

Livestock



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Foreword

Bernard Hubert¹

I would like to thank the editors who invited me to write a brief foreword to their book which will constitute a significant contribution to the current situation of livestock husbandry in many parts of the world, enlightened by a long-term view, which is fundamental to understanding where we are and where we come from. I appreciate it all the more because I know personally almost all of the authors even if I am neither an animal nor a political scientist. However, I have been interested for decades in livestock farming practices across the world from the ecological and social sciences points of view.

Thus I will not repeat here what the editors present very well in the introduction, as they draw attention to the major points in the 22 situations that constitute the book. I strongly encourage anyone to start by reading the introduction before entering the fascinating narratives from all over the world.

For me, livestock farming is not an activity like any other. It has relied on human-animal relationships as an inseparable pair since the earliest days of domestication in order to transform some elements (mainly plants!) of the environment into resources for humans (meat, milk, eggs, fibers, labor force, mobility, etc.)... and this depending only on solar energy! This is why it has been multifunctional since the beginning, including the so-called cultural aspect... and mainly ignored today. It has been reduced to specific targets, because of the commoditization – among others – of animal products and the marketization in a global world, as it is developed in the book. However, it relies also on the increase in a technological vision of the relationships with the living world, in order to dominate it as well as to protect humans from its disorders and to emphasize its exploitation as a reserve of goods. One illustration is the renamed 'animal production' once called 'animal sciences' departments in research and higher education bodies.

Although it is not explicitly documented in the book, you can find the increasing role of technology in the main changes that have occurred in livestock farming in relation to changes in public policies. The techno-scientific way of thinking has progressively dominated our views on food, energy, 'natural resources' (renewable or not), and the elements, living or not, involved in those issues. It has led to a whole framework of normalization and prescriptions that are the tools, not only to implement these policies but also to design them, as a dominant way of thinking!

One of the last illustrations, clearly highlighted in the book, is the rise of veganism. On one hand it is completely contradictory. For the sake of animals, veganism denies the long history of human-animal relationships which have led to the diversity of domestic breeds, actual cultural productions from people fashioning the living world according to a variety of situations and interactions. On the other hand, it advocates for more technology to produce 'meat' without animals, from cells or soybeans or whatever else. And who are the main companies committed to these innovations? No longer the agrofood industry, but the digital and web giants, those who have altered our lives so much in the last years!

Fortunately, and thanks to Mongolia, 2026 could be the International Year of Rangelands and Pastoralists!

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At the time of publishing this book, it is necessary to thank the projects, and indirectly the institutions, that have participated in its writing through funding and/or any other support, as well as the colleagues, other than the authors, who have helped to conceive and structure it.

Among the projects, we should mention without being exhaustive, UFSM-PPGZ (CAPES-UFSM-PVE132/2017, UFSM-PPGZ/BR), MOUVE (ANR-10-STRA-005, INRA/FR), CAPES-PVE (298115, UFRGS-PGDR/BR), ECOTERA (ANR-13-AGRO-0003, CIRAD-GREEN/FR), ARIMNet (FP7-KBBE-219262, INRA/FR-EU), CAPES-PRINT (745377P, UFSM-PPGZ/BR), NEXUS (CNPq, NEXUS-PAMPA-2017, UFSM/BR), HIGHLANDS (H2020/MSCA/RISE-872328, IGF/AT-EU).

We would also like to thank Pr Marianne Schmink and Pr Pierre Valarié, both retired and from the University of Florida (LATAM/USA) and CNRS (CEPEL/FR), respectively, for their scientific and methodological support during the launch of the book project.

We finally wish to acknowledge all the authors' unfailing patience and collaboration throughout the long gestation of the book.

Contents

Foreword B. Hubert	3
Contents	5–6
Introduction J.-F. Tourrand, P.D. Waquil, M.-C. Maraval, M.T. Sraïri, L.G. Duarte, G.V. Kozloski (Coordinators)	7–13
Livestock policy in Special Areas, Alberta, Canada P. Strankman	15–24
United States of America's Dairyland S.E. Lloyd	25–32
Livestock policy in the Brazilian Amazonia colonization V. Vaz, S. Carvalho, A. Bendahan, R. Poccard-Chapuis, L.G. Duarte, J.-F. Tourrand	33–46
Livestock farming and public policies in Rio Grande do Sul, Brazil C.M. Ribeiro, P.D. Waquil	47–57
Livestock public policies in Uruguay H. Morales, M.I. Moraes, M.F. de Torres, A. Saravia, J.-F. Tourrand	58–66
Sheep policy in the colonization of Argentine Patagonia F.R. Coronato, J.-F. Tourrand	67–78
Policy and livestock in the Andes: Recent history in Ancash, Peru L. Oscanoa, J. Recharte	79–89
History of livestock policy in Mozambique C.J. Quembo, J.A. Mateus Libombo Jr.	90–97
Livestock development policy analysis in Benin B.G. Comlan Assogba, I. Alkoiret Traoré	98–108
Livestock policies in Senegal from 1960 to 2012 Effects and impacts on pastoral systems in the Sahel zone A. Faye	109–123

Public interventions regarding pastoral activities in the argan-tree area in Morocco: continuity and changes J.-P. Dubeuf, T. Linck, S. Chatibi	124–133
Public policies and their effects on the livestock subsector in the Gharb plain, Northwestern Morocco M.T. Sraïri	134–148
Overview on livestock policies in the Bedouin area Northwestern coast zone of Egypt I. Daoud, M.A. Zaher Osman, V. Alary, J.-F. Tourrand	149–161
Challenges facing agropastoral systems in the Arab dry region: case study of Lebanon M.G. Chedid, L.S. Jaber, S.K. Hamadeh	162–175
Livestock and animal sectors in Brittany A look at three-quarters of a century of change J. Lossouarn	176–186
Livestock policy in Norway A. Hegrenes, L.J. Asheim	187–198
Livestock policies in Switzerland M. Zumbunnen, H. Joerg, B. Reidy	199–211
Livestock systems in the midst of History's upheavals in Kazakhstan G. Konuspayeva, B. Faye	212–224
Qilian Mountains, Gansu Province, China: Tibetan Plateau biome Xiao Jing Qi, Ruijun Long, Luming Ding, Tingting Yang, B. Hubert, J.-F. Tourrand	225–236
Livestock development, land-use reforms and the disinterest for pastures in the Northern highlands of Vietnam G. Duteurtre, J.-D. Cesaro, Le Thi Thanh Huyen, S. Ives	237–246
Livestock policy in Indonesia: Case of the dairy subsector P. Sembada, G. Duteurtre, C.-H. Moulin	247–256
Socioecological system approach to incorporating biodiversity in landscape change R. Beilin, L. Wedderburn	257–271

Introduction

J.-F. Tourrand¹, P.D. Waquil², M.-C. Maraval³

M.T. Sraïri⁴, L.G. Duarte⁵ and G.V. Kozloski⁶

Two questions were at the origin of this book. Firstly, why should animal breeding face severe bashing for its environmental impacts since the beginning of the millennium and for its inhuman animal-human partnership, above all from the veganism, after it has withstood decades of criticisms for its negative social effects and its part in food safety crises, among others? Secondly, why do public policies appear as the main drivers and factors of change in the animal production sector, especially in the past decades with the demands from the environmental lobby?

To understand better the processes that have occurred in the livestock sector and to sketch out evolutionary scenarios for the future, established experts have described and explained the breeding history for their respective regions trying to identify the main phases and factors of change, on the long term, for more than fifty years. Twenty-two study regions were selected in twenty countries, reflecting the wide diversity of agricultural potentials at a global scale. Each chapter covers one region whose location is shown in a world map (see next page).

