The use of grazing pastures in goat production: An approach to combine the optimized use of forage resource and the control of related risks

Martine Napoleone, Herve Hoste, Y. Lefrileux

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The use of grazing pastures in goat production: development of an approach to combine optimized use of the forage resource and the control of related risks

Napoléone M.1, Hoste H.2, Lefrileux Y3

Summary
This article aims at describing an approach to accompany changes in herd management to increase the proportion of grazed forage in the diet of dairy goats. This research has been developed through collaboration between researchers, extensionists and farmers. The use of grazed forage introduces many sources of uncertainty for the farmers (fluctuating resource, risks of drought or parasite infestations). Therefore, it is difficult to propose a robust technical model that is reliable in a variety of circumstances. This article proposes an approach aimed at making a progressive adaptation of herd management feasible. It is based on a formalisation of farmer practices according to time and space scales and makes it possible to analyse combinations of the various grazed resources in relation to indoor feeding, production management and the epidemiology of gastrointestinal nematodes, used as a model of parasite infections. These representations help in diagnosing the system, identifying the possibilities of adaptation and in discussing corrective actions. In supporting and guiding these innovative processes, researchers and extensionists have to modify the angle from which they observe the situation. This tool was initially developed from data acquired in Mediterranean conditions. However, it might be of interest for other production systems and/or in other regions, in particular for farmers currently involved in intensive systems, who have lost the know-how for managing a grazing herd, but who are concerned by a return to less intensive systems of management in order to fulfill the criteria of sustainable development.

Introduction
In goat farming, the development of grazing is a major issue, whether from the viewpoint of returning to less intensive practices, reducing farming costs, organising work, or making best use of links with the “terroir”. However, the use of grazing is accompanied by risks related for example to the evolution of the grazed resource or increased exposure to risks of parasites.

Developing grassland obliges livestock farmers to manage their herd in situations of uncertainty, requiring them to move from a logic where the objective is to control the principal parameters of herd management (for example, calculating the ration to adjust feed inputs to the needs of the animals or managing health hazards such as parasite infestation), to a posture where they come to terms with risks by seeking balances. In the great French dairy goat areas, grazing had become anecdotal until recently, but in the 1970s it was one of the driving forces for neo-rural people setting up pastoral goat-farming systems in areas of woods and rough grazing in the Mediterranean regions. Thus, in the Mediterranean region, goat farmers, using grazing land, established alternative management methods to the technical models that dominated in goat farming. To compensate for the relative lack of control over each resource, the farmers combine a diversity of spontaneous and cultivated resources, whether at the daily level, or at the level of the whole grazing period.

In this context, for about fifteen years now, work has been carried out in close cooperation between researchers, agricultural advisers and farmers, with the aim of developing approaches that will strengthen abilities to control the management of herds using diversified grazing land. This work relies on the study of farmer practices, and is based on the identification of keys for interpreting and analysing the situation.

Taking this work as our basis and using a concrete example, we present in this article an approach for planning the use of grazing land, estimating the risks associated with the management of milk production and risks of parasite infection. This approach is based on the co-construction of graphs of the herd management to facilitate the situation analysis, and help in the diagnosis and search for corrective scenarios.

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1 INRA SAD Ecodeveloppement – Domaine St Paul – Agroparc – 84914 Avignon cedex 9
2 INRA UMR 1125 INRA ENVT, IHAP – 23 chemin des capelles – 31076 Toulouse cedex France
3 PEP Rhône Alpes – Le Pradel – 07170 Mirabel - France
In the first part, we will present the general principle of the approach. The second part stresses the creation of technical diagnoses to optimize the use of resources, on the basis of two angles of analysis: the management of dairy production and the consideration of health hazards, taking as a model infestation by digestive tract strongyles. The discussion will centre on the role of the intermediate object and the indicators, to help elaborating a shared diagnosis process.

