

The social and environmental challenges faced by goat and small livestock local activities: Present contribution of research – development and stakes for the future

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Abstract

Small livestock (goats, sheep, llamas, camels...) like other agricultural activities could have to face dramatic social, economical and environmental challenges. These challenges are identified underlining that these activities are often important and well present in countries with low incomes or in less favored areas. Although they are often low input production systems with lower environmental impacts, they face desertification and less water availability, genetic erosion, soil degradation and degradation of rangelands, competitions for land use. The needs of policy on more research, education, micro credits, organization and extension are enhanced. A global review of publications in the main scientific journals shows that relatively few works are still dedicated to marketing, Economic development, management and productions systems. The main subjects related to these challenges are the control of emergent diseases and parasites, the improvement of nutrition in harsh conditions, the genetic characterization of local breeds. But these results confirm that most articles have few links with the demand for innovation. The several journals in social science publish relatively few works on these livestock activities. To face these challenges, the discussion proposes new forms of governance in which priority is given to the participation of all stakeholders and the confrontation between local and scientific knowledge. This would have consequences on educational programs and training. The awareness of the public powers on these questions has to be improved by a coordinated and argued active communication. At short term, new types of events and conferences at local and international levels have to be created to manage innovation and transitions towards the necessary destabilizing changes

Key words: Innovation, small livestock, environment challenges, governance, development, prospective

Introduction

This presentation will analyze how goat production systems (and more largely the small livestock activities) could face the several challenges of agriculture and animal production revealed by the present crisis. We will particularly focus on family household farming respecting agro-food industry and their impact on rural development. What is needed to initiate the changes required? What types of innovations to impulse? What scientific research could bring and what must be the role of public services?

Several past publications have identified the position and diversity of goat industry and production systems in the 6 continents (Morand – Fehr and al., 2004; Dubeuf and al., 2004): To sum up their diagnosis, goat farming is more present in countries with low income (about 80% of the goats around the world), particularly in tropical areas of America, Asia and Africa. In these countries the livestock increased when it decreased in other countries and particularly in Europe. Nevertheless, the diversity of production systems is high with very different conditions of farming. Goat farming is very apart from the market economy what confirms its social function for rural populations of many countries and isolated areas. Nevertheless, In Europe and in many developed countries, the dairy goat sector can be very well organized. It is market oriented with an investment of dairy industry and concentration although the small scale and farm made sector is more important than in cow milk dairy sectors. Their development is very dependent on the specific valuation of goat milk products and their ability to reach large markets.

Some small niche markets for goat milk products could exist in developed countries. An underestimated small but quickly developing world goat meat trade exists although goat meat production is still largely marketed informally on local and village markets. These observations confirmed that more than for other species, activities involving goats can be taken in example to analyze the conditions of rural and social development in many situations and their integration into an economically sustainable life.

On one hand, and more generally, we will analyze first the awareness of the environmental, social and food challenges how humankind will have to face them and their consequences on animal production and more precisely on goat activities.

On the other one, we will study how scientific research has incorporated these new patterns in their organization and orientations.

Main challenges for humankind involving animal production: a review

Environmental, economical and social challenges are well identified and developed in the media. There are often presented dramatically considering that humankind is facing unprecedented turmoil and change as it seeks to survive and thrive at the start of the 21st century.

Environmental challenges

The environmental crisis has questioned clearly our collective capacity to maintain our productivity and find a balance between short term and long term solutions: Climatic changes and global warming will have probably significant effects on the natural cycles of plants and the physiology of animals bred and will dictate to reduce the emission of greenhouse gases (IPCC, 2010). There is also an increasing awareness that global warming, associated changes in precipitation patterns, and the frequency and the severity of dramatic weather events such as droughts,

hurricanes and floods are having direct and indirect effects on both human and animal health¹ (Peacock, 2010). Environmental effects of pesticides on soil fertility and their biodiversity will impose to reduce their use with possible effects on the productivity of Agriculture. The long term impact of soil erosion due to mechanization and over-intensification (that have enabled a constant growth of yields during the previous 40 years) is identified and begins to be estimated (FAO, 2010).

The loss of bio-diversity and genetic erosion has already led to the disappearance of many wild and domesticated vegetal and animal species and breeds. Out of 6300 breeds registered, 1350 would be threatened by extinction or are already extinct. Among them about 20% of sheep and goat breeds would be threatened at short terms in spite of their large genetic variability and capacity of adaptation (FAO, 2004).

Nearly all the sources insist on the advances of desertification (for instance, Talbi and al, 2008, estimate that over 250 million people are directly affected by desertification but that about one billion people in over 100 countries are at risk including many of the poorest, most marginalized population in the world), the threat of more water shortages (water being more than before a strategic resource), the danger for food safety and environment of the conversion of many lands for production of bio energy.