Crossing the information from the twenty-two case studies revealed three main findings. Firstly, public policies have been essential drivers of the dynamics of the livestock sector in almost all the cases, both in the past and today. Secondly, the same four to five main phases have been identified in nearly all the regions, showing the long history and relevancy of common processes at a global scale. Understandably, the factors of change are more or less the same, above all those acting at a global scale. Thirdly, there has been an increasing number of stakeholders, policy-makers and levels of governance influencing the livestock issues as in other sectors.

Importance of public policies on the trajectories and dynamics of livestock

The diachronic analysis shows the importance of public policies in the livestock sector. It is a major finding shared among stakeholders in all the research sites; hence,

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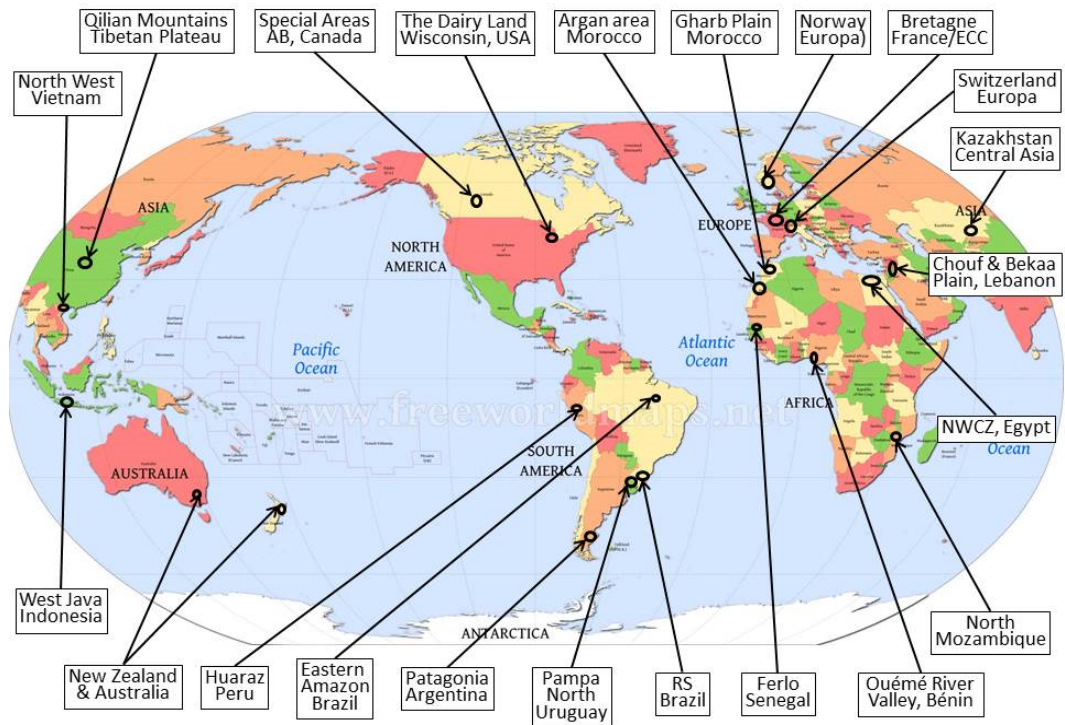
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The 22 Livestock Policy research sites



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the local livestock history can be described using the successive public policies at the local and national scales. Furthermore, almost all of the stakeholders think the future of livestock depends on the current and future policies.

This result is not surprising in the areas where livestock development has been initiated by public policies, as in the agricultural frontiers described in the case study of Canada in the first half of the 20th century, earlier in Argentinian Patagonia, Australia and New Zealand, and more recently in the Brazilian Amazonia during the 1960s. In these regions, the history of livestock has been planned by public policies, which have defined the milestones of the trajectories and dynamics of the livestock sector. Some of these policies have been directly linked to livestock production development, for instance through facilitating the purchase and import of animals and inputs, national and local plans to control diseases, special equipment for processing and marketing animal products. Other policies focused more on the improvement of pioneers' livelihood, such as transport infrastructures, access to energy and water supply, social services, development agencies. In addition, it was found that, in order to reduce the vulnerability of the livestock sector, policies have consistently considered the availability of natural resources, especially water and forage, because of the strong dependence of livestock production on these resources, as shown in the case studies of dry Southern Patagonia and Western Canada, and in other arid areas

such as Egypt, Lebanon, the Gharb Plain of Morocco, Senegal. The situation is similar in North Vietnam and Indonesia where the development of animal production resulted from a national policy aiming at reducing the cost of animal product imports.

In the pastoral sites, where animal breeding had been the pillar of human societies for a very long time, public policies aimed at adapting the livestock activity to the changes of the bioclimatic and socioeconomic context. This is the case in Africa (Senegal, Mozambique), the Mediterranean (Egypt, Argan ecosystem in Morocco, Lebanon), Central Asia (Kazakhstan, Tibetan Plateau), South America (Pampa in Uruguay and Brazil). In North Senegal for example, specific measures were implemented in the 1950s to secure water supply for humans and herds, and to enable the permanent settlement of Peul families. More recently, similar measures have been applied in the 1990s to enable Bedouin breeders to settle down, through the development of wadi irrigation as an alternative to drought. Similarly, during the 1980s, the Chinese national policy for the rangelands aimed at improving the livelihoods of breeders in order to reduce differences with other regions and to support them in adopting sustainable rangeland management. Therefore, livestock policies are key factors that help pastoral societies monitor trajectories and support the dynamics of the livestock sector.

The situation is a little different in the sites with crop-livestock integration farming systems, such as in Morocco's Gharb Plain, Benin, Europe (Norway, Switzerland and France), Southeast Australia, the Midwest of the United States of America, and the Andean Peru, where livestock is a component of the farming systems, and sometimes the main one. In these areas, policies usually targeted households and communities. However, livestock was also targeted because of its multiple functions in the farming systems, and because it strongly and directly depends on the applied measures. In the Gharb Plain (North Morocco), for example, the development of an irrigation scheme for cash crops led the farmers to grow fodder crops more frequently in order to control diseases and improve soil fertility. Since forages are used to feed animals, especially dairy cattle, the Gharb Plain has thus become a major dairy land at national level, mainly because of the development of the cash-crop policy. Similarly, the successive USA policies targeting the market of grains and commodities at international level have directly impacted the dairy production which is also linked to the share of grain production in land use and farming systems. In the same way, European breeders received significant subsidies, according to the size of their herds to maintain rural settlement. Therefore, even though the policies did not directly focus on livestock activities, they affected them because of the function of livestock in the farming systems, in land use and in local development.

The four phases of livestock policies

The long-term analysis of livestock sector dynamics at the local scales shows four main phases. Firstly, until World War II around 70–80 years ago, livestock policies

mainly addressed local issues strongly linked to the local context in relation in some case studies with a long history, in other cases with the recent settlement of breeders. For example, a slaughterhouse, a dairy factory, or a group of small workshops would bring about a local policy in partnership with local stakeholders and representatives. It was the 'Local' phase. Secondly, after World War II until the 1960–1970s, livestock policies mainly depended on national decisions, which usually focused on rural development related to food security or exports. Some countries chose to reinforce their livestock sector to improve their exports when others preferred to open the borders and meet the local demand in animal products by massive imports. It was the 'Import-Export' phase. Thirdly, in the 1970–1980s, policy-makers usually tried to adapt their national agricultural sectors, including livestock production, to the market demand. Hence, the market progressively became the main driver of livestock dynamics and policy in the 1990s, especially focusing on food quality and safety. During this period, the reference to globalization became more frequent. It was the 'Market' phase. Fourthly, in the late 1990s and at the beginning of the new millennium, the environmental issues emerged and have gradually become the main factors of policy making and legislation; they even strongly affected the market demand. Consequently, today, as previously mentioned, the livestock policy at the local and national scales takes into account the environmental norms that are defined at a global scale. It is the 'Environment' phase.

