginable to "break" the meadow, we must not..."*. Meadows were a notable component of farm patrimony transmitted from one generation to the next one : *"they taught us patrimony and meadows respect. The grass was growing in It, so It had to be cleaned up, respected and nurtured"*.

#### **III.2.2.1. Tame the Touya**

Meadows were either replacing old fields or established on moor lands, *"every farmer was always clearing moor lands"*. Local climate and soil characteristics were suited to local flora, so called *touya*. *Touya* is the name given to gorse and fern plant as the main flora present in Pyrenean moor land. This vegetation trend to overrun meadows, *"the meadow goes back to its origins, the touya"*. Thus, establish and nurture the meadow required to change soil characteristics and to make it hostile for the *touya*. Fertilization and mowing were the best way to tame the *touya*: *"a meadow, if you don't nurture it, if you don't fertilize it, if you don't mow it, the fern will come back"*.

##### **III.2.2.1.1. Mowing and grazing to clear the meadows**

#### **Mowing is hostile for *touya* flora**

Meadows were not only mowed for hay production, *"mowing was a meadow's clearing system"*. It is the first levers for meadows' weeds control mentioned in interviews: *"mowing removes weeds and plants left after grazing"*. Several persons interviewed qualify mowing as very unfriendly for the *touya*: *"those plants don't like we disturb them [...] when we mow them, they can't store nutrients on their roots... while grass can endure to be cut frequently"*. Hence, we can assume that mowing was seen as a way to control meadows' plant composition.

#### **Rotational grazing in order to avoid wastes**

Grazing, like mowing, is a meadow clearing system, *"with grazing it is completely cleared"*. But it always has to be completed by mowing because when grazing animals tend to consume only

plants they enjoy and to leave other plants, “*this kind of plants then flourished and little by little overrun the meadow*”. The abandon of inconvenient (too far or too steep) meadows that occurred during forage revolution lead to their rapid degradation; they were still grazed but it was not enough to maintain them clear.

However, rotational grazing was frequently done in order to avoid this phenomenon. It is actually a tradition in Pyrenees called the “*three hairs grazing*”: “*we need three hairs. The cow, the sheep and the horse which are grazing grass left. It was always done this way. That is why these three animal species were always bred in farms*”. Most of the interviews refer to this tradition but under another titling that do not consider horses but only sheep and cows. Rotational grazing was based on animal species complementarities since cows are less picky than sheep and waste less grass, then “*cows were the first to graze the meadows and in November or December, sheep grazed what cows had left*”. The order of animal grazing was thought taking animals’ physiognomy and grazing behavior into account: “*sheep don’t have teeth on upper jaw unlike horse which graze uproots removing*”. Indeed, horse is often described as the best way to clear a land: “*horses were the land-mower at this time*”. To conclude, rotational grazing was optimizing meadows management.

#### *III.2.2.1.2. A grazing management avoiding pasture damages*

In interviews only few people talked about over grazing but most of them agreed that livestock were very often present in the pasture. Sheep were over grazing, however careful grazing management avoid damaging pastures.

First of all, sheep grazed several spots per day. Meadow plant compositions, state and geographical location were regarded when choosing pastures to graze: “*farmers knew that in this spot they could not leave sheep too long [...] sheep grazing was managed taking into account the weather and what sheep had eaten earlier. It also depends on pastures’ state*”. Farmers chose to graze filtering slope or rocky spot rather than watery meadows, “*when it was raining we knew it was bad to go on those pasture so we were going to healthier slope*”. Every day, the first spots to be grazed were those getting sunlight early. Avoiding humidity limited to damage the pasture with animal trampling.

Furthermore, livestock’s behavior was observed in order to limit animal trampling: “*they graze for one and a half hour, and when they stop grazing we take them out the pasture. Otherwise they start walking around, trampling...*”. As a result, meadows degradation caused by grazing was limited thanks to farmers’ careful observations.

Over grazing is frequently criticized by retired agronomist we interviewed: “*livestock kill the grass if it is all the time grazing the same spot*”. But this practice this usage is also often related to the development of a specific flora which value greatly the *regain*. Short rosette-forming plants, as dandelion and ribwort plantain, are notably related to over-grazing. Hence, we can assume meadow plants composition, related to over grazing, gave its high nutrient value to regain produced before farm modernization.

Quite the contrary, farmers avoid to leave cows in the pasture in winter time and when it was raining. In many farms, cows were only grazing the meadow in autumn when coming back from mountain pastures: “from the first of August to the first of October, cows were grazing on meadows”. In winter, cows green feeding was preferred to grazing, even if it was much more time consuming. This last point illustrates well farmers’ willingness to maintain meadows permanent.

To finish, it appears to us that animals’ health was the first criteria leading their choice in meadows management. In fact, they were avoiding grazing humid environment in order to decrease the risk of animal infestation: “we knew liver fluke\* was in humid pasture”. Likewise, meadows rich in leguminous were carefully watched in order to avoid bloat risks.

#### *III.2.2.1.3. A low nitrogen fertilization favoring leguminous development*

After mowing, fertilization is the second levers for *touya* taming. As described on the previous chapter, field and meadows were fertilized were animal manure and lime locally produced. Farmers usually prioritized fields for the fertilization: “*we automatically spread manure on corn and potatoes field, for meadows it was every two or three years*”. Thus, they believe meadows were less nurtured and less productive than nowadays, “*grass had a slower growth*”. However, even if meadows fertilization was low, it was done regularly and it was considered as essential for maintaining meadows quality.