Social and economical challenges

Most of the present and future social and economical challenges are the consequences of the environmental, stakes described previously but also of economical and energetic issues. More than one billion people all over the world live in chronic hunger and this number could increase in absence of solutions and decisions. As recalled by FAO, hunger exists because there is not enough investment in the rural sector in many countries to support agricultural development. Recently, hunger has increased significantly because the financial and economic crisis affects the poor most of all by reducing or eliminating the sources of income they depend on to survive. Competition on energy may make more difficult the capacity of investment of farmers, accelerate the use of land for producing bio-fuels, or purchase by foreign companies or states (several cases all over the world).

Situation of the goat and small livestock activities regarding these challenges and priorities for Research, Development and Innovation

Recently, the livestock, environment and development (LEAD) team at FAO publishing the report *Livestock's Long Shadow* (Steinfeld and al., 2006), brought together a large weight of evidence showing the damaging environmental effect of livestock and livestock-related anthropogenic activities. Since this report, they have offered a more nuanced and balanced view of the complexities of the environmental impact of different species of livestock in different systems. For an estimated 100 million people in arid areas, and probably a similar number in other zones, grazing livestock is the only possible source of livelihood. Livestock can improve soil and vegetation cover and plant and animal biodiversity, for example by removing biomass, which otherwise might provide the fuel for bush fires, by controlling shrub growth and by dispersing seeds through their hoofs and manure, which can improve plant species composition. In addition, trampling can improve seed germination and break-up hard soil crusts (Steinfeld and al.; 2006; Peacock, 2010) and grazing could help to prevent fires in many cases. As goat and small livestock farming systems are mostly rural landless livestock production, extensive or crop-based systems mixed farming systems,

¹ Appearance of Blue Tongue virus in regions and on species where he was absent

(Devendra, 2010) and often apart of the market economy they could be affected very soon by these challenges. The vast majority of goats and small livestock and family animal farming being kept in low-input systems, they have, in most cases, a comparatively light environmental touch. They could be also less dependent on the vagaries of the economy what confirm its social function for rural populations of many countries and isolated areas.

In many cases, emerging issues in the future and looming concerns were identified and several papers as this of Devendra, (2010) emphasise “*the need for collective efforts to promote the potential future contribution of goats*”. Policy elements would include also advocacy, education and empowerment, gender action, direct government action, laws in favor of micro credits and NGO participation but above all investment in research and development (R&D): The overriding challenge would be to define policies that can improve the livelihoods of small farmers and the landless, foster greater institutional involvement, investments in target agro-ecosystems, promoting increased adaptive research and development involving productivity, enhancing technology application, and innovation. It would need to include post-production systems, linkages and market access.

At a more general level than goats and small livestock, Herpin and al. (2008) proposed what must be the future for research in animal production and animal health. They confirmed the main challenges and planetary dimension of research problems (sustainable development, climatic changes, biodiversity management, water quality, food safety, emerging diseases and bio energies) for animal production. They insisted on the growing need in the future to increase world food supplies as an answer to an increasing demography and the evolution of the animals' status have placed the animal, breeding management, and their products at the centre of the society's debates.

A logical hypothesis is that the recent scientific results are a good indicator to estimate the present situation and orientation of Research in favor of these urgent stakes for innovation in animal production and particularly in small livestock and family animal farming. To test it we have surveyed the scientific literature on these subjects

A survey of the scientific publications during the latest 5 years in Animal production

We have investigated the latest 5 years in the main available data basis on scientific literature, through the ISI Web of Knowledge: Web of Science and CAB Abstracts. Several topics were chosen (Table 1).

This short review confirmed that the scientific production on Sheep, goats or Small livestock is important but that the strategic topics for sustainable development are not very frequent. Two general journals on Animal production with a good Impact Factor were chosen to deepen this review, Livestock Science and Small Ruminant Research. The total number of articles published by these journal is important (1470 and 1160 respectively in the latest 5 years) if we compare it with the total number of articles published during the same period by a journal more specialized on the development of agriculture like “Agriculture and Human Value” (282). There is no specific journal dedicated on socio-economical subjects in Animal Production. The several articles are shared between 9 general topics and the animal species (Tables 2 and 3).

The results show that during between 2006 and 2010, the main usual topics of Animal production (Nutrition, Physiology, Veterinary medicine, reproduction...) were predominant comparing with marketing, Economics, Development or Production systems and references in the 2 journals. In Livestock Science, the articles on sheep or goats are 25% of the total.

This tendency is confirmed in the last issues of Small Ruminant Research in 2009/2010: Publication on marketing, economics, development are only 5,7% of the total, Management and production systems 13.7%. Besides, most of these articles are included in a special issue to publish the Proceedings of a Conference, what underlines the specific function of Conferences for debating and presenting strategic papers.

