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Future Prospects on the Goat Activities for the Coming Decades in the Context of a World in Transition

Jean-Paul Dubeuf

Abstract

This article explores the evolution of the goat sector in the world between 2000 and 2020 and its prospects. We base it mainly on the statistics available as well as on the author's observations and his involvement in various projects. It also updates a study carried out on the same subject on the last decades of the 20th century. We observed a constant development and growth of the goat sector during this period. The trend has been the same between 2000 and 2020 but less strong and more localized in Asia and Africa. Several scenarios on our global future lead to consider the absolute need to preserve environment and biodiversity but above all to reduce the emission of GHGs for all productive sectors on the planet. In this case, we will face a dramatic progress and a development paradigm shift. Although goat systems emit less GHGs than other ruminants, we can also observe an overall increase in net emissions by the goat sector between 2000 and 2020. So, they contribute significantly and their net emission has to be reduced, which will disadvantage the most intensive systems. However, while animal production and the consumption of its products are increasingly ostracized, goat farming (as pastoral farming in general) could have a bright future in this context. Goats, particularly those of local populations and breeds, have more than any other ruminant significant capacities to valorize spontaneous absorbing GHGs forage resources (grass, shrubs, crop or feed residues) and without other uses. In addition, goats are easy to integrate in small farms and strengthen the complementarity between agriculture and animal production, largely abandoned in favor of specialization. The strengthening of localized and interdisciplinary scientific research will also be necessary to strengthen the role of goat farming and innovation and the author proposes the establishment of "living labs" associating all the actors involved for this purpose.

Keywords: prospective, innovation- research, ecological transition, goat sectors

1. Introduction

For centuries, humans have used goats for many purposes under various conditions but until recently, goats were less supported publicly and academically than other animal production sectors. Since the 80's, we have observed a renewed interest for goats and goat's breeding and the creation of several institutions and

associations dedicated to the development of goat production for milk, meat and fibers. In addition, the creation of the International Goat Association in 1982 has contributed significantly to develop an international network of professionals and scientist to favor innovation and research on goats and organize frequent events to discuss and debate on the more recent knowledge and trends about goats.

At the beginning of the 21st Century, several studies have described the situation of the goat sectors (and small ruminants in general) all over the world as well as their contribution for the development of rural zones and what could be the future of these activities [1, 2, 3, 4]. The objective of this article is to up-date these initial perspectives to consider the on-going changes and their consequences for the goat sector and its future.

Since this period, the world has faced radical challenges that have changed in the visions of Science and our Society regarding livestock production. We studied the main trends of global and climate changing and their consequences on the livestock sector including the goat sector. After having reminded the suggestions and recommendations stated at the beginning of the 2000's, we updated data on goat stocks and productions and main observed tendencies.

The implications of global change and ongoing transitions on the evolution of goat production but also on goat science and the type of scientific knowledge requested are explored. In a last part, several possible scenarios are proposed and discussed.

2. Methodology: a prospective approach based on existing statistics and personal experiences

To update the horizon of goats, we first provided a retrospective view of the changes in the goat activities between 2000 and 2020. We compared the present statistics with the trends observed at the beginning of the 2000s. From an analysis of some inflections in these trends, we have developed a prospective analysis of the present changes at work. The prevalence of documented climate issues has been considered as one of the main levers for designing scenarios for the evolution of the goat sector for the next 30 years. The main hypothesis explored here is that the world has to manage a major structural mutation, which will change in depths our way to organize our activities.