People interviewed often enhance the connection existing between fertilization and meadows plant composition. For example, leguminous were highly appreciated by farmers and often, they were looking forward favoring them in meadows composition through a low nitrogen fertilization and liming.

#### **Thin animal manure was researched for meadows fertilization**

Interviews describes a big variability on meadows fertilization. Variation factors are season of spreading and the kind of manure spread: age, origin (sheep manure, cow manure...) and litter.

But generally the manure texture was deciding on its use: “*meadows have to be fertilized with thin manure*”. Hence, thin manure, with a litter rapidly degraded were kept for meadows fertilization; “*we avoided putting too much disparate elements on meadows*”.

- Use of manure according to its litter composition

Some retired farmers interviewed distinguished cows manure to sheep manure. Sheep manure was said richer than cows manure, “*cows manure was “cold”, and it needed time to be effective*”. On this point, fertilization is very different from one farm to another; according to some people, “*sheep manure was better for field fertilization*” because richer. Whereas for others, “*it was kept for meadows because this manure was more rapidly degraded; fern disappears faster than gorse*”. In fact, sheep and cows litter did not have the same composition: it was made with fern for sheep and with gorse for cows. Hence, sheep and cows manure had a very different texture, which impact on their usage.

- The use of manure depended on its age

Based on data analysis we have done, we assume old manures were thinner and then used for meadows fertilization. Manure was spread on meadows during spring or summer. Manure could also be spread “*during winter. I remember we were taking manure out of the barn and leaving it in piles near the fields*”. In other farms it was spread on fields in spring and what was left was spread on meadows in autumn, when workload was lower. Manure spread in autumn was usually older because it was either a few months old manure produced in winter or manure gathered in the *bordes* which were not empty every year. In the valley of Baïgorry (in Basse-Navarre), there were sheepfolds in moor land in which sheep were staying during summer days. No litter were put on these sheepfold, the manure was pure. It was taken out every two to three years, thus this old manure was very thin and very valued by farmers.

Some people also describe a manure management comparable to composting, which aimed to obtain a good texture: “*every days we had to hoe and turn over the manure pile. Today we compost the manure, at this time we were doing it but without knowing it was composting. We were composting the manure in order to ventilate it, to dry it and to make it lighter for transportation*”.

### **Liming causes *touya* withdrawal and favoring leguminous growth**

First of all, many interviewees said that liming was very important to tame the *touya*. They often refer on soil natural acidity helping the development of this kind of flora, the fern being the more

quoted. A great part of soils in the area studied is acid because in spite of limestone presence: “*here soils are acid [...] Since it rains a lot, the rain take more lime than stone can produce. Calcium balance is negative*”. Hence, fern is described as a acid soil plant and liming as this soil acidity reviser. Correcting soil acidity also favor leguminous development: “*lime areas are more favorable to clover or plant inducing animals bloat*”.

Secondly, slags were described as a liming substitute. This fertilizer was a blast furnaces’ residue from the iron or desphosphorisation. Farmers very liked it because it was rich in phosphorus and in lime. Moreover since lags were nitrogen free their use is often linked to meadows richness in leguminous and especially in trefoil: “*after lags spreading, meadows were completely yellow, a beautiful trefoil*”.

### **Meadows racking maintain it clean and make the manure thinner**

Meadows were systematically racked after manure spreading in order to keep them clean by taking out litter residues. It also had an impact on manure texture, by broking aggregates it better manure assimilation in soil: “*manure is “eaten” rapidly when it is stirred*”.

Moreover, racking was disturbing a certain type of flora, in particular weeds like couch-grass, “it is very superficial so if we rack it...”, or moss: “*moss was growing and if you had not managed to stop it, it was going to damage the meadow. People were used to it and they utilized spiny shrubs tight together, with a heavy trunk on the top, drawnd by cows; they were racking the meadow with this home made tool to remove the moss*”. Contemporary harrowing is kind of this practice substitute.

### **III.2.2.2. Meadows were resilient ecosystem with a diversified flora**

Traditional practices enable a very diversified flora to grow in permanent meadows.

#### **III.2.2.2.1. In the past, there were only very few weeds in pastures**

Plants of the meadows were seen differently in the past. All plant species, even the low productive ones, had an interest. Hence, many people thought that meadows had very few weeds before the introduction of commercial seeds: “*at this time we were never talking about weeding, why? Because there was no weed*”. Several reasons explain this point. First of all, “*some people accused agricultural cooperatives to have brought rumex within commercial seeds*” while others think it has been introduced with outside straw and hay purchase. But above all, the definition of weeds changed during the forage revolution: before, it was invasive plants not eaten by animals, toxic plants or plants causing a discomfort (difficult to mow like brachypodium, difficult to dry in the hay or thorny like thistle or gorse). The plants the more described as a weed is the rumex.

Nettle, bramble and buttercup are also often criticized. With the introduction of commercial seeds, more productive, weeds became all the plants which had not been sown by the farmer and that were less productive: “plants like those, it is ok if there are few, it can even be good because they are rich in trace elements, but it is bad if there are too much! Because it lower meadows productivity”.