Increasing the number of stakeholders, policymakers and levels of governance

Simultaneously with the active norm-building process and norm integration in policy making, the diachronic analysis shows a significant change in the governance of this policy making. Decades ago, and during the Local, and Import-Export phases, the governance revolved around a few entities, usually directly linked to the government, at the local, regional and national scales, such as a few representatives of public institutions and managers of private companies or cooperatives. For example, in pastoral areas, tribe leaders and local government representatives participated in the local governance. In the case of agricultural frontiers, leaders of pioneer communities and local government representatives managed the local governance. In the third (Market) and fourth (Environment) phases, more stakeholders participated in the local governance. For example, in North Senegal, representatives of rural communities, politicians, local councilors of rural and urban areas, leaders of associations, small agribusiness managers, women's groups and young people are involved in the local governance along with the tribe leaders and government representatives. Above all, the decisions are usually debated in the various bodies of society with eventual consequences until the next elections.

The increase in stakeholders, policymakers and levels of governance is similar at the regional, national and global scales. For example, in each country of our sample study sites, representatives of Greenpeace, World Wildlife and International Union

for Conservation of Nature have regular contacts with the secretaries of the ministries of agriculture and environment. They finance their own research programs, generally in partnership with national research institutes. They promote and disseminate results at different levels of society, usually with an aggressive communication strategy. Moreover, they rely on local environmental associations to strengthen their bases, develop specific actions and show their local attachment. Livestock lobbies such as cattlemen's associations, national and international agribusiness, representatives of livestock sectors usually act with similar objectives and strategies. The leaders of two competing lobbies often share the same academic background, and may even have graduated from the same universities. Even lobbies have short-term challenges; but above all, they have medium- and long-term objectives which define their strategies and actions. In comparison, governments usually have short- and medium-term objectives and strategies, and in some developing countries, they do not have the funds to compete with the lobbies.

In conclusion, at both local and global scales, the governance is shared between diverse stakeholders who represent different points of view, hopes and fears, which should be balanced against one another during the policy-making process. Whereas in the past the governance depended on the decisions of a few stakeholders, today it has become a consensus of many different lobbies at all scales.

Besides these three main generic results, the twenty-two case studies show cultural permanence as a key factor in livestock policy, a subject worth investigating in the future. There is surprising similarity within the livestock policies of the case studies of Britannic origin (USA, Canada, New Zealand, and Australia) on one hand, and within those of the case studies of South American origin (Argentina, Uruguay, Brazil, and Peru) on the other hand. In the same way, certainly because of geographic and cultural proximity, there is strong resemblance between European public policies, whether inside the European Union (presented by the French case study) or outside (Norwegian and Swiss case studies). Moreover, in the last three decades, the Chinese livestock policy appears similar to that of the European Union, especially regarding subsidies and the family focus. In Moroccan case studies, the livestock policy appears very similar to that of the European Union since foreign settlers and experts had designed its main goals during the colonial era. A research question could be the role of cultural permanence in livestock policy making. In addition, in some case studies the sequences in the breeding policies are not clear. However, it should be considered that not making a policy is also a policy.

Two other points need to be detailed. The first one is the weight of globalization in the livestock sectors. The second one concerns the effect of recent human consumption behaviors (most of all the vegan concept) on the animal production sector, which, since animal domestication, could deal a major blow to the recent dynamics.

Globalization is moving forward

As already mentioned, one major result of the diachronic analysis is the gradual emergence of the market as a key factor of livestock production by the end of the 1980s, especially through the setting of norms in terms of quality, and environmental issues. The case-by-case analysis shows that the importance of the market goes back much earlier than during the 1980s. Indeed, at the local scale, markets have strongly interacted with livestock production in defining the level of demand, the prices of products, and the opportunity to sell to neighboring countries. For example, in all the case studies the development of urban centers created a new local demand for livestock products, which benefited the surrounding rural areas as they could sell their production. Similarly, the building of a road opened new marketing options to the areas along that road, providing access to the regional market.

More specifically, at the end of the 19th century, the development of transportation by steamers, followed by the adoption of refrigerating processes completely changed the international meat and dairy markets, opening new options for exports, especially for countries in the Southern hemisphere, far from big consumers' areas, such as Argentina, Uruguay, South Africa, Australia and New Zealand. Conversely, the south of Patagonia, which was a key place for transoceanic transportation, became an isolated region with the opening of Panama Canal at the beginning of the 20th century.

Globalization appears as the most significant factor of change because it mainly affects the market at the global, national and even local scales, but also the information and technology fluxes, consumers' behavior, the social and cultural bases of societies. Through national policies and tax levies, countries try to control import costs, at least to adapt their production to the global norms and thus face the competition, or to find alternatives, such as the niche markets in Europe for example.

New human-animal relationship based on animal welfare

Because of the successive food safety crises since the 1990s, part of the consumers either stopped eating meat and dairy products, or at least reduced their meat consumption and have been more careful about the origin and quality of the animal products they purchase. By the mid-1990s, during the bovine spongiform encephalopathy outbreak in Europe, a research showed that around 40% of young English people were ready to stop eating meat. Until now, this reduction has not impacted the meat market because consumption increases in other parts of the world, especially in emerging and pre-emerging countries where people have recently reached the middle-class status. Furthermore, a significant part of the world population (around 10–12%) does not eat meat for cultural or religious reasons: mainly in India, at least 500 million people in Asia, around 25 million in the USA, 8 million in Germany and 6 million in Italy. Several lobbies act against meat consumption; they finance

studies showing the incoherence and the danger of intensive livestock farming systems, including fish production, on human health and the environment. They rely on formal and informal networks, which usually act in environmental domains. In addition, research institutes are currently working on new forms of proteins as alternatives to meat proteins. In this new context, some stakeholders suggest changing the human-animal relationship based on old mental models founded on animal slaughter. Hence, the future would be the emergence of animal welfare issues in human societies and their consequences on rationalizing livestock activities and decreasing animal suffering.

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Livestock policy in Special Areas Alberta, Canada

Peggy Strankman¹

This chapter presents the successive policies since the mid-19th century in Alberta's rangelands south of the North Saskatchewan River, and running to the northern border of the United States covering most of the southeast corner of the province. We will see that this set of policies has had a major role both in the settlement of immigrants and in their permanence on their lands, and in the construction of a rural society based on livestock farming.

LIVESTOCK POLICIES BEGINNING IN MID-1800S

It is argued Special Areas is one of the areas in Western Canada that should have never been plowed. These lands had been inhabited for centuries by nomadic indigenous peoples who followed the buffalo. The explorer, John Palliser, spent three years (1857–1860), on behalf of the Canadian Government, inspecting lands in what was then called the Northwest Territories. His report warned much of the land he had traveled would never support human life. He saw a barren prairie in the drought portion of the weather cycle that continues to mold and challenge inhabitants today. However, years later, ranchers drove herds of longhorn cattle up from Texas finding ample grass, and good water supplies (Gorman, 1988).

The Canadian government's need to solidify ownership of the western prairies soon brought a railroad and with it farmers. Under the Dominion Land Act of 1872, people could file a claim on 160 acres (about 65 hectares) of land for 10 CA\$. Settlers had to live on the land with commitment to plow a portion and seed a crop. Many of those early settlers came from the British Isles bringing primarily cropping skills. The Canadian government began to implement a series of policies designed to settle the West to supply raw materials to the established manufacturing businesses in Central Canada and to become a market for the finished products (Gorman, 1988).