Foresight approaches and prospective are necessary to imagine these possible futures whether at local and global levels. Prospective are methods to try to face what could happen and how to be up to the identified challenges. They are neither forecast nor anticipation but a reflection on the future and its possible orientations for stakeholders [5]. Foresight produces scenarios on the strategies they could implement and challenges they could face. To develop a prospective approach, strictly speaking, it is necessary to organize a device with a prospective group of experts and several actors mobilizing documentation and proposing a diagnosis on the present and some scenarios for the future. Consequently, it would imply giving up top-down approaches, still too often the most common ones. Prospective procedures take into account the diversity of local expectations and visions and combine them to formulate realistic scenarios. Until now, the goat sector implemented poorly such foresight visions. For instance, nevertheless, a group of regional partners has organized recently a workshop on pastoral goats and pastoralism in Corsica, a mountainous Mediterranean French Island. The group has built innovative strategic orientations on pastoral breeding and goat farming in this Island for the coming decades [6]. From these scenarios, the stakeholders could discuss what

priority actions they should implement. The next step will be to build operational action plans.

In this article, such a device could not be organized at a world extent for obvious reasons of lack of funding and logistics. Nevertheless, to bypass this difficulty, we applied some principles of foresight methods by crossing recent data with our observations on the expectations of goat in several situations and the results of an already published global prospective for agriculture [7]. We are aware that we will need to formalize the proposed scenarios and to validate them locally in the several types of goat systems and situations in the several continents.

3. Results

3.1 The situation of the goat sector as it was presented at the beginning of the 2000s, its prospects and priorities

After a fall of goat stocks at the end of the 19th and the first part of the 20th centuries due to industrialization of animal production and the development of intensive cow and sheep farming, the trend has been reversed during the second part of the 20th century. Statistics on the goat sector [8] showed clearly its growth in all regions of the world. The number of heads increased significantly of nearly 60% in 20 years from 1980 to 2000 and was still constant during the first two decades of the 21st century. Between 2000 and 2010, the total stock of ruminants grew 24% (3.31 billion heads) but the part of goats was higher from 22 to 26% of the total heads.

This global growth has been still more significant in countries with Low Individual Family Incomes (+ 75%) but is general and concerns all continents [4]. The presence of goats in rural areas with a subsistence economy and rising demography explains partly the increasing number of goats. The relative improvement in living conditions among these populations can also explain their ability to increase their herds, which nevertheless generally remained very small (2 to 4 mother goats). Even if the share of goat production in organized markets tended to increase, it remained very small compared to the informal sector, which underlines the social importance of goat farming [3]. At this time, the main issues and challenges for the goat sector in the early 2000's were, moreover, to promote training and technical support for goat keepers with a crucial need for technology transfer and collective governance of the local projects. Another key point was the acceptance of goats in the forest areas with an improvement of the herd management.

In developed countries, the goat sector initially relied on niche markets for the dairy and cheese sector. In this situation, the strategy for development was overall, improving, through technique and investment, the efficiency and performance of production factors (labor, capital, animals) and by reducing production costs. Although, it enhanced the peculiar role of goats, the intensive goat systems followed the same logics than all animal industrial production and in particular that of the dairy cattle sector. For instance, In Europe (France, Spain, Netherlands mainly) the progresses made possible to achieve very high performances equal to or even superior to that of bovine dairy genetics (+ 1000 l of milk/goat/lactation) with a strong specialization of breeding. This success has also often been a model for many projects in Southern countries even if local conditions did not allow the same technologies to be implemented what led to many failures. The development of goat farming was here an alternative to the industrialization of animal production but by proposing to mobilize the same techniques and the same logics.

The prospects for the 21st century were considered favorable, so far as developments led to the modernization of goat farming being increasingly integrated into the economic life of rural populations. The improvement of the health and dietetic quality of the products should make it possible to meet the needs of consumers and improve the image of the goat and its products. Everywhere THE solution proposed was integration into the market economy and scientific research had to produce knowledge to meet these challenges.

3.2 Between 2000 and 2020, the trends on the goat sector confirm the previous prospects and do not take into account new challenges

Between 2000 and 2020, we observe the main trends than previously but with slight inflections. Regarding the goat world stocks, the number of heads has kept on growing dramatically of +44% between 2000 and 2019 (**Table 1**). More precisely, it nearly doubled in Africa but more slowly in Asia and America. Simultaneously, we observed a decrease of the goat herd in Europe (−15%), in Northern America and in China (−8%). These data confirm the increasing importance of goats for small holders in low- income countries.