The several articles of SRR in 2009/2010 were listed and analyzed. Less than 20 were synthetic articles on specific topics involving several aspects of small livestock activities (for instance, the organization of goat breeding in Brazil or breeding research in Mexico, development of sheep and goat production systems based on the use of salt tolerant plants and marginal resources in the United Arab Emirates, the importance of social behavior for goat welfare in livestock farming, situation and perspectives for goat production systems in Spain, managing goat production for meat quality, study cases in the Caribbean, etc.). In Genetics, many papers were on the genetic characterization of local breeds but very few on the condition of economic valorization of these breeds. Other papers were on the characterization of local products and on emergent diseases and parasites controls. A special issue was dedicated to the utilization of halophytes.

But the main results of this survey are that a majority of articles and researches were about applications of methods developed for other species in other situations. They show often imitative behaviors. Many researches aim to apply methods to give more references on local breeds, local forage, with not necessary references to a social demand. The general purpose of many results is to improve the efficiency of production with few relations to multi factorial socio and economical conditions to apply these improvements.

New paradigms to build on research, innovation and development

The previous observations are explained because many researches could be justified by the underlying paradigm that the improvement of productive performances would have necessary positive effects on the human and economical development. The current challenges require greater modesty and new paradigms.

A dominant intensive model

There is a competition between innovators and competitors and in many cases the organization of the Academic research favors imitation. In other words, science is not synonymous of innovation. In the case of small livestock production the paradigm is more or less consciously that the intensive model of animal production would be better than pastoral and more extensively using land systems. This position has been justified by the past successes during the past 50 years and its capacity to feed the world until now. In science as in other areas, we live often in the illusions of modernity. The progress of science and technology is still considered as redemptive. They refer to the old dream of a biblical nature

under control, dominated by men, to reach and bring a more just social order dominated by reason (Linck 2010). The negative externalities of science are today well identified at both social and environmental levels for instance in the *Millennium Ecosystem Assessment* carried out under the aegis of the United Nations,(2005)². This is not to deny the interest of scientific knowledge. But it is necessary to confront it reflexively to other forms of knowledge.

The situation described for science can be logically extended to extension and development. Cowan and Gunby (1996), working on the economics of technology (more specifically on the chemical control of agriculture pests) have emphasized the effects on technological trajectories of positive feedbacks. They have showed that in a competition among technologies that all perform similar functions the presence of increasing returns to adoption can force all but one technology from the market. Previously, Nelson and Winter (1982) had defined the concept of “lock in”. They explained that a technology is not chosen because it is the more efficient but because it enables economies of scale (the more we produce, the less costly to produce a unit), learning effects (the more a technology is trained, the more people use it), possibilities for dissemination in a large network (more numerous are users, more useful appears technology). It could be used to explain many present situations where many environmental or social negative externalities were not internalized. For instance, pastoral references or local know-how are often showed to be more efficient and adapted to local conditions than intensive ones. Nevertheless, they are still considered as marginal, traditional and backward –looking.

The several sides of innovation

These comments insist also on the fact that the priority for Research, Development and Innovation to face the identified challenges can not only be an incantation. Innovation needs a theoretic frame work. Innovation is multiple and involves, classically, production techniques, work organization, equipment and infrastructures, collective features for selection, reproduction, feeding or sanitary devices. They have concerned also (and more and more) local organizations such as product labelling, new dynamics around local breed, collective rules for supply basin or new products approaches for new markets. Many think that innovation is a linear process, with successive stages of research, design, development, production, and finally marketing. On the contrary it is a very interactive and collective process.

The sources of innovation are potentially multiple and limited to research: sometimes in development organisations, sometimes with farmers, but in all cases, the conjugation of the efforts of all will be necessary to adapt it to the diversity of environments and determine its area of validity (Bouche and al., 2010, Meynard and al., 2010). In a recent Conference, Andy Hall (2010) a specialist of Innovation insists that “*the future of agricultural innovation systems is not going to be the mass re-engineering and neohomogenisation of national patterns of innovation. The future is going to be a mosaic of initiatives occupying a multitude of market and social niches championed by individuals and organizations committed to managing and accepting both the trade-offs and synergies between social, economic and sustainability concerns*”. He refers to the challenges for policy to enable a positive environment for this mosaic of niche innovations processes. Policy must avoid the temptation of viewing success stories as pilots and models as it has been very often done particularly in goat development projects.