1. Methodological elements

Characterising the technical management of a grazing herd

In the South of France, a great deal of research or development has centred on understanding how pastoral farms function so as to be able to work out situation diagnoses. They study the way in which the process for developing productions is organised over time. To understand the organisation set up by the farmers, and to make this analysis easier, various authors have recommended the adoption of calendars to represent practices (Landais and Balent, 1993). Thus, Bellon et al. (1999) work out grazing calendars to study the use of the various fields of the farm. These representations, carried out at the scale of the farming production year, make it possible to characterise the farmer’s management entities and the way in which he combines and prioritises his practices. These authors then interpret the coherence underlying this organisation. So these representations make it possible to connect a practice carried out at a given moment (such and such a field used in rotation) to the overall organisation over the farming year (such and such a field having such and such a role in the grazing calendar). Various works have concerned the grazing strategy (Bellon et al., op.cit.), the feed strategy (Hubert et al., 1993), or the production strategy (Napoléone, 1999).

The livestock diagnosis: a question of viewpoint and angle of analysis

Characterising the way herd management is carried out over time makes it possible to identify the strengths or points considered to be problematic, then to consider ways of improving the situation. However, the same situation can give rise to various diagnoses and lead to quite different courses of action according to whether it is evaluated from a technical or a practical point of view (Darré, 1999).

The technical diagnoses...and their different angles of observation.

The diagnosis can be made from a technical point of view, from references and indicators measuring a difference between a standard or a model and what is actually carried out, or estimating a risk, taking into account what is known about the subject. Observing a situation, the technician notes a certain number of parameters to form his way of thinking and make his evaluation. These parameters are of course specific to the question asked. A grazing calendar can be analysed to optimise plant production for example. In this case, the interest will be in the number of days spent grazing on the fields used, so as to estimate their production, which can be compared with regional references. The same calendar can be analysed from the point of view of managing the milk production of the herd grazing. In this case, the accent will be on how the unfolding of the calendar is linked to the development of production. On the other hand, if the question is the control of parasite infestation, they will seek to estimate the risks associated with the use of the grazing land. A technical diagnosis can be formulated at several levels. It is directly related to how the question is put at the outset, which itself conditions the technical indicators chosen for the analysis.

The diagnosis of the one carrying out the practices... expresses implicit and varied factors

The farmer’s diagnosis is made from the point of view of the person carrying out the practices. He evaluates the situation, taking into account his production target, his constraints, the way he organises his work, his way of perceiving risks... In other words, it is a set of factors, implicit or explicit which contribute to his assessment of the situation.

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4 technician: Someone having a technical understanding as an extensionist or a scientist.
2. Making a shared diagnosis to planify the use of grazing land by managing associated risks

A situation diagnosis shared between a technician and a farmer is difficult to make since it involves constructing a judgement from 2 points of view on the same situation (Darré and al, 2004). To get round this difficulty, the grassroots approach we present is based on 4 steps made together with the farmer:

- represent the practices on graphs: Co-build with the farmer a chart which will be used as a basis for dialogue between the technician and the farmer.
- analyse this representation to understand - and formalize - the organisation method and the underlying logic
- establish a diagnosis, identify the key points and the problems, estimate risks… from the two points of view
- imagine ways to act, to test a new organisational method to reduce these risks (e.g.: reorganisation of grazing, compatible with the operation of the farm)…

This diagnosis approach, carried out in year N, is based on a comprehensive interview lasting approximately 2 hours. Initially the farmer describes and tells how his practices unfold. A calendar represents this process visually. In the second part of the interview, this calendar helps in the analysis of the situation and in devising a combined diagnosis. In year N + 1, the same approach can be repeated to make a new assessment, to learn from the corrections made, or adjust the system again according to the objectives.

We will present the approach of aid to diagnosis on the use of grazing land, based on a concrete example, (boxed text 1), and on participatory research concerning the technical management of a grazing herd (I.E., 2007) and associated risks (PEP, 2007). We will first of all develop the step characterising the use of grazing and the herd management method. We will then tackle the question of the diagnosis, developing 2 successive points of view: i) analysis of the production calendar from the viewpoint of herd production management; ii) analysis of the calendar from the viewpoint of gastro-intestinal infestation by strongles (SGI). We will show the interest of managing the two assessments together to identify prospects for organisation taking these two aspects into account.

Boxed text 1: « Mr M », a goat farmer making cheese, in organic production, in the Drôme Provençale.
Herd: 70 Alpine goats. Production: 720 l/year/goat and 50,000 l/year for the herd.
Territory: 18 ha of fields that can be cut, 35 ha of woods and heath.
Processing at the farm and direct sale of Picodon AOC.