During this period, the production of goat milk increased in all continents (**Table 2**). These data confirm that intensification remained the main trend in Europe for milk where the goat milk industry is rather strong (+42% milk yield

	2000	2010	2019
World	758	918	1094 (+44%)
Africa	243	348	459 (+89%)
America			
North	2.3	3.06	2.65 (+15%)
South	20.1	21.1	23.1 (+15%)
Europe	19	17.5	16.5 (−15%)
Asia	458	510	575 (+12,6%)
Chine	148	142	137 (−8%)
India	123	137	149 (+21%)

The data are in 10^6 heads – [8].

Table 1.
Goat heads from 2000 to 2019.

	2000	2010	2019
World	13	17.6	19,9 (+53%)
Africa	3.1	4.3	4.35 (+40%)
America			
North	0.025	0.033	0.026 (+1%)
South	0.31	0.31	0.34 (+10%)
Europe	2.5	2.7	3.07 (+22%)
Asia	7	9.8	11.7 (+64%)
Chine	0.23	0.28	0.24 (+4%)
India	3.3	4.6	5.4 (+63%)

Data in 10^6 tons – [8].

Table 2.
Goat milk production from 2000 to 2019.

per animal from 2000 to 2019). At reverse in Africa, the dairy performance has decreased of an average of 27%. Although these data meet a high diversity of systems we can consider that the recommendations to invest and control more efficiently have not been applied successfully. In spite of many development projects implemented to support the role goats in small-scale farms by international institutions and Not Governmental Organizations, we have shown that market issues and the governance of the projects limited their impact [9]. Nevertheless, In Asia the dairy collection contributed to the milk supply of rural population with an increase of the dairy performances of goats (+13%). This growth is for instance significant in India.

Goat meat production has also grown steadily during the period, confirming the trend and prospects suggested previously (**Table 3**). Although it keeps minority, the world market of goat meat increased significantly during the period. China followed by India area the two main goat meat producers. China developed export of goat meat between 2000 and 2010, which doubled between these two dates to reach 6700 t but kept at a relatively low level comparatively to production.

Regarding the fibers, several projects in Central Asia promoted the quality of cashmere and the organization of the market although China increased its leadership on the sector with an identified environmental negative impact on the desertification of Inner Mongolia highlands due to overgrazing [10, 11].

This quick outlook of the goat sectors around the world between 2000 and 2010 confirmed at a large extent the trends proposed previously. In spite a steady growth of these sectors goats remain a minority sector comparatively to other animal production sectors like for instance the dairy cow milk and cattle sector in a ratio of 1 to 10 for meat and 1 to 35 for goat milk although this ratio should be significantly higher on informal markets [8]. However, it appears that the goat sector like other animal production sectors has followed the same paradigms than during the previous period. People consider often progress only through the prisms of the growth and the improved efficiency of production factors.

3.3 The general context has dramatically changed between 2000 and today

Sustainable Development Goals are the global goals adopted by the UN system in 2015 (previously the Millennium Development Goals) as universal call to action to end poverty and ensure that all people enjoy peace and prosperity by 2030. 17 SDGs have been integrated that is, they recognize that action in one area will affect

	2000	2004	2010	2019
World	3879	4500	5200	6250 (+61%)
Africa	886	1030	1230	1470 (+65%)
America				
North	9.7	11.5	11.5	9.9 (+2%)
South	71	71	71	74 (+4%)
Europe	139	140	135	96 (-31%)
Asia	2710	3200	3600	4500 (+66%)
China	1290	1630	2000	2350 (+82%)
India	470	480	520	550 (+17%)

The data are in 10³ tons – [8].

Table 3.
 Goat meat production from 2000 to 2019.

outcomes in others, and that development must balance social, economic and environmental sustainability” [12]. Beyond the formula and the slogan, the development of goats could be an important lever among others to reach these goals and improve human condition in many areas.