#### III.2.2.2.2. Meadows' floristic diversity makes it more resilient

A resilient ecosystem is able to adapt to environmental disturbance thanks to its diverse components (Gliessman, 1990).

Several interviewees put emphasis on floristic diversity advantages for meadows: “*A meadow with a high floristic diversity, with several plant species, is always better than a meadow only sown with orchard grass. I assume it is better for meadow's perennality*”. The floristic diversity had a lot to do with meadows resilience and with meadows floristic composition balance. According to interviewees' observations, species are complementary, because having their individual fragility and specificities. Thus, meadows with a high floristic diversity are more resilient to climate disorders, usual or punctual: “*there are dry years and rainy years [...] some grass grow better in dry year while others prefer rainy years. It is better when there are several plant species*”. Natural meadows were less sensitive to drought, “*it could endure dryness every year, it hold better than nowadays' meadows*”.

Meadows of traditional farming systems are also described as less sensitive to pest. There have been recurring caterpillar attacks on meadows in Pyrenees since the sixties, several hypothesis about this phenomenon are given by interviewees. First, some people assume that bred grass varieties are more sensitive. Secondly, low floristic diversity on meadows composed with only one grass specie are the more attractive for this pest: “*caterpillar eats grass, with a preference for orchard grass. It is a good reason for having a high variety of species in your meadow. It does not eat leguminous...*”

#### III.2.2.2.2. farm-saved grass seeds diversity and cleanliness

Many interviews enhance the concern farmers had to maintain perennial meadows. The use of farm-saved seeds for meadows' renovation illustrates well this point. In fact, it was used for re sowing spots with low grass density, or where manure was piled. Old farmers interviewed call farm-saved seeds the dust they were gathering in the hay barn at the end of winter. This dust very



**Figure 15: Hay dust collected at the end of winter (source: H. Proix in Suhescun, France)**

rich in seeds that had fall down from the hay is also commonly called *hay barn scrap*, *fenasse*<sup>11</sup> or *hay dust* (figure 15). Any selection was done on these seeds, hay residues were just taken out before using the seeds.

Several interviewees described the concern farmers had toward

*hay dusts*' quality; this point is generally related to haying.

First of all, the first cut was realised gradually throughout summer allowing the presence of hay cut at diverse plant stages and thus to have a very high species diversity in the *hay dust*. Moreover, this late mowing enables plenty of grass species to be re sown naturally on the meadow. As a result, we assume that if late mowing was not producing high quality hay, it was very important for meadow regeneration and for conserving a natural balance within meadow floristic composition.

Secondly, *hay dust* has to be “clean<sup>12</sup>”: “*We used to sow hay dust. But we treated it very carefully [...] We try to choose spot without weeds, without rumex when haying*”. Hence, rumex were manually taken out the meadows before haying in order to not pollute the meadows in the following year: “*those people were very careful with rumex seeds*”.

### III.3. Traditional knowledge origins and evolutions

#### III.3.1. Traditional knowledge specificities: how they were produced

TK described previously are based on two different categories: empirical knowledge and scientific knowledge. Empirical knowledge is based on experience (<http://dictionary.reference.com/browse/empirical>).

##### III.3.1 empirical knowledge based TK

One main difficulty when collecting TK was to make people explaining on which knowledge their decision on meadows management were based; a ethnologist we met had to deal with the same issue: “*I asked it to several shepherds [about lambing date variation between valleys], they never knew how to answer it*”. Many interviewees were also very skeptical toward TK existence when we introduced study purposes: “Well, traditional knowledge... I wonder if there really are traditional knowledge. I don't think so”. But these same people, by describing their farming practices were demonstrating they actually had knowledge they are not aware of; “*knowledge is something that ... Throughout generations we observed and asked ourselves without knowing its*

<sup>11</sup> Fenasse : could be translated as hay residue (*foin* is hay in French)

<sup>12</sup> For farmers, clean means without weeds' seeds

*origins, raisons and its evolutions' stages. We do it that way because it seems right and that's it".* Therefore, traditional knowledge is empirical; this is why it was difficult to have them described during interviews.

Elders we interviewed count as knowledge scientific knowledge only. Several expressions are utilized to name what was guiding farming practices on the past: commonsense, tradition, custom, routine, habits and believes. Those namings refers well to TK essence: it often seems without logic but when studied in its context, it is meaningful. For example, low mowing is said to be a "bad practice" according to scientific criteria but it actually has great benefits for the traditional farming systems (cf. III.2); benefits which are not visible when studying the practice outside its context. Many interviewees believe low mowing was a custom: *"I don't know if we really were aware of low mowing benefits, we were just used to do it like that"*.

TK were built on predecessors' practices imitations: *"actually, behind knowledge there are facts accumulated from centuries"*. Traditions' respect was thus essential for knowledge creation. This is to relate with the "peasant wisdom" that was setting rural societies against green revolution at the beginning of the twentieth century (cf. I): *"it is obvious that this elders' wisdom, some people still have it while others have already lost it"*.