2. 1. Understanding herd management and the use of grazing land

a) Representing the grazing calendar and the herd management

The first thing to be understood is the way in which the farmer structures and divides up his territory. Thus in the example in figure 1, the farmer creates units of use, which he gives precise names to. These using units are defined through the use by farmer. They are not nescesserally adjusted with agronomic properties or with cadastral plots. Their periods of use can be indicated on a grazing calendar.

Figure 1: From the description of the territory to the grazing calendar
From the calendar base, the grazing can be placed in relation to management practices (reproduction, feed, pathology, grazing...), or to the evolution of herd production. A factual representation is thus obtained of how the herd management unfolds (Figure 2).

Figure 2: a factual représentation of herd management

b) Characterising the organisation of grazing in relation to herd management

The calendar representation makes it possible to analyse the combinations and successions of practices then formalise the organisation of herd management. So, to take our example again (figure 3), boxed text 2 formalises the progress of herd management and grassland management set up by «Mr M ».

Boxed text 2

Elements of the organisation of herd management. Year N

The herd is managed in a single batch, with births grouped in season. The herd grazes from early April to December. The grazing land constitutes the whole of the basic diet from mid April to the end of September. « Mr M » complements the diet by 700 g of grain (1/3 barley, 2/3 concentrate) during the lactation period. He keeps a field of sainfoin for the spring grazing. The other fields of pulses, mown in the first cut, will only be grazed in the summer and autumn.

Organisation of grazing: in every season « Mr M » associates pulses, natural grasslands and rough grazing.

Put out to grass on natural grassland in early April. This transition period lasts for 10 days until the end of hay.

In spring (mid April mid May): Continuous grazing on 4 fields of grassland and heath, complemented by the use of the field of sainfoin.

Late spring (mid to end May): the sainfoin is finished. The herd grazes on the grassland used since they were put out to grass and on new heath.

Transition from spring to summer. The oats vetch established to « weld together » the spring grazing and the summer grazing complements grazing on heathland and natural grassland.

Summer-autumn: One meal on pulses (used in rotation) and one meal on grassland and heath.

2.2. Making a diagnosis on the use of grazing

a) From the viewpoint of herd production

In the grazing situation, herd production can show more or less large variations. An abrupt change in quality or quantity of the grazing land results in a marked evolution of production. The analysis of the temporal agreements between management sequences and production management thus makes it possible to make a diagnosis of the links between practices and production and plan courses of action.
with the farmer. In the example used, (figure 2) the diagnosis carried out in year N highlighted that difficulties in maintaining production in spring are directly related to the management of grazing land (exhaustion of the resource on sainfoin used since putting out to grass, continuous grazing on a large area, no more grazing on a fodder surface at the end of May). Three courses of action are studied: re-examine the balance between cutting/grazing and assign an additional field for spring grazing, subdivide and organise rotations in the fields of natural grasslands and heathlands, establish vetch oats specifically for the transitional period at the end of spring.

The new organisation set up in year N+1 settled the problem of production management in full spring. However, the analysis of its progress highlights a new question: the risk incurred if the only resources to be grazed in summer are fields of sainfoin established in the year (see boxed text 3).

**Boxed text 3:**

**Diagnosis carried out over year N**

On the calendar, (figure 3), it can be seen that in the middle of spring, herd production drops by 25 % in 1 month and a half. We assume with the farmer that this marked fall is related to the progressive lack of sainfoin and the continuous grazing on too large an area. At the end of spring, the effect on production of the use over four days of green oats could be seen immediately. In summer the production is stabilized from the moment when the second pulse growth (alfalfa) can be grazed.

**Key points to plan the calendar of year N+1**

1. Organise rotations on the spring fields
2. Do not under-dimension the leguminous plant fields reserved for spring grazing. Reconsider the assignment of cutting vs. grazing
3. Plan “special crops” for the transitional period from end of spring (approximately 1 month)

**Diagnosis carried out over the year N+1**

The new grazing calendar set up in spring had the anticipated result. The farmer succeeded in managing regular feed at grazing, as the production kinetics show. It should be noted however that in summer: i) the fall in August production starts at the time when young leguminous plants are used; ii) stabilization takes place as soon as they are moved to 3 year old alfalfas.

**Key points to plan the calendar of year N+2:**

Is it necessary to rest the grazing of 1 meal on a good area, on young leguminous plants in summer? In this case, would it be necessary to supplement this meal by another area (grassland, alfalfa in year 2, sorghum…)?