But simultaneously, in 2015, under the pressure and dissemination of the reports of the International Panel of experts on Climate Change (IPCC, [13]) and the concrete observation of the present effects of the climate change (higher prevalence of hurricanes, floods, drought, big fires, heat waves), a large number of countries firmed the COP 21 Paris agreement. By this agreement, the world realized the dramatic possible incidence of global changing on the humanity’s living conditions at short and middle term. The COP 21 and the following COP fixed goals to keep the increase in global average temperature to well below 2°C (3.6°F) above pre-industrial levels; and to pursue efforts to limit the increase to 1.5°C (2.7°F), recognizing that this would substantially reduce the risks and impacts of climate change.

In spite of the denial on the realty and future impact of this climate changing by some countries (USA until 2020, Brazil...) and some experts, they were a minority. The awareness of the danger is now nearly universal and the discussions and debates are more today to the intensity of the measures to take for the mitigation of the increase in Green House Gas (GHG) emissions. CH₄ and N₂O emissions from manure management, deposition on pasture with enteric fermentation make livestock the main agricultural source. The total emission of GHG at the world level and their sharing is on **Table 4**. From these data, we see that agriculture and food systems are responsible of nearly 30% of GHG emissions, the main responsible in climate changing and animal production of 15% (+ 12% from deforestation for Animal production). Some studies have estimated that Agriculture, animal production and forests could provide 1/3 of the total potential mitigation of GHG emissions.

The total livestock numbers has kept on growing dramatically in all major categories from 80 to 210% between 1990 and 2018. As animal production is a major responsible of climate changing for many institutions and environmental organizations, the need for the mitigation of the GHG emissions would lead to limit significantly animal production and reduce milk products and meat! There is a real trend to substitute animal for plants in the food systems.

Nevertheless, we have to relativize these drastic orientations. Firstly, the growth in animal numbers, milk and meat production is mainly due to industrial production systems that still increase their level of intensification and are very dependent on not renewable resources. Secondly, the data are global which simplifies the issue; we have to differentiate the characteristics of each production systems and the contribution of each system for climate warning could vary significantly.

	Annual GHG emission	%
Total	37	100
Agriculture and food systems	11	30
Total Animal Production	5.35	14.5
Enteric Fermentation –Animal production	2.1	5.4
Deforestation due to Animal production	4.44	12

The emissions are in Billions tons equivalent CO₂ – [8, 13].

Table 4.
Total emission of GHG at the world level.

Secondly, the recommendations of the experts on climate changing have always insisted that integrated responses should be imagined to link mitigation of GHG and addressing poverty eradication and rural employment while positively contributing to fiber and food security. Other issues have to be taken in account and measures for reducing loss and waste could be very positive.

3.4 A focus on the role of goats towards a climate-friendly and resilient livestock development

There is a global consensus to consider that the challenges we are all facing concern all sectors of activity. **Table 5** logically shows that the impact of goats on CO₂ and CH₄ emissions is relatively low compared to, for example, that of dairy cows. 3% and 10% of the total emissions are due respectively to the enteric fermentation of goats and cows respectively. However, ignoring these emissions is impossible and for instance, there is an increase in these emissions in Africa and Asia, whereas they tend to decrease in Europe.

In this logic, intensive goat farming wherever it is must really control its emissions such as for dairy cow. In most other situations, goat farming is rather characteristic and emblematic of integrated small-scale farming in domestic economies and agriculture and small herds are often associated. This often involves either extensive systems, based on the use of grassy or shrubby rangelands either small family farms of 2 to 4 heads that consume family residues or fodder resources at the edges of plots. In all cases, we speak of resources that would have no other valuation than through animal production.

In addition, family breeding helps to fertilize crops without mineral fertilizers; we know also that one ha of natural meadow absorbs 1 t of Co₂ and one ha of forest 3 t which brings an additional benefit. These systems, often associated with transhumance, also make it possible to depend less on supplementation based on creatures and proteins such as soya.