#### III.3.1.2. how were traditional knowledge transmitted to young generations?

Knowledge were handed down, within the family, from a generation to the next one, *"from father to son"*. They were part of family's tradition, thus their transmission was a kind of "ritual", *"it is the ritualization of agricultural practices. We do as our father and grand father were doing... we don't know why but we have always done it like that"*. Children were learning how to manage a farm through practice. "Kids were participating to farm activities since they were very small", they were following elders in their daily lives and were imitating them. Some specific duties were even systematically done by children: *"children tend the herd"*, *"we were sent, us the children, to take out rumex flowers before mowing"*. By participating to farm yards, children were learning their future profession. When talking about this learning process, elders interviewed expressed implicitly the fact that academic teaching cannot provide necessary skills for becoming a farmer: *"to truly be sheep breeder, but a good sheep breeder, we had to be born in the midst of sheep"*. As a result, knowledge transmission was not only about academic scientific knowledge but about skills, behavior and values. For example, farm patrimony respect was very important in Pyrenean TK: *"they taught us meadows and farm patrimony respect"*.



Knowledge was also transmitted from one farm to another. Farmers were learning from each others through talking, especially when they met on the roads: *“on roads you meet neighbors going to work on the fields, people were talking a lot [...] Thus we all had very similar farming practices”*. In the past, farmers were working a lot together for special farm activities as killing porcs or lime production: *“the exchange of knowledge was related to farms cooperation which was very common”*. Moreover, *“when family were poor, the eldest son was working in another farm since it was 13”*. However, it depends a lot on valley’s population density, when it was low farmers encounters were less common: *“it is not like in the Valley of Ossau, if you go to Banca there is at least one hour walking between farms. They were only meeting on Sunday, at the mass”*.

### III.3.1.3. Observation: a skill producing traditional knowledge

According to interviews analysis, peasant societies seemed quite stable or with very progressive evolutions, but still, practices were changing from one generation to another. Some practices were abandoned whereas others were adopted by farmers, for example, lime local production and field irrigation were abandoned at the end of the ninetieth century. Practices change and are gradually re adapted to a changing food system; *“agriculture and breeding had been developed like that, often empirically, supported by observations. Analyze and then being able to synthesize what they had seen”*. Innovation skills of farmers depend thus on their sense of observation. Besides, observation is described as the heart of Pyrenean TK. It is in relation with local culture and tradition and crucial for farmer success:

*“A farmer having beautiful crops and livestock has the sense of observation. Sometimes they were secretive, because Basque people are not southerners, they are not talkative, they are shy, etc. They are observing. So a neighbor having regular results was watching the farmers with a better production, he was observed how he was farming”*.

The low population density of this mountain territory formed these characters relying more on their observations than on conversations for learning from their neighbors.

Sense of observation was taught as well as others knowledge: through experience. Shepherd are said to be very observing persons and this skill is linked to the nature of their activity. Indeed, shepherds are always watching out sheep: *“it is a thousand years old tradition, all Pyrenean shepherd have this gift, being good to observe”*. There are two different points of view when describing sense of observation as a gift. Some people think that child’s future professional activity was decided very early according to his personality. An observant child would be a good shepherd. But according to many people, the child future depended on it family rank: the eldest

had to take the farm over and “*the youngest was milking and breeding sheep*” or “*he was trying to get married with a heir of another farm*”. This second theory assesses that child were educating depending on their future professional activity, sense of observation would then be a skill learnt through concrete experience under parents’ advices.

To conclude, nowadays, knowledge is much more based on academic teaching and farm consulting than before. Before the green revolution “*we were much more observant than nowadays. Today we listen a lot, [...] have you heard about the agricultural law of orientation of 1960, when France was not self sufficient for agricultural production? At this time, chamber of agriculture and farm consulting have been set up. They made a lot of noise, well they gave a lot of advices, and now we are paying the price for it*”.

### ***III.3.2. the green revolution: A change in farming practices and a knowledge mutation which is now seen as a loss***

#### **III.3.2.1. productivity-driven farming induced new ways to get knowledge**

##### **Academic teaching and farm consulting**

Empirical knowledge were transmitted from generation to generation since centuries. Farm mechanization and forage revolution had been conducted by farm counselor and agronomist who introduced scientific knowledge within rural communities, “*they led farms’ and practices modernization*”. Most of them had grow in the Pyrenean territory; they were family’s youngest child who could not take over the familial farm and chose to continue studying: “*my eldest brother took over the farm and they encourage me to continue studying*”. As a result, farm counselors and teacher in agricultural schools beneficiate from depth knowledge of local context and farming systems.

Forage revolution gave agricultural schools and farm consulting an influential role on farmers’ choices in meadows and livestock management. Choosing commercial seeds for meadows is a topic especially described on interviews. Many retired farmers automatically refer to school and counselors when asked about meadows floristic composition: “*in school they had taught us ray grass, orchard grass and white clovers were high productive species, thus in 1975 I ploughed everything [permanent meadows and fields] in order to plant grass*”. Teacher and counselors also had to “*change people’s habits*” and to enhance productivity criteria in farming systems. Those scientific knowledge were completely new for farmers who got no chance to step back toward technical and commercial speech: “*I did not understand but I was listening to my*

*counselor. I trusted him*". However, most of farmers were still distrustful and close minded toward innovation, "*innovation was rejected, probably because of "territorialisation"*".