Toward a renewed governance of information systems of Agriculture and Animal Production

These observations can be applied in many situations of Agriculture all over the world but they are particularly suited to small livestock (sheep, goats, camelids) and family herds because they are very characteristic of many multi-purpose local activities and rather poor populations. We have insisted on the need of very diverse non universal solutions. And in an overpopulated world with less available energetic, land or water resources, we must still increase productivity and preserve environment. We are faced with conflicting objectives and new types of governance would be required. For instance, the governance system of Agricultural research could involve changes in criteria used to evaluate agricultural scientists, and changes in the attitude of scientists towards their environment. Through a process of "joint-formulation", "joint-implementation" and "joint-evaluation" in which all actors could participate and contribute that an innovative agricultural policy is designed. This emphasizes on the importance of dialogue between the different stakeholders.

Very often, sustainability is emphasized as an objective. But the contradictory previously identified challenges could reduce sustainability of agricultural and animal breeding activity if they are considered individually. This leads Bush (2010) to consider sustainability as a wicked problem. He suggests to consider optimal solutions and not only those that maximize a result. Failure must be accepted to favor innovation, prioritize problems that can be solved from other without solutions. We must be able to look for several complementary and multi scales (herds, farm, region levels) ways to reach an objective.

Conclusion: Changes to impulse and face the new challenges

These previous considerations are a constructive base to elaborate some operational proposals to face the identified challenges. We must be aware that these necessary changes would result of combined efforts and would not occur without tensions and conflicts. We have already mentioned tensions between economic and environmental requirements; we could add between the individual decisions and the territorial dynamics (a farmer preferring for example the best genetically homogeneous and highly productive breed that could favour the development of epidemics). This refers also to the tension between short term private interests and long term or public ones.

These tensions have to be managed and it would be unproductive to ignore this. Scientific research is not absent of these tensions. It will not be so easy for scientists to accept that innovation will not come only from scientific knowledge but also from other types of knowledge. In the field of livestock, and particularly for goats more than in others, local know-how and individual experiences should be enhanced. New methodologies to associate academic and practical knowledge have to be elaborated, evaluated and disseminated. And the objective could be that in the next 5 years the results of another survey on the "Web of Knowledge" would be significantly different!

The function of information and extension has already often enhanced. These functions have to be strengthened, once again without illusion about their intrinsic power to solve problems. And the stake is also to improve the awareness of farmers, politics or companies on these dramatic challenges. We have enhanced the orientation toward more multidisciplinary and participative or systemic approaches. These approaches have to be a priority in research but also in extension and training: New methods for analyzing the problems, global perspectives, social and economic issues must be included in training programs. The future changes will be hard to be accepted and we will have to manage the transitions between the old situation and the new one.

Organizing debates, discussions, Internet forums and exchanges between several types of stake holders can be an efficient way to improve the awareness of many. The conferences must be organized in this direction with more spaces for testimonies and structured discussions and less academic results. The function of Associations like IGA to favour this awareness could be very important in the future if they strengthen their capacity of acting.

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Table 1: Number of references during the last 5 years for each topic and species on the Web of Science and CAB abstracts

Topic 1	Species	Number of references (Web of Sciences – CAB)
Sustainable Development	Goats	35 -60
Climatic Changes	Sheep Goats	31 -139
Economic Development	Goats	65 -167
Rangelands	Goats	49 -394
Small livestock	-	825 -2535
Goats	-	8705 - 10781

Table 2: Livestock Science; main topics quoted during the latest 5 years on the Web of Science

Disciplines									
Total	Marketing Economics Development	Production systems Management	Nutrition	Physiology	Genetics Breeding	Pathology	Parasites	Technology	Reproduction
1470	12	322	770	547	345	110	31	23	233

Species						
Cow	Cattle	Buffalo	Pigs	Sheep	Goats	Sheep and Goats
380	550	35	505	220	69	74

Some articles may have several topics

Table3 : Small Ruminant Research: main topics quoted during the latest 5 years on the Web of Science

Disciplines

Total	Marketing Economics Development	Production systems Management	Nutrition	Physiology	Genetics Breeding	Pathology	Parasites	Technology	Reproduction
1160	30	189	495	338	287	215	100	26	227

Some articles may have several topics

Species

Sheep	Goats	Sheep and Goats	Camelids
475	299	315	21

Table 4 Small Ruminant Research August 2009/ July 2010

	Sheep	Goat	S/G	Camels	TOTAL	%
Marketing/Economics/Development	2	5	3	-	10	5,68
Management/P. Systems	13	10	-	1	24	13,64
Nutrition	15	8	9	1	33	18,75
Reproduction	7	10	0	2	19	10,80
Physiology+ Reproduction	10	10	2	2	24	13,64
Genetics+ Breeding	15	3	-	2	20	11,36
Vet. Medecine	10	12	2	1	25	14,20
Parasitology	7	5	1	0	13	7,39
Technology	-	3	-	-	3	1,70
TOTAL	79	66	17	9	171	97,16
%	46.2	38.6	9.94	5.26	100	