	2000	2010	2018
Dairy Cow World			
CH ₄	0.16	0.18	0.18
CO ₂	3,4	3.79	3.76
Goat World			
CH ₄	0.038	0.046	0.052
CO ₂	0.79	0,94	1,09
Africa			
CH ₄	0,012	0,017	0,022
CO ₂	0,26	0,37	0,46
America			
CH ₄	0,0017	0,039	0,002
CO ₂	0,036	0,37	0,04
Europe			
CH ₄	0,009	0,0087	0.0084
CO ₂	0,020	0,018	0,0176
Asia			
CH ₄	0,027	0,025	0,023
CO ₂	0,48	0,54	0,47

The emissions are in billions tons per year – [8].

Table 5.
Enteric fermentation from goats from 2000 to 2019.

A simplistic but a more and more widespread view today tends to ban animal production from agricultural and food systems and their future. This militant and extreme vision does not take into account the diversity and complexity of the situations present in particular in the Southern regions and may even have a negative balance in GHG emissions. The few elements we have developed above encourage us to reconsider animal production and a majority of goat systems not as a sector of activity, as an “industry”, but as a component of complex and diversified agro-food systems.

Reconsidering goat farming also implies moving away from the analysis of life cycles based only on the efficiency of each production factor taken individually. These perspectives open up new and numerous fields of research and production of knowledge. We had already underlined the importance of simultaneously mobilizing and combining the contribution of several disciplines [14]. In Human Sciences, we have to understand the conditions for a constructive dialog between the various stakeholders and promote the local organization of activities, the quality of production and the marketing of products.

The analysis of the interactions between animal system and agricultural system should lead to redesigning new technical itineraries. The hybridization of local knowledge with generic science could allow goat activities to be primarily based on human capacities. By favoring an intensification, not of production factors, but of skilled labor, we will favor innovative design systems that will give the goat its full place in these systems [15, 16]. We will also support local policies to generate positive externalities and respond to the challenges of global change and agro ecological transition. Thus, the orientation of goat research must be redefined in a more open and systemic perspective. We know that science, with all society, often remains ideologically locked up to the point that it is almost impossible to question our representations and our paradigms. The ever-present and rather totalitarian processes of cognitive locking in often unconsciously lead to the stifling of all critical thinking [17, 18].

3.5 What scenarios for goat farming in the next 30 years?

We have enlighten above the path of the futures of goat farming by looking at the present and its challenges, but also by looking back on the past. From these elements, it is thus possible and necessary to envisage in a lucid way what could happen at short and mid-term. We have showed previously that at a large extent, the future of goat farming will depend on the local dynamics of the territories where it is present. It is the strong implication and the broad participation of all the involved actors, which through their dialog will be able to build futures, which are not yet pre-determined today.

But, at a more global level, the future of goat farming will be decided upstream by the future trends of human societies and the main scenarios of change at work with regards to the global change mentioned above. Of course, it would be neither coherent nor legitimate to propose a general foresight on goat farming in the world. Nevertheless, the possible evolution of the place of goats and their role in the dynamics of many rural areas can be explored from the main global trends and policies in the world on one side on the diversity of the goat production systems on the other side [9]. We use for this the global foresight Agrimonde project to explore the possible futures of the world’s agricultural and food systems up to 2050, and too face its key fundamental challenges [7]. The scenarios of the Millennium Ecosystem Assessment (MEA) are the bases of the hypothesis formulated by Agrimonde. The MEA scenarios differ according to the geopolitical configuration (globalization versus regionalization), and the management of environmental issues (proactive versus reactive).