### **The educational methods**

According to Mendras (1967) most of peasants refuse innovations because it would be a rupture with tradition. Thus, farm consulting rely on farmers more open to change: "*I'm not saying I was modern, but I tried to do better than in the past. I was among the firsts that bought a mowing machine*". A new technique is first adopted by one farmer before being transmitted to the whole farmer community through snowball effect. Educational methods also relied a lot on the fact that observation was omnipresent in knowledge acquirements: by implementing locally modern techniques they convinced people of their values. Using productive plants varieties, or artificial fertilizers, was rapid for showing modern practices advantages: "*they were all [farmers] watching this barley which was stunning*", "*they wanted to show nitrogen advantages*" and "*we had to convince farmers that fertilizing meadows was good [...] and to show them fertilizers benefits we spread it on fields along the roads*".

### **The gap of scientific knowledge**

When describing how the green revolution had been led in their mountains, elders step back and give their analysis of the contemporary food system issues. They also address several critics to educational methods.

People with scientific knowledge, as agronomists, teachers and counselors, acted as "ambassadors" of the rural world: "*they were like missionaries of modern agriculture*". They believed farmers were ignoramus: "*they did not know, they did not have knowledge*". The meanings of traditional practices within the local food system specificities were thus not taken into account. Forage revolution favored agricultural supply chain competitiveness rather than farms' ideal and farms' patrimony : "*all the big seeds companies had only one goal, sell seeds. Thus they never recommended permanent meadows*".

#### **III.3.2.3. conflict between farmers' generations and the loss of knowledge**

Farms and techniques' modernization broke up the transmission of knowledge from one generation to the next one.

On the one hand, since traditional farm management was taught through children participation to farms activities the abandon of many practices led to a loss of knowledge based on it.

On the other hand, "teenagers rejected elders' advices because they were going to agricultural school. They wanted to show they knew more than elders". Academic teaching conveying "modern" techniques and scientific knowledge was in opposition with elders' traditions. As a

result it locked up the dialogue between generations. The “young” generation of the years 1960 to 1980 was looking forward technical progress for improving their way of living, arduous in mountain areas. In the previous generation, it was the opposite; people were very protective towards traditions: *“the Basque country is very conservative, the head of the house, even when he was 70, was controlling everything. The son, he had 50, was not allowed to take decisions [...] they had a argument on this topic...”*.

To conclude, conflicts between farmers’ generations due to technical innovation and new educational methods induced a loss of Pyrenean TK. Young farmer looking forward progress and denying elders’ wisdom whereas elders refused to passed down knowledge they assumed to be obsolete.

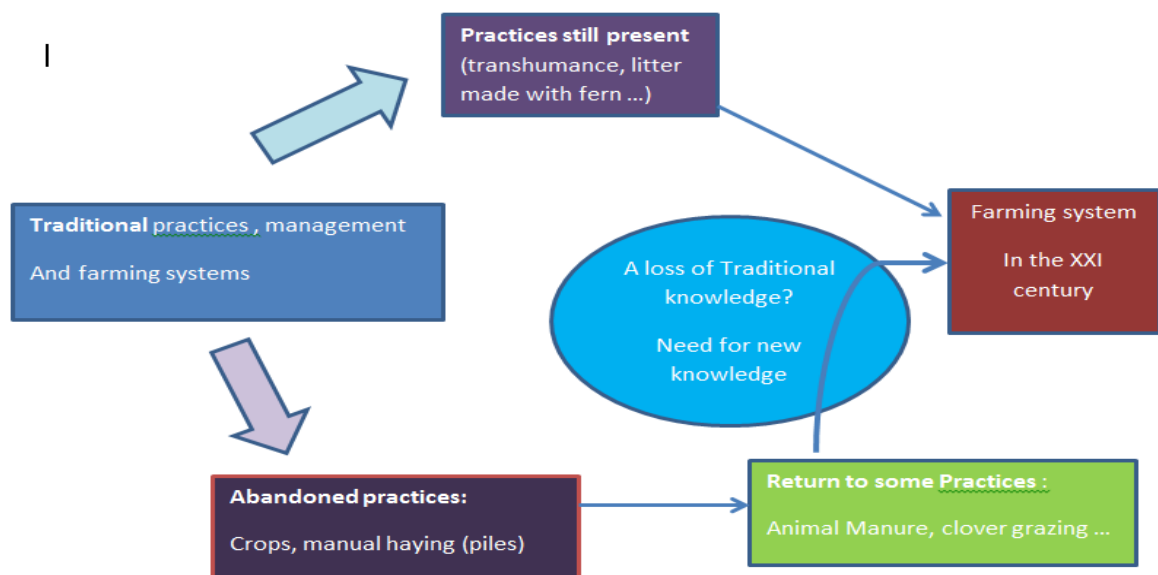
## IV. Discussion

The previous chapter developed the results of this study, based on qualitative data analysis and literature reviews. It actually includes two dimensions:

- a technical dimension as outcome of traditional agricultural practices' description
- a more conceptual dimension: the knowledge dynamics.