Special Areas is a municipality of about five million acres (2.1 million hectares) in South-eastern Alberta, on the border with the province of Saskatchewan to the east (Figure 1).

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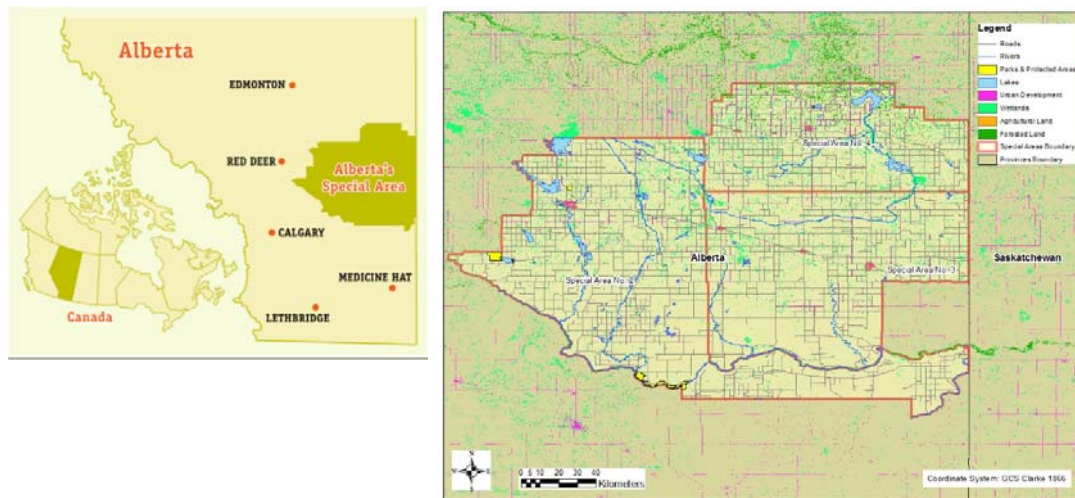


Figure 1: Location of Special Areas within Alberta Province, Western Canada

This rural municipality, home to almost 5000 residents, has a unique governance arrangement in Alberta. After an economic depression and drought in the 1930s decimated the area, the Alberta Government established a special governing body to provide municipal services. Administered under the authority of the Special Areas Act, the Minister of Alberta Municipal Affairs, through ministerial order, delegates authority to the Special Areas Board to provide those services. This Board is responsible for the administration of about 2.6 million acres of provincial Crown land. The land is leased directly to agricultural producers for grazing and cultivation by the Special Areas Board. The majority of the farms and ranches in the area produce a mix of annual cereal and oil seed crops, and almost exclusively beef cattle with a few producers raising sheep.

A dark brown soil zone underlies about a third of the area, primarily north of the town of Hanna with the less fertile brown soil zone found in the remainder of the area. Annual precipitation is about 325–355 mm, with 177–228 mm (7–9 inches) falling as rain in the growing season and the remainder coming as snow in the winter months. Yearly precipitation varies greatly from year to year. In the period 2009 to 2018, some years were as low as 268 mm and as high as 423 (Alberta Agriculture and Forestry, 2018). The area operates in a mean moisture deficit created by strong summer winds and high temperatures. The extreme fluctuations in precipitation result in great uncertainty in forage and crop yields from year to year and in the carrying capacity for livestock. The natural vegetation is classified as the northern plains which in Special Areas is primarily a mixed grass prairie ecozone. This North American grassland ecosystem is significant as pasture and wildlife habitat as the basis for extensive cattle production and western culture (Gauthier et al., 2003).

Drivers influencing land use change in rangelands and grasslands of the world can be grouped into the four following areas: i) technical changes, ii) market and supply chains, iii) socio-demographic trends and iv) public policies. The following discusses how those drivers have impacted change in Special Areas.

TECHNICAL CHANGES

Technological advances meeting the demands of climate and markets have long been the source of prosperity in Canadian agriculture. The word technology brings to mind the high tech world of grain production or hog barns. However, cattle producers tend to think more of management tools, e.g. managed grazing using electric fences, limit access to wetlands to decrease diseases like foot rot, and improve animal performance with improved water quality. Another tool is adding legumes to a seeded grass mix primarily to increase productivity but with collateral benefits such as decreasing methane production from cattle digestion.

A recent study of leading-edge cattle producers in Alberta found active participation in regional forage associations, or applied research organizations, attending field tours and seminars was an important characteristic. It is long recognized that management practices must be customized to each farm. Exposure to new ideas and innovative thinkers is an important factor in making changes efficiently. Producers see the cattle and their relationship with the land as being very complex. They see a need for systems thinking but also emphasize their needs to be a balance, utilizing technology and keeping management simple (Strankman and Reid, 2013).

The use of electric fencing is common but not necessarily widespread. Traditional wire fencing is the primary method of pasture confinement. Solar panel technology has improved, and is often used for fence and water systems on pastures not near electricity sources. Solar and wind powered watering systems have become less expensive and more reliable. New technology has also increased use of small lines trenched from farm site wells out to watering sites in pastures to increase water supply and thus flexibility in grazing management.

Some changes in livestock management in recent years are viewed as low-tech. Controlled grazing is a good example. This is possible in the spring and summer growing season, and also utilized with bale, and swath grazing in the dormant season from July into the autumn months. In Special Areas the majority of the forage growth happens in June. By mid to late July and certainly by August moisture is limited leading to decreased forage growth on both natural and seeded pastures. Therefore, management of those pastures in May and June is critical to the grazing strategy. All progressive productive cattle producers use some type of managed grazing systems. This promotes pasture

productivity and biodiversity. All practices that lengthen the grazing season are identified as making the producer money.

Many producers have been moving the calving season out of the colder snowy early part of the year to early May. The calves are born when the weather is warmer and drier, potentially involving less labor and causing less susceptibility to animal disease. This change has also resulted in other modifications such as changing pasture grazing rotations to ensure the grass/forage mix is suitable for the season of grazing.

Productivity in forages has increased significantly with new varieties and especially by increased use of legumes in the seed mix. The addition of legumes such as *Medicago sativa*, *Astragalus cicer* and *Onobrychis viciifolia* Scop. fixes nitrogen and makes it available for the grasses. This increases the amount of forage produced per hectare and increases the longevity of the pasture. Without the legumes or commercial fertilizer, the productivity would generally begin to decline after five to seven years.

The cost of winter feed is a significant component in the cost of production for cow/calf producers. Reducing those winter feeding costs has been a focus for increasing the viability of this sector. Producers often hesitate to modify their tried and true winter feed management strategies until seeing new techniques used by others. Demonstrations and research trials administered by their regional/provincial applied research forage association are very useful, showing the basic technique and identifying costs and benefits.

High-speed Internet, smart phones and social media such as Twitter and Facebook provide access to information not easily accessed previously by rural landowners. Special Areas Board recognized the need for access to high-speed Internet by their constituents, aggressively moving to ensure high-speed access across the whole area. This access to information has provided new tools such as up-to-date weather information which producers considered to be very important. The use of high-speed internet has allowed some producers to develop direct marketing businesses.

Many producers now use software, such as TraceBac and Biotrac, to inform breeding and genetic selection decisions. Increasing numbers of producers are using DNA and expected progeny differences testing to manage for carcass characteristics while using good traditional cattle management to keep mothering ability. Artificial insemination is not widely used except by the purebred industry (Strankman and Reid, 2013).