**b) Optimising grazing with respect to parasite infection**

The use of grazing land exposes the animals to the risk of parasites, the most common being digestive strongyles. In conventional livestock farming, the control of this parasite infection is based on the regular use of chemical worming treatments. However resistance to these molecules is under constant development in worm populations (Jackson and Coop, 2000). In organic farming, there are strict quotas on the use of these synthetic molecules. The management of parasites must therefore reconcile 2 contradictory aspects: greater exposure of the animals to risks of parasites and a reduction of intervention possibilities. Whether in conventional farming or organic farming, it is important to develop innovative diagnostic monitoring tools at animal level or management systems to avoid massive recourse to chemical substances. We sought to develop a tool for the diagnosis of parasitic risk factors, usable by farmers and technicians, and based on the analysis of herd management practices in relation to the kinetics of herd milk production.

The infestation of pasture by nematodes is related to their use by the animals

The infestation of a field depends on the quantity of larvae present on these grasslands. It is indeed related to the number of eggs deposited by the animals which graze there. The nematode cycle lasts for about 3 weeks but the larvae can still infest the land for several months. The infestation of a field will thus depend on the stocking density (number of animals/ha), the length of use by the animals, the state of the animals which graze there. The more the animals use a field, the more they contaminate it. In the same way when an animal has just used a contaminated field and it moves onto another field, it will carry the contamination with it. However, certain agronomic techniques (ploughing, mowing), or
significant and durable weather phenomena (frost or long drought) can contribute to reducing the rate of infesting larvae. Consequently, it is particularly important to identify periods in a grazing calendar where the fields are rested, while keeping in mind aspects related to availability of resources and their valuation to maintain productive expectations. On the other hand, in temperate conditions, management of grassland with short rotations over a collection of small fields has the same consequences in terms of infestation as simultaneous and uninterrupted use of all these fields. In this case these fields will be regarded as only one block of use in considering the risk of parasites.

*Estimating risks from practices*

Armed with this knowledge, a group of agricultural advisers and researchers designed a diagnostic approach to the risk of parasites inspired by HACCP approaches and the previous approach (PEP, 2007; Hoste et al, 2005). From the analysis of farmer practices and the grazing calendar, we estimate the state of infestation of fields and also that of the animals, to anticipate the risk of parasites. So, to return to the example of Mr. M’s farm, the grazing calendar of year N+1, considered satisfactory as regards herd production management, can pose some problems in terms of parasite infestation. With regard to parasites, we think it is useful to raise the question of:

- The regular use of the « Morgan » field, from putting the animals out to grass to winter. The periods when this field is not used are too short to have a positive impact on the rate of larvae present.
- A return in early summer to the « Bute » field of sainfoin used on the spring.

Taking the knowledge stated above into account, we make the hypothesis that the management method of these two fields can lead to a risk of infestation in summer. To limit this risk, two methods can be planned: 1) subdividing the fields of natural grassland called « Morgan » and managing them as fodder areas, with rotations rather than continuous use and 2) leaving a longer interval between the two uses of the « Bute » SF.

2.3 Simulating a new organisation taking into account the production issue and risks of parasites

By taking these two angles of analysis as his base (production and health risk), the farmer can refine his organisational principles to design the grazing calendar and new organisational rules. Thus, on the example used:

* associating pulses (1 meal after midday) and heath land (1 meal in the morning), throughout the grazing season;
* not under-dimensioning the fields of pulses reserved for the spring
* managing the fields in rotation, and leaving sufficient time before returning to the same field
* specifically establishing resources for the transition in late spring
* watching carefully the use of young fields sensitive to drought in summer

He can also set up elements to monitor the progress of the farming year, by identifying the critical moments, the objects that have to be watched and corrective measurements that can be applied. For example:

* watch carefully the spring-summer transitional period: If I see that production shows a persistent fall and the resource becomes insufficient on the fields in spring, then I can mobilize such and such a « buffer » resource while waiting for second cut regrowths (e.g. valley floor reserved for this purpose).
* watch the state of the animals if the spring is very rainy and if it is necessary to return to the spring fields: if I see that the animals have soft droppings, or their coat is dull then I can suppose that there is parasite infestation and take the necessary measures
* watch the use of young fields of sainfoin in summer, (because sensitive to drought)....
3. Discussion

Representing the action to help in the interpretation and construction of a shared diagnosis

The diagnostic approach that we have just presented is an iterative approach, from action towards analysis. The chart of the progress of herd management and the use of the grazing land plays the role of an intermediate object (Vinck, 1999), facilitating dialogue between the technician and the farmer but also helping the farmer himself to stand back and judge the situation.