### IV.1. Traditional knowledge in Pyrenees and in the rest of the world

#### IV.1.1. Traditional knowledge value within the contemporary food system



**Figure 16: practices and farming systems evolution in Pyrenees (Source: H. Proix)**

Traditional practices and know how have evolved in several ways, some have been forgotten while are still used even if farmers are not always aware of their origins (figure 16). Some practices, as the transhumance, the fern harvest in moor lands and winter grazing, are still utilized in the contemporary food system but have barely evolved; they have been adapted to new way of producing and to new tools. Others practices, like traditional haying, have disappeared because they cannot be adapted to the current economic and social context. However several practices that had been abandoned are now coming back. For example, we can mention the culture of crimson clover for sheep grazing and the use of animal manure that had been neglected since artificial fertilizers were available. Nevertheless they have not learnt how to work with these practices because necessary knowledge had not been transmitted by elders. Adem64 and SPID64 (2011) states that farming system permanently adapt to new socio-economic situations. In the Pyrenees, until the beginning of the twenties, it was subsistence

agriculture. From 1960 to 2000, farming systems aimed to a maximum productivity by using new techniques, plant varieties and with inputs improving both crop and animal production. Currently, with environmental issues, climate change and inputs raising price, farming systems are trying new way of producing, and are diversifying and relocating their production. Farmers are as well rediscovering permanent meadows benefits compared to sown meadows but they are missing knowledge for their management. The purpose of our study was thus to register knowledge that could be useful in the future before we lost it forever.

As a result, we can state that TK are trendier and trendier in agricultural development. But too much emphasis is sometimes put on this “new” topic and people mixed-up traditional with “the best”. Actually, not all traditional practices are relevant for the contemporary agricultural development; tradition is not a guarantee of value. Many traditional practices had been gladly substituted by farmers because they were too physical and time consuming. Most of elders are not wistful at all toward the past. However, some practices that are not anymore economically sustainable in the current agricultural context are still valuable in other fields such as environment preservation. For instance, mowing slopes in mountain areas preserves habitats and landscape and it has to be done manually as farmers had always done before farms mechanization (Chocarro and al., 2010). Our work point out traditional practices and know-how cannot be neither studied nor used outside their context without risking losing their logic. This point is widely admitted in most of indigenous knowledge projects (Boven and Morohashi, 2002).

#### ***IV.1.2. Knowledge evolution and dynamics***

Most of IK projects aim farmers empowering by proving they are knowledge and skill holders. Thus they also aspire to preserve world cultural heritage: knowledge and know-how about to disappear (Boven and Morohashi, 2002). In our case study, active farmers are not holding those knowledge, they were actually requesting their collect within the elders’ population. Hence, this work partly focused on the relationship between tow generations, active farmers and elders, and brought a new understanding of knowledge dynamic. Our findings put some lights on errors made during the green revolution, especially by teaching technical and scientific knowledge in order to increase farms productivity without considering the local context and farmers’ knowledge, aspirations and goals.

The third part of results illustrates well the social representation (SR) theories of Moscovici when studying how knowledge where generated and transmitted. Traditional knowledge, since it

is empirical is socially built on everyday reality, on community shared values, ideas, beliefs, wisdom and practices. When adopting an innovation farmers have to re adapt the complete farming system. Innovations also induced a change in rural community social representations (Gonzalvez, 2008). We assume the inter-generational dialogue in Pyrenean rural communities have been broken because with the green revolution, SR of younger farmers became too different from the traditional one that elders had conserved. This phenomenon took away new generation of farmers' heritage and ability to rely on their own knowledge.

## **IV.2. Local forage production and feed self-sufficiency**

### ***IV.2.1. Re localize feed production***

As we previously noticed, traditional practices taken individually, out of its context are barely valuable. This is why we had to adopt a systematic approach when collecting data. Since the first reunion with SPid64 during data analysis step, the presentation of traditional farming system as feed self-sufficient aroused a real infatuation. This is in fact a one of the main challenge for local agriculture development organizations and they were very interested in finding out how farmers traditionally managed to feed their whole livestock with locally produced feed.

(Re) localise animals feed production is becoming a very common field of reflection in agricultural development. This is due to raising environmental concern on the one hand and to the increasing price of feed. Most of French husbandries rely on soybean purchased from the American continent in Brazil or USA for protein intakes (Chambre d'Agriculture, 2004). Soybean intensive production is first the cause of great deforestation and the degradation of soil fertility in Brazil. Secondly, consumers are more and more concern with gmo soybean used to feed French livestock (Rés'OGM, 2008).

The traditional Knowledge collect in Pyrenees provide many development paths toward this self-sufficiency. The farming systems elements to work on to achieve this goal are: protein production in the farm, meadows management and preservation and livestock management. Naturally, traditional practices cannot be directly transposed to contemporary food system but it gives solution to think about. First, crimson clover was a protein source as well as to avoid hunger gap. Secondly meadows and lands management enable farm to produce enough hay at the farm. And last but not least, livestock's needs were adapted to farm production. This last point refers to farmers' choices and to animal breeding criteria. To achieve their self-sufficiency goals farms should rely more on less productive animal.

### ***IV.2.2. Meadow within the farming system***

The forage revolution in Pyrenees as it has been described encouraged farmers to sow improved pastures in order to increase grass production. Nowadays, meadows ecosystem services are widely recognized. Natural meadows have a very high value for biodiversity preservation (Chocarro and al., 2010). Farm intensification after the sixties did not consider this aspect and leading to a loss in biodiversity intensive practices are endangered by those practices. Since the CAP foreseen encourages meadows and farmlands management recognising it as high public goods value (Beaufoy and al., 2011).