The Chinook Applied Research Association (CARA) is a producer-directed society formed to fill an identified need for the application of agricultural research and new technologies to the unique environmental and climatic conditions in East-Central Alberta. Projects focus on transferring soil and climatic relevant research technology to

the producer community. The forage component of applied research trials and demonstrations focuses on forage species selection, grazing management, improving condition of native ranges, pest management and utilization of resources other than native pastures for grazing and pest management which address the eco-agriculture theme of ecosystem integrity (Chinook Applied Research Association, 2014).

MARKET AND SUPPLY CHAINS

The last decade has brought significant challenges for the Alberta cattle sector. Drought in 2002 forced many to bring down cattle numbers because the pasture grass to support them was not there. That type of unplanned marketing causes expensive disruption in breeding and marketing programs and has tax implications. Then in May 2003 the industry was rocked by the discovery of bovine spongiform encephalopathy which closed the border to exports. Canada is still dealing with residual trade restrictions. Through the last half of 2007, the rising Canadian dollar and high feed costs created significant additional financial hardship for cattle producers. This was followed by the global economic crisis of 2008 that further eroded sale prices for cow/calf producers. In addition, in late 2008 the United States implemented Country of Origin Labeling (COOL) causing a significant negative impact on Canadian beef export prices. With about 50% of Canadian beef production going to the US, Canadian prices are essentially set by the net price received from shipping to the US. COOL discrimination costs Canadian cattle participants around \$640 million per year. This presents a dilemma given that about 85% of Canadian beef and cattle export trade is with the US generating 1.8 billion CA\$ in total sales (Canadian Agri-Food Policy Institute, 2012).

Special Areas cow numbers have followed the Canadian trend, decreasing since 2005. Canada's cow herd has decreased by one million head (20%) since 2005. How Canada will ensure sufficient cattle supply to meet the future market opportunities is challenging. Per capita consumption of beef is falling domestically (10.7% since 2001) and across the Organisation for Economic Cooperation and Development (OECD). This is contrary to the increase in meat consumption in the developing world. The predictions for continued growth are based on the increasing affluence of middle classes. Canada will need to find ways to out compete effectively other beef exporting countries which are also developing marketing strategies to serve these markets.

Some of the challenges to managing Canadian beef marketing are as follows: reducing dependency on the US market; leveraging strengths of animal identification and traceability in select markets; creating traceability through entire beef chain; growth of domestic market based on an increased understanding of consumer needs; improving communication on consumer issues such as nutrition and product preparation;

effectively utilizing the Canada brand through the Canadian Beef Advantage program (Canada Agri-Food Policy Institute, 2014).

Nearly 60% of Canada's beef is produced in Alberta. The largest confined cattle feeding network and the largest beef processors are located there, and beef is Alberta's number one agricultural commodity.

The majority of Special Areas cattle producers market their 500–600 lb (227–272 kg) pound calves in October/November. Generally, the calves will go directly into confined feeding operations to be fed to a finished weight of about 1200 pounds. Some calves may go to what is termed backgrounding operations to be fed primarily forages for a period of time until market conditions determine timing is good to begin to bring them to market weight. Canada markets a grain finished beef so the calves are fed increasing amounts of grain until they reach their finished weight. That grain is generally barley unless corn prices in the US make it economically advantageous to import and displace the barley in the ration.

Cattle identification in Special Areas originated in the late 1800s utilized a hot brand system that permanently marked the animal's hide. This system continues. In addition, the Canadian Cattle Identification Agency maintains a mandatory cattle identification program. Established initially as a trace back system designed for the eradication of animal disease, technology advancements now support use of approved radio frequency identification tags (Alberta Agriculture and Forestry, 2018). Efforts are underway to utilize this tagging program to provide an information exchange system to link an individual animal to carcass data. Such a system would help producers genetically improve their herds and market the unique herd characteristics to buyers. Special Areas cattle could potentially be identified for various attributes other than carcass such as raised on natural grass pastures supporting unique wildlife habitat.

Special Areas livestock producers benefited from research and marketing initiatives of the Alberta Livestock and Marketing Agency (ALMA). Incorporated in 2009, their business plan was based on a mandate to advocate for industry by influencing policy development regarding legislation and programs consulting with all industry sectors and government to provide focus and direction. The agency supported the Alberta government's vision of industry development in an economically and environmentally sustainable way having a role in the enhanced competitiveness and profitability of the livestock industry in Alberta (Alberta Livestock and Meat Agency, 2011). Recent changes in government resulted in the dissolving of this agency with research being again handled within government departments and a decrease in the amount of funds allocated. These abrupt changes in research approaches are disruptive to research programs which often require many years of data to reach conclusion.

Increasingly, agricultural producers are being asked in differing ways by different stakeholders to account for the environmental and animal care performance of their management practices. Agrifood companies have increased their focus on sustainable development and corporate social responsibility. For example, most recently McDonald's has committed to sourcing sustainable beef in Canada. The effort to define what that will mean is happening through the Canadian Sustainable Beef Roundtable affiliated with the Global Roundtable on Sustainable Beef, initiated by the World Wildlife Fund and McDonald's (Canadian Roundtable for Sustainable Beef, 2014).

SOCIODEMOGRAPHIC

The first colonists settled in Special Areas in the early 20th century, coming from other provinces in Eastern Canada, Europe and the USA. Organized into communities, they built their farms based on a mix of livestock and rain-fed cultivated agriculture.

It was becoming apparent in the 1920s the farming/cropping systems were not sustainable. The plowed land was very susceptible to wind erosion. The extreme fluctuations in rainfall had a serious effect on agriculture production. Families were leaving and the social fabric of the area was unraveling. The 1930s brought severe drought and a North American wide economic depression. More and more families left (Gorman, 1988). A commission recommended a board be appointed to administer the lands and bring stability to the region. In 1938, the Special Areas Board was established by the Alberta provincial government to provide municipal services.

In 2000 the population of the area was 11,200, a density of one person per 188 hectares (450 acres). In 2013 the population had dropped to just over 4499 people. About half of the population lives in small urban areas. The average age of the population is increasing, exacerbated by a high percentage of young people who leave the area. In a concerted directed effort to deal with that loss, Return to Rural, a development initiative, focused on engaging, attracting and retaining youth, was launched. The strategy is to utilize tools such as the Internet, social media and advances in communication technology to connect young people with the opportunities available in Special Areas (SAMDA, 2014).

In 2011 there were 847 farms and ranches in Special Areas with 475 reporting having cattle (Statistics Canada, 2011). This was down 122 farms from 2006. The number of cattle in the area had dropped by about 43,500 from 2006 to 2011. The land in Special Areas is about 45% privately owned with the other 55% leased from the Special Areas Board (Government of Alberta 2009).

Currently, a portion of farms in Special Areas are able to supplement their income with revenues linked to oil or gas-well drilling, or a gas pumping station. Land access payment for the drilling of a gas or oil well is in the neighborhood of 1400 CA\$ a year. The Alberta strong oil-based economy pushes many young people to migrate for wage employment in urban areas, i.e. close to services and with more flexible working hours.

Decreasing agricultural income raises questions regarding the farm/ranch viability for the next generation. Declining farm incomes also have a negative impact on intergenerational transfer within the agricultural community with young potential farmers being driven to urban areas for employment and resulting depopulation of the rural area (Agriculture and Agri-Food Canada, 2006; Canada, Standing Committee on Agriculture and Forestry, 2006).

Although there are numerous and significant economic and social challenges in this region, there is also a strong sense of community and a spirit of cooperation. The majority of the residents do see the area as special, with a natural beauty in the native grass lands and its wildlife. There is uniqueness to the region believed to be marketable. However, to date only traditional recreation opportunities in the form of parks, campgrounds and golf courses have been developed.

PUBLIC POLICY

As discussed earlier the federal government policy in the late 1800s encouraged the cultivation of the native grasslands. However, it is now Special Areas policy and regulation that encourages the retention of rangelands.