The chart makes it possible to link the short term and the long term and therefore connect a collection of elements which might appear anecdotal when they are taken individually. It helps in clarifying tactical decisions, and in the analysis of these decisions in the organisation of herd management. So it involves a true process of abstraction, from the calendar graph, which makes it possible to pass from a factual representation to the formalisation of an organisational method and dialogue with the farmer on the underlying logic.

As we recalled at the beginning of the text, there can be several interpretations of how the management progresses, leading to different diagnoses. The representation makes it possible for everyone to clarify the elements he uses to construct his interpretation. Thus dialogue can begin between the farmer and the technician on these respective keys to understanding. Eventually the diagnosis resulting from this exchange of views on ways of seeing will be neither completely that of the technician, nor completely that of the farmer. The way of formulating - in writing - this combined interpretation, and the question(s) to treat which result from it, is a crucial point which conditions the courses of action considered.

In the search-for-solutions phase, the chart makes it easier to imagine new organisation scenarios. Scenario is taken here in the meaning of a unit formed by the description of a future situation and by the advance of events - which must be coherent - making it possible to pass from the situation of origin to a future situation (Godet, 1991). Several scenarios can be imagined, represented, discussed, to choose eventually only one estimated to be both desirable for various reasons (technical, economic, work…) and achievable in the eyes of the farmer (taking into account for example compatibility with the operation of the farm, or the interaction with other activities).

Over the long term: a learning process

Over the long term, this approach can be renewed here and there. From these successive analyses, placing the action in relation with the interpretation (figure 3), the farmer and the technician construct new knowledge which they use to design new organisations, aimed at improving the points considered to be problematic. They also create means of monitoring and analysing the situation, based on observation of the herd and the resources, in order to readjust management if necessary. In this way a succession of tests – errors is obtained leading to a process of organisational learning.

These reference marks and knowledge are hybrid know-how, resulting both from observations and analyses of how the action proceeds and from technical models (e.g.: the physiology of lactation, vegetative cycles, or parasitic cycles). This hybrid knowledge is then formulated in the form of rules which can be placed in relation with the action.... If I see that... (and that...)... then… The formalisation of this know-how, and its organisation, for its subsequent mobilisation remains an open question, whether it concerns an aim of farm management (for the practitioner) or an aim of support and guidance (for the adviser).

This aid to diagnosis approach will not inevitably have the same direction; it depends on the life cycle of the farm concerned. For a farmer who is setting up his business or a farmer who wishes to make important changes to his herd management, this approach is a way of acquiring knowledge and know-how that is internal to the farm. It can for example be useful for goat farmers engaged in a process of moving to less intensive management practices. For an experienced farmer who has tested the robustness of his herd management for a long time, the exercise of explaining his organisation and taking time to analyse it with someone from outside the farm, allows him to call into question possible organisational routines, which might imperceptibly lead to delicate situations. But this approach can also be the means of anticipating and monitoring a period that this experienced farmer is able to manage delicately.
New postures for the adviser and the researcher....

In this posture, the adviser has the role of guide to reflexion, and to helping in the expression of the project. His is not the role of the expert, from whom specific information to answer a particular problem would be expected. This approach can only be carried out if the farmer and the technician are indeed in an exploration logic. The posture of guidance modifies the classic format of "agricultural advisory service" and the linear dissemination of research knowledge, towards technical institutes and farmers. These approaches helping the expression of a project specified have shown their effectiveness in contexts of research and development. Their extension remains conditioned by the organisation of advice structures, and missions intended for advisers. Finally, the context of the Mediterranean zones, in which farmers manage balances between a diversity of resources, made a necessity to the search for alternative approaches to reinforce the capacities of control of herd management at grazing. We put forward the hypothesis however that it is a challenge for farmers in intensive systems, who have often lost the know-how to manage grazing land and who, taking sustainable agriculture into consideration, are confronted by the necessity of moving to less intensive practices.

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New ds for innovation in the Mediterranean animal production

Figure 3: A example: calendar of herd management