As a result, there is now a trend to accord more interest to natural meadows. This is also due to several issues on improved pasture. First of all, selected grass varieties, as we described it in results, are more sensitive to both caterpillar and climate disorders than local varieties. Moreover, sowing a pasture is getting more and more expensive with the increasing price of gas and fertilizer. Then, farmers are looking for more economically sustainable way to produce grass. And finally, organic farmers are very limited for organic grass seeds purchase. Two main points can be drawn on results about traditional meadows management. First, farmers were able to sow a meadow, but a great emphasis was put on the tradition to keep the meadow permanent and to respect it as part of the farm patrimony. Secondly, the floristic composition of meadows was a necessary condition for its resilience. Far to be struggling with unproductive plants, farmers were appreciating it and considering they made the meadow resilient and brings a balance diet to animals. The late mowing, a practice commonly disparaged during agricultural practices intensification was actually a guarantee for this diversity since it enables plants to be naturally re sown. This practice is now the more widespread way to restore meadows and grasslands (Huhta, 2001).

### **IV.3. Limits of the study**

As it was said previously, among studies on Indigenous or Traditional knowledge this work was very special because focusing on practices not used anymore. Therefore we found only few examples for establishing the methodology to collect and analyze data. The work we conducted is thus exploratory and we could not go into details as much as we could.

First of all, the territory was big and the high diversity and variation we got in data complicated their analyses. Secondly, we were very limited for establishing the population sample because the population targeted was between 60 to 90 years old. Interviewee had to be able to talk in



French and in an understandable way. Interviewing educated people, with similar framework as mine and who already had been thinking on the topic of TK was the best way to avoid too much misunderstood during interviews.

Farmers are not used to talk about their practices. Who do daily make sense for them but they are often not able to clarify the choice they are making since they are not aware that they are doing, they call that the commonsense (Peaucelle, 1976). This is even stronger with elders. As a result, this kind of study fit better to ethnographic work. Spending few days with interviewee would have allowed a better understanding of the context and to rely more on observation and not only on speech.

## V. Conclusion

The raising emphasis on permanent meadows ecosystem services and beneficial within the farming system, supports new research programs on meadows development and participatory breeding grass varieties projects. In this context, several young farmers farming in mountain area in Pyrenees asked for a collect of traditional knowledge of elders who were in the past managing permanent meadows with a high floristic diversity.

Through elders' interviews and literature review a very rich material has been collected about meadows management and traditional farming systems. Its analysis, more than practices taken individually, describes how were meadows and farming systems managed in order to be self sufficient for animal feeding on the one hand and to maintain a high diversity in perennial meadows' floristic composition. Moorlands and mountain pastures grazing from May to the end of summer allowed hay production on meadows. Late mowing was a practice very common before farm mechanization. It enables farmers to produce enough hay for their livestock winter feeding. It was also very important for meadows floristic composition because allowing grass species to be re sown every year. To complement rough hay produced on this first cut, high nutrient value second cut and a feed intercrop turnip-crimson clover were also given to animal in production. To finish, hay dust gathered in hay barn at the end of the winter was used to restore damaged plot in meadows. It was very diverse and also used sometimes to sow a meadow on small areas. The use of this farmed-saved seed disappeared since the mechanization of farms, since seeds were falling down before to be stored in the barn because of machine shaking out. The green revolution based on scientific and technical innovation have neglected this traditional knowledge and broken down their transmission within farmers' family. By stepping back we are now realising that it is essential for farmers' empowerment.

To finish, knowledge collect lead to such a great diversity of traditional practices that many topic could be analyzed since we decided to focus on meadows management. For example, the intercrop crimson-turnip integrated within a biennale crop rotation might have several beneficial on soil fertility and soil structure. Moreover, shepherds had a large knowledge on plants and animal health; for example they knew how to avoid bloat or other intoxication. Those subjects might be quite relevant for the agronomic research community.

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**Appendices**

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## Appendix I: Glossaire

**Bloat** : A swelling of the rumen or intestinal tract of cattle and domestic animals that is caused by excessive gas formation following fermentation of ingested watery legumes or green forage.

(Source: <http://www.thefreedictionary.com/bloat>)

**Bordes**: Barns located in the piedmont areas

**Feed crop**: culture of vegetable or leguminous utilized for animal feeding

**Hay tedding**: tool attached to the tractor in order to shake out hay when tedding. Often call with a familiar name “pirouette” in interviews.

**Lime kiln**: oven utilized for lime production

**Liver fluke**: flat worm visible in ruminants’ digestive system

**Regain** (French): name given to second or third cut of hay.

**Ribwort plantain**: (binomial name: *Plantago lanceolata*) “A short rosette-forming herb with leathery ribbed leaves sprouting from the base of the plant”.

<http://wildseed.co.uk/species/view/102>

**Slag**: blast furnaces’ residue from the iron or desphosphorisation used as fertilizer in agriculture activity

**Tedding**: it is the action leading from fresh grass to hay.

**Touya**: vernacular name for plants growing in moor lands in Atlantic Pyrenees

## **Appendix II: Survey Guide**

### **Farm's context description**

*Use of an IGN map 1/25000 during farm description*

- Farming system description (UAA, crop rotation, productions, labor...)
- Meadows classification (plaine, mountains, *bordes*) when did they buy or sow it?
- Were the meadows mechanized? Have they sown them once or more times? With which varieties?