Land use management in Special Areas is influenced by a mosaic of federal, provincial and municipal division of power and responsibility in the areas of agriculture and environment. Environment is one policy area where there has been growth in intergovernmental administrative interactions responding to the increase in bilateral and multilateral intergovernmental agreements. Agriculture and Agri-Food Canada, on the other hand, has managed intergovernmental relations by integrating into several department units. All provincial governments have adopted the concept of sustainable development or sustainable resource management and this influences municipalities such as Special Areas (Kennedy and Donehee, 2006).

Increasing producers' profitability has long been the primary goal of Canada's federal and provincial agriculture departments. Farm incomes have been supported and stabilized by a variety of policy instruments with market promotion and trade liberalization being the favorite for the export-oriented grains, oilseeds, and livestock sectors (Skogstad, 2011).

Perhaps the most significant recent change in Canadian agriculture policy was how the federal and provincial governments interacted on the development of what was called the Agriculture Policy Framework (APF) (2003–2008). For income safety nets / business risk management programming, there was a five-year government commitment of funding as opposed to the former three-year agreements. Secondly, business risk management goals were clearly linked to public goods such as food safety and environmental protection (Skogstad, 2011). APF was identified as being an integrative approach to agriculture policy support, agricultural economic viability and improving environmental performance and benefits to society. Subsequent frameworks, Growing Forward I and II, weakened that integration (Strankman, 2014).

Through APF 2003–2008, an important agriculture sustainability tool was developed and delivered in all provinces: an Environmental Farm Plan (EFP). This process supported producers identifying risk and developing a plan to reduce those risks. A suite of 30 Beneficial Management Practices (BMP) received federal and provincial funding. The majority of the BMPs increased agricultural productivity by increasing efficiency, however, there were several BMPs, such as Riparian Area Management, Shelter Belt Establishment, Invasive Alien Plant Species Control, Species at Risk, Grazing Management Planning, Biodiversity Enhancement Planning, positively impacting livestock production (Agriculture and Agri-Food Canada, 2006). The EFP process is no longer actively supported by the federal government through direct guidance or funding. It is still delivered at the provincial level, however, with a wide variation of objectives and support.

In Alberta, the Alberta Land Stewardship Act (ALSA) was passed in 2011 to support a transparent and accountable regional planning process (Alberta Government 20). These regional plans will integrate provincial policies, setting regional land-use objectives, providing context for land-use decision-making within the region, and reflecting the uniqueness and priorities of each region. Special Areas will be involved in the development of the Red Deer regional plan which supports a sustainable development approach by integrating economic, environmental and social factors, and ensures that planning for land use, water and air quality are aligned.

These plans will develop a strategy for conservation and stewardship on private and public lands promoting efficient use of land to reduce the footprint of human activities on Alberta's landscape. These plans if delivered with the promised support and monitoring system should contribute to continuous improvement of land-use planning and decision-making to the benefit of livestock producers in Special Areas.

The livestock producers in Special Areas and the rangelands of Alberta and Canadian Prairies continue to overcome challenges brought by weather and markets. The communities are strong, and the people determined. The spirit of rural people finds opportunities in markets, technology and the traditional ways and stewardship of the land continues.

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United States of America's Dairyland

Sarah E. Lloyd¹

INTRODUCTION

The state of Wisconsin, located in the Upper Midwest, or Western Great Lakes region of the United States (Figure 1), is known as 'America's Dairyland'. You can see this proclamation on the state's automobile license plates and also by the foam hats made to look like a large wedge of cheese that Wisconsinites wear to cheer on their American football team, the Green Bay Packers. Wisconsin dairy farmers produce the second-largest volume of milk in the US after California and the state has been the top US producer of cheese since 1910, producing over 25% of all cheese in the country, with a record of 29 billion pounds of milk produced in 2015 by more than 1.28 million milking cows on just under 10,000 farms (WMMB, 2016).



Figure 1: Location of Wisconsin State, USA

Source: [wikimedia.org \(https://commons.wikimedia.org/wiki/File:Map_of_USA_WI.svg\)](https://commons.wikimedia.org/wiki/File:Map_of_USA_WI.svg)

Wisconsin dairy production is characterized by relatively small, family-owned and operated farms. The average dairy farm has 146 cows (WMMB, 2015). Wisconsin farmers own and rent land to grow crops and forage to feed their herds. This is in contrast to some other parts of the United States. In California, for example, farms are larger,

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with an average herd size of over 1,000 cows. Farms are also primarily family-owned, however, many California farmers do not grow their own feed, buying the majority of feed and hiring more non-family labor than their Wisconsin counterparts. This 'California-style' operation is beginning to be seen in Wisconsin, with an increase in the reliance on hired labor, purchased feed, and an increase in the number of herds over 1,000 cows. Wisconsin now has several farms with over 6,000 cows. The largest Wisconsin dairy farm has over 12,000 cows. This shift to fewer but larger farms is a nationwide trend (Gilbert and Akor, 1988; Jackson-Smith and Barham, 2000; McDonald and Newton, 2014).

Figure 2 shows the change in the number of dairy farms in 'Dairyland' over the years. The number of farms has dropped precipitously from 86,000 in 1965 to 11,295 counted in 2012 (USDA, 2018). As of March 1, 2018, this number was down to 8,719 (WMMB 2018). Despite this rapid reduction in the number of farm operations, the total number of cattle has remained steady and the total production of milk has continued to rise.

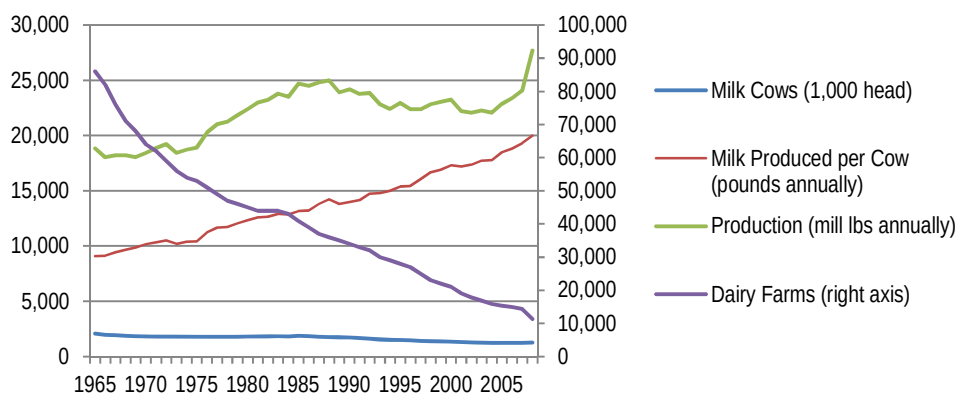


Figure 2: Trends in the Wisconsin dairy industry. Source: USDA

TECHNICAL CHANGES

The increase in overall production and production per cow has been accomplished through a number of technological changes in dairy farming. Advances in scientific feed rations for cattle, as well as more farms moving to three-times-a-day milking have resulted in increased production per cow. Improvements in cow comfort and breeding have also resulted in increased production per cow. The majority of dairy farms in Wisconsin operate confinement systems, in which cattle are housed in free stall barns with limited access to pasture and are fed a “total mixed ration” strategically designed to maximize milk production.

It is important to note that not all farms are using a confinement system. At least 22% of the total dairy herds in Wisconsin are practicing management intensive rotational grazing (MIRG) (Paine and Gildersleeve, 2011). In the MIRG system cows are moved at least once a day to fresh pasture. This results in reduced production per cow, compared to confinement operations. However many farmers using the MIRG system achieve a better financial return per cow and per volume of milk produced because of lower input costs (Kreigl, 2016).