The first hypothesis proposed by Agrimonde is that the world will collectively succeed and decide to face the challenges of climate changing, environmental control and apply the principles of sustainable development. This hypothesis leads to a scenario for feeding the planet by preserving eco-systems, reducing GHG emissions and use of fossil energy. We see major changes in how losses will be managed, in dietary habits and in organization of production systems: It will thus mean a substantial change in current habits and trends. This hypothesis asks new questions about how research is tackling the changes in yields and in the areas used for agricultural production, and their extent and their technical, economic, social and environmental consequences. By linking the technical and land-related aspects of the yield-area pairing, it establishes ecological intensification as a major issue. With this hypothesis, agricultural development could become again a driving force of global economic development and poverty alleviation. Rural areas could create many jobs to absorb underemployment caused by automating many functions in administration, finance, travel, etc. In this world, animal production and consumption will significantly decrease globally, but this hypothesis could be a chance for goat farming and more widely pastoral systems. This scenario will be favorable to the development of systems combining agriculture and animal production. Family farming will be more efficient and more integrated. Research would orient its priorities in favor of agro ecological transition with reinforced financial resources. Agriculture will be more attractive to many young people and goat farming will benefit from a positive image; pluri - activity will replace previous trends towards specialization. Efficient extension services will relay the knowledge produced and new technologies; simultaneously, a better control of the management of pastoral herds (goats and other species), particularly in terms of valuing spontaneous resources and fodder could limit overgrazing and erosion. Conversely, we will see the reduction of the most intensive systems, as for other livestock sectors.

The second hypothesis will make still global economic growth a priority to feed the human population. Technological development will allow for a more intensive farming, as well as for an extended use of fertilizers and plant material, much of them genetically modified to prevent environmental impacts. The vast majority of farms, both small and large, will be highly mechanized and industrial. Local know - how will be often replaced by standardized industrial methods and the variety of agricultural species will keep on decreasing. Multinational firms are a predominant feature of this scenario; they will increase their control over plant and animal production, primarily through the development of new genetic strains. In this second hypothesis, awareness of global issues is slower and more controversial but environment and climate changing are also a priority. The general opinion is that technological innovation is the solution face these challenges. New digital technologies will better manage and control the management of herds and their environmental impact. The divide between the most favorable areas for agriculture and livestock farming and the marginal areas would remain predominant. The search for productivity will continue to be the engine of change in areas with the highest potential with a concentration of capital, land and equipment. This trend will favor goat farming with large, high-performance herds in dairy production, but also meat and cashmere; but they will benefit a relatively small number of breeders and social or equity issues will be few integrated in the implemented strategies. In addition, the growth of goat heads will continue in marginal areas under the effect of demographic pressure. Goat farming will thus contribute to the subsistence economy of many populations without benefiting from the support necessary to improve their living conditions. In this scenario, the effects induced by climate change will probably also still impact negatively the poor rural populations.

4. Discussion and conclusion

Between 2000 and today, throughout the world, numerous projects involving goats and in favor of poor rural populations have been implemented with the support of international NGOs, International institutions or private actors. The comparative study carried out in 2013 for IFAD identified success indicators to scale up these projects [9]. It also showed that many of them failed because poor anticipation of the real market for goat products, their bad governance and inadequate funding (often too large for a too short period). The organization of a goat industry consolidated in Europe, America and Asia for milk meat and fibers but the share of the goat stocks and farmers in the informal not profit sector is still dominant.

Given the economic and social climatic challenges that the world will have to meet, goat farming can play an important role in the restructuring of the agricultural systems of many regions. We are indeed in a situation of paradigm change. In terms of research and production of knowledge, we will have to understand better the practices of farmers, and integrate crops and goat farming, to control diseases without antibiotics and to identify what social economic technical performances they need. The organization and development of training will be another important issue.

This conclusion opens up new perspectives for scientific research and interdisciplinary research. Less than ever, there will be a single model of goat development. For each region, it will be necessary to identify the potential of existing production systems, breeds, available food resources, value chains. This will involve new ways of doing research. For example, living labs are a methodology where all the actors involved in a problem participate fully in the research and innovation process [19]. For the goat sector, the implementation of “living labs” type devices could allow the design and full-scale testing of innovative goat systems for new uses for the products and services necessary for them to develop.


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