### **Livestock management**

*Use of an IGN map 1/25000 for livestock grazing management description*

*Establishment of a calendar of livestock management during the interview*

- Animal species bred on the farm (cows, sheep, goats, pigs...)? How many animals?
- Farrowing periods? Why (link with natural environment and seasons, for example with grass growth)?
- At which periods of the year were they grazing on farm meadows? Mountain pasture?
- Winter grazing?
- How was decided if animals could go in the meadow (humidity, grass volume and density...). *This question aim to determine how farmers avoided meadows' damage*
- Grazing schedule: at what time animal were they grazing? (link with humidity and temperature)
- Other source of feed (corn, tree leaves, turnip...)? Depending on animal species, age (clover for milking animals)?
- Grazing pressure on grassland?
- Animal diseases? Plant intoxications? How were it avoided? Bloat?
- Were animals' species managing differently (cows vs. sheep)?
- Litters?

### **Meadows management**

#### ***Fertilization***

- Did they spread manure or fertilizers?
- Animal manure composition (litter)?
- Liming: where was the lime from? Lime kiln?



- Quantities spread?
- Spreading techniques (manual, tools...)
- When (which season) were meadows and field fertilized?
- Some field or meadows were they more fertilized than others? Why, according to what criteria?
- Use of *bargueros* (paddock) for fertilizing directly with animals grazing?
- Fertilizers purchase: what, when did it start (history)? What did it change in the fertilization management

### ***Irrigation***

- Meadows or fields were they watered?
- At what period of the year?
- How did they choose which field to irrigate?

### ***Meadows floristic composition***

- Grass species naturally growing in meadows (without having been sown)
- Grass species sown/ commercial seed (ray grass, orchard grass, fescue, clover, alfalfa...)
- Undesirable species: weeds, toxic plants, shrubs...?
- Is the floristic composition evolving with practices changes? Climate change?
- How was voluntarily influenced the floristic composition (late mowing, weeding, overseeding...)? What were the influential factors?
- Presence of pests in meadows (caterpillar)? Evolution?

### ***Saved-farm seeds***

- Hay dust: quality, uses (where, when, how, overseeding?), storage?
- Did they trade seeds with neighbors?
- How was the hay dust “harvested”?
- Seeds selection?
- Turnips seeds production? What modalities?
- Seeds purchases: Varieties and provenance? Who was advising farmers on seeds choice (sellers, counsellors)?

### ***Weeding***

- What was a weed according to farmers?
- Weed management?

- Manual weeding: who, how much time, what species?
- Mechanical and chemical weeding?

### ***Hedges and low stone walls***

- Purposes and consequences since they disappeared?
- Shape and location?
- Hedge tree/bush species?
- Uses (firewood, forage)?
- Shape and size of meadows?

### ***What is a good hay***

- Ask for a complete description of haying
- Period of the year? According to what factors (weather, plants stage, floristic composition)?
- How was the weather forecasted (winds, sayings)?
- How many times per year meadows were cut (1, 2, 3)? Depending on meadows?
- Haying: at what time, tedding...?
- Tools used?
- Hay storage: describe the haybarn, how long?
- What was a good hay according to farmers: composition, plant species, haying process, nutrient quality, odor, taste...?
- How to make good hay
- Piles: size, where and when, how much time were they keeping it?
- How did haying change with farm mechanization? Consequences?

### **Knowledge creation and transmission**

- Opinion about agriculture development?
- Were farmers talking together about their practices and techniques (knowledge)? Where?
- How were provided technical advices (milk recording agencies, counselors)?

### **Meadows transect (when possible)**

- ask for a description of species observable. Are they “good”, undesirable? Why?
- How was this meadow managed this year?
- Is it a “good” meadow? Why? Meaning of “good”?

- Did this meadow change since the farmer was younger (quality, floristic composition, use...)?

### **Ending questions**

- Are they people still having or working with these knowledge?
- How do you children work now?
- Opinion on contemporary practices?
- Climate change consequences on the farming system?
- Interest for meadows plant breeding within a local project (pro ABiodiv)?

### Appendix III: List of interviewee

Interviewee	Occupation	Age	Activity	Production	Valley
1	farmer	60-80	retired	Cows	Baretous
2	farmer	40-60	working	mixed Non	Baretous Basse
3	counselor	60-80	retired	applicable	Navarre
4	farmer	80 and more	retired	sheep Non	Basse Navarre
5	counselor	60-80	retired	applicable	Navarre
6	teacher	60-80	retired	mixed	Basse Navarre
7	teacher and farmer	60-80	retired	mixed	Basse Navarre
8	farmer	60-80	retired	sheep Non	Navarre Basse
9	counselor	80 and more	retired	applicable Non	Navarre Basse
10	counselor	80 and more	retired	applicable Non	Navarre
11	teacher	40-60	working	applicable	Labourd
12	farmer	60-80	retired	mixed	Labourd
13	counselor	80 and more	retired	sheep Non	Labourd Non
14	Ethnologist	60-80	retired	applicable Non	applicable Non
15	Biologist	60-80	retired	applicable Non	applicable
16	counselor	60-80	retired	applicable	Ossau
17	farmer	40-60	working	Cows	Ossau
18	farmer	80 and more	retired	Cows Non	Ossau
19	counsellor	60-80	retired	applicable	Soule
20	farmer	60-80	retired	mixed	Soule
21	farmer	80 and more	retired	sheep Non	Soule
22	teacher	60-80	retired	applicable Non	Soule
23	teacher	60-80	retired	applicable	Soule
24	farmer	60-80	retired	mixed	Soule
25	farmer	40-60	working	mixed	Soule