The technological changes seen in Wisconsin are similar to those seen in the US in general. The changes have been supported by research and development primarily through the University of Wisconsin system, as well as federal dollars coming through different departments of the US Department of Agriculture (USDA). Federal support also comes in the form of grants and favorable loans to individual farm operations and state and local level agencies to assist with installation of new technology and adoption of conservation practices. The industry itself also funds research and development in the sector.

MARKET AND SUPPLY CHAINS

Wisconsin is known for its cheese, both the large-scale production of commodity cheeses, such as cheddar and mozzarella, and a diverse mix of smaller-scale, artisanal production. Wisconsin ranks fourth in the world in cheese production, just behind the rest of the US, Germany and France. In 2016 Wisconsin cheesemakers made more than 600 different varieties of cheese in 144 licensed cheese plants. Ninety percent of all the milk produced in Wisconsin is made into cheese and 90% of this cheese is sold outside of the state of Wisconsin (WMMB, 2018).

Over 75% of all milk produced in the United States is procured, processed and/or marketed through farmer-owned cooperatives (Cropp and Graff, 2001; Geiger, 2013). The rest is pooled and processed by privately held businesses. Compared to other parts of the country, Wisconsin has had good competition for farmers' milk because of the volume and diversity of cheeses and other dairy processing in the state. Despite strong demand for milk in Wisconsin, dairy farmers have faced increasingly volatile prices and increased feed costs (Burdine et al., 2014). Many farmers are operating for increasingly long periods with prices paid below their cost of production. This has led many farmers to go out of dairy or to look to expansion to produce more to keep their farm business afloat. Access to credit for capital inputs has helped in this trend toward expansion. In 2017 and 2018 farmers were impacted by a new scenario, that of regional overproduction surpassing processing capacity. There were more frequent reports of farmers receiving 30-day or more generously 90-day notices from processors saying they would no longer take a farmer's milk because there was no room at the plant

(Hansen, 2017; Morgan, 2018). This situation continues and will push more farms out of business.

A notable trend in the marketing and supply chains of Wisconsin has been the development of the certified organic market for dairy products. Wisconsin has a strong place in the national organic production because of the founding and development of the Coulee Region Organic Produce Pool (CROPP), marketed nationally under the brand Organic Valley. There are also other organic dairy producers and processors operating in Wisconsin. In the United States, certified organic dairy production prohibits the use of synthetic pesticides and herbicides, as well as antibiotics, and requires that animals have access to pasture in the dairy production system. In order for a farmer to sell milk as organic, he must have a third-party certification based on a set of criteria overseen by the USDA National Organic Program. The move to organic production and certification is a strategy used by farmers to try to find more viable markets for their milk.

Wisconsin ranks first in the United States with 466 organic dairy farms (Carusi et al., 2015). Farmers receive a premium price for organic milk, often 10–15 US\$ higher per hundred pounds of milk than the price received by conventional farmers. There have also been efforts by Wisconsin farmers to differentiate their product as grass-fed or grass-based. Some efforts to market fluid milk, butter and cheese have come and gone, but this remains a potential market for premium prices for farmers who are producing in pasture-based systems but may not be certified organic. In 2017 and 2018, organic farmers began to be impacted by oversupply, like their conventional counterparts. Reports of organic milk being sold without a premium in the conventional market were more common (Durisin, 2017).

FARMERS' SOCIO-DEMOGRAPHIC CHARACTERISTICS

Wisconsin dairy farms are getting larger and fewer in numbers. Also of importance is the age of the average dairy farmer. According to the 2012 USDA Census of Agriculture, the average age of the principal farm operator in Wisconsin is 56.5 years (USDA, 2015). The structural changes of Wisconsin dairy farming described above also include a shift toward the use of hired non-family labor. This shift comes both from farms getting bigger and needing labor outside of what the family can provide and also changes in family labor availability. Many farms send a spouse off farm to work for additional household income and to obtain health insurance in the US health care system which is tied in most situations to employers and employment. Additionally, many farmers do not have children who are interested in working on the farm nor taking over the farm business. The increase in the use of hired labor has been characterized over the last two decades by an increased reliance on immigrant labor, primarily from Mexico.

It is estimated that over 40% of the Wisconsin dairy labor force is comprised of immigrant workers. US agriculture has a long history of reliance on migrant workers; What is unique in dairy and Wisconsin is that the reliance on immigrant labor only began in the last 10–15 years, and the workers stay year-round on the farm and are not itinerant in the same way that harvest labor for other produce often is (Harrison and Lloyd, 2013).

PUBLIC POLICY

The public policy that impacts Wisconsin dairy farms comes from federal, state, and local municipal levels of government. US federal agricultural policy dictates price supports and subsidies on products and crops and also provides resources for farmers to implement conservation and nutrient management systems on their farms. Federal money is also made available to assist in new market development, including the expansion of export markets. Federal policy has shifted over the years and has had different impacts on dairy farmers and dairy production.

The 1933 and 1949 Agricultural Adjustment Act, and the 1954 Agricultural Trade Development and Assistance Act are the key pieces of federal legislation that created the base of policy impacting agriculture for decades to come. The 1933 Act set up the concept of parity pricing. The 1949 Act created the price support system, and the 1954 Act encouraged export of price-supported products (Weimar and Blayney, 1994). The federal policy from 1933 into the 1980s was based on the idea of parity. Prices paid to farmers for their outputs should reasonably cover the cost of their inputs or cost of production, and farmers should have an income and level of well-being comparable to non-farm families. This US Federal government policy was set up over these years to support prices to parity or some percentage of parity when the market did not reach this level. It also included market intervention mechanisms, primarily through the Commodity Credit Corporation (CCC), to purchase and store surplus product to attempt to increase prices paid to farmers. The concept of parity was a driving force of price support programs in the US through the early 1980s.

In the 1980s and into the 2000s, dairy policy moved away from parity pricing ideas and was primarily based on the federal government setting ‘floor’ prices and stepping in with ‘counter-cyclical’ payments to farmers when the market fell, or ‘disaster’ payments when weather or climate severely impacted production. CCC purchases also continued. There has been limited use of voluntary supply management in US dairy policy. In the 1980s the Food Security Act of 1985 offered whole herd buyouts to farmers to try to remove production from the market (Weimer and Blayney, 1994; Brown et al., 2010).

In the 2010s, federal policy has moved from direct payments to farmers to a system of federally subsidized insurance premiums to protect against crop loss and ensure price margins achieved in the market. The crop insurance mechanisms are either run by private insurance companies receiving premium subsidies from the federal government or in some cases the programs are run entirely by the government. The 2014 Farm Bill set up the dairy Margin Protection Program (MPP), run by the USDA, that should allow farmers to ensure a certain margin over cost of feed, replacing the Milk Income Loss Contract (MILC) program (USDA, 2018). Since its inception MPP has not proven to be an effective mechanism to support dairy farms during low-price periods.

There are other federal policies that impact dairy farms. The federal Environmental Protection Agency (EPA) also has some jurisdiction over water quality issues connected with dairy farms. However, EPA jurisdiction is currently being contested in the court system by owners and organizations representing large-scale dairy farms. The state of Wisconsin also has a hand in policy, primarily in overseeing nutrient and water impacts of dairy farms of over 1000 animal units. Attempts by local government (county, city, town or village) to put limits on large-scale animal operations have been thwarted, with the state of Wisconsin stepping in through the Livestock Siting Law, which was enacted in 2004. This has put control of siting rules at the state level and out of the hands of the local government. Individual citizens, sometimes acting with support from non-profit organizations, have had to challenge individual farm expansions in the court system (MEA, 2018).

The state of Wisconsin also administers programs and grants, some of which come from federal money, to provide tax incentives to increase production and processing of dairy products in the State. County and local governments also oversee zoning and provide technical assistance for farmers in conservation, nutrient and land management.

In addition to policies listed above, historically the federal government has made credit available to farmers for operating loans and capital investments. This comes in the form of the Farmer Services Agency administered by the USDA but also the Farm Credit Services system, which is a national network of borrower-owned financial institutions originally chartered by the US government. Private banks also provide credit for farmers allowing them to operate their businesses.

THE FUTURE OF DAIRY FARMING IN WISCONSIN

The history of dairy farming in Wisconsin is long and has fundamentally shaped the landscape and the economy of the state. The business of dairying for farm families has been one of both economic struggle and success over the decades. At the printing of

this chapter dairy farming in Wisconsin is threatened by overproduction and catastrophically low prices, making it difficult for even the best business person and the hardest worker to make the farm business function. If farmers and agricultural advocates, along with politicians and decision makers, can come together to address the price issue then Wisconsin will surely continue to be a strong dairy producing state in the future. However, the lack of historical precedent for supply management does not ensure that this mechanism will be employed to try to mitigate the impact of continual low prices due to over-supply in the market.

Of any of the states in the country, Wisconsin has the most promise in finding diversified markets and premium prices. The wide diversity of processing, seen primarily in the specialty or artisanal cheese production, can be a real strength for dairy in the State going forward. In addition, the strength of the organic and the grass-fed/pasture-based dairy sectors hold continued promise to give Wisconsin a unique spot in the marketplace. Consumers increasingly are looking for information about where their food comes from and who produces it. Wisconsin has a dairy structure, diversity and distribution, that if strategically managed, could find a true fit for these consumers.

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Livestock policy in the Brazilian Amazonia colonization

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INTRODUCTION

Half a century after the colonization of the Brazilian Amazonia launched in the 1960s by the military government, the frontier – as it has often been called – seems more than ever to have reached a decisive stage. The pioneer phase is just about finished. All the elements of the puzzle are there, have been brought in or built, and have been organized, gradually or intermittently, with more or less reluctance, in a logic of construction not always very well coordinated. Many authors have mentioned the central role of livestock in the colonization of Amazonia (Santiago, 1972; Ianni, 1978; Moran, 1993; Veiga et al., 2004; Sayago et al., 2004; Walker et al., 2009), in particular as one of the main drivers of deforestation (Schmink and Wood, 1992; Droulers, 1995; Faminow, 1998; Treccani, 2001; Caldas et al., 2002; Porro et al. 2002; Tourrand et al., 2004; Pacheco, 2009a). Also, the ‘colonization by the cattle leg’ (*a colonização pela pata do boi*) and the size of the herds, as a means of differentiating between the large inevitably dominant and the small necessarily oppressed, have contributed to making cattle breeding as the ‘bad guy’ (*vilão*) of Amazonia, an expression that means the entity responsible for many evils of the regional rural society. This ubiquity of livestock farming in Amazonia’s recent history makes it an excellent observation post of the dynamics under way since the beginning of colonization, including the successive policies implemented in the region. Thus, the objective of this chapter is to present, based on a diachronic analysis, the main steps of livestock farming in the Brazilian Amazonia and the policies that have been associated with it.

First of all, Amazonia means different things, even diversity is a major biome constant (Figure 1/1). As shown on the map in Figure 1, there is the Brazilian Amazonia (Figures 1/2 and 1/4), which alone covers nearly two-thirds of the Amazon basin, the Amazonia of Guyana in the northeast and the Amazonia of the Andean countries

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in the east (Figures 1/2 and 1/3). There is the Orinoco basin or Llanos biome (Figure 1/1) which may or may not be included in Amazonia. Within Brazil, we can distinguish Legal Amazonia (1/4), which includes in a vast administrative space Amazonian ecosystems strictly speaking (Amazon Rainforest, Figure 1/5) and some pre-Amazonian ecosystems with characteristics closer to those of neighboring biomes, such as the Cerrado of the western part of the state of Maranhão (MA), the center of the states of Tocantins (TO) and Mato Grosso (MT), or the savannas of the state of Roraima (RR) to the north.



Figure 1: Some of the diverse names of the Brazilian Amazonia

Moreover, colonization has not been uniform because it has been forced to take into account the constraints and specificities of each ecosystem. This has led to different dynamics in the major regions of Amazonia. Moreover, following Droulers (1995), the scientific community distinguished the 'Amazonia of the Rivers' (*Amazônia dos Rios*) from the colonial phase of the late 19th century and the first half of the 20th century. The Amazonia of the Rivers is populated by Amerindian and Caboclo communities (resulting from successive crossbreeding between Amerindian populations, slaves and settlers). These populations are settled around rivers, the main transport routes. On the other hand, the 'Amazonia of the Roads' (*Amazônia das Estradas*) is populated by migrants from the colonization set up in the second half of the 20th century. These migrants are settled along the roads and tracks built for colonization and going as far as the heart of the forest massifs. Our scope of observation was limited to the colonization along the roads of Brazilian

Eastern Amazonia, and more specifically to that of the state of Pará with three sub-regions: Redenção and the south of Pará State around Redenção at the border with Tocantins and Mato Grosso states; Altamira and the Trans-Amazonian Highway in the center of Pará State; and Paragominas in the northeast of Pará State at the border with Maranhão State.

This chapter presents a chronicle of the successive public policies in general, and livestock policies in particular, implemented in Brazilian Eastern Amazonia since the beginning of colonization. Presented phase by phase, the observations are based on livestock issues for the reasons previously indicated; the chronicle also focuses on the different activities concerning rural environment.

PREFACE OR COLONIZATION GESTATION MORE THAN HALF A CENTURY AGO

Livestock farming has reportedly been present in Brazilian Eastern Amazonia since the first Portuguese settled in Belém Region (Velho, 1972; Vaz, 2013). Arrived with the settlers' boats, livestock has been from the beginning an essential component of the farms located on the outskirts of Belém, along the Atlantic Coast, then of the railway crossing Bragantine, a region located in the east of Belém City. This is evidenced by the two bust statues at the entrance of the former railway station of Belém built during the rubber era at the end of the 19th century. The transport of cattle by river on the Guamá, Tocantins and Pará rivers for slaughter to supply Belém's market is also mentioned. The island of Marajó, located on the other side of the southern mouth of the Amazon River, was also a breeding area very early on, because of the presence of vast savannas suitable for this activity. Finally, according to Vaz (2013), the arrival of livestock in southern Pará is more recent, by the end of the 19th, then by the beginning of the 20th century. These various introductions could explain why the first pioneers of the mid-20th century found a local workforce accustomed to handling livestock.

1960S: BIRTH OF COLONIZATION

As early as the 1950s, alongside traders searching in the Amazonia for various 'drugs of the bush' (*drogas do Sertão*) (gum, rubber, aromatic and medicinal plants, and wild animal skins) to sell them in other parts of Brazil, the forerunners traveled through the Amazonia, some in search of gold mines, others to delineate their future lands and obtain titles that could be traded later on (Vaz, 2013). Their presence in the region was justified in large part by the imminent arrival of colonization. Indeed, several of them had experienced or witnessed similar land speculation a few years earlier during the colonization of the Cerrado (Savanna of Central Brazil) and Mata Atlantica (Atlantic Forest along the coast) biomes. They had been able

to appraise the great opportunities of the land and thus positioned themselves in Amazonia very early on. As soon as colonization was officially launched in the mid-1960s, land was available for sale to migrants who had decided to settle.

The proposal for Amazonia aimed to develop and integrate the region into the national and international market through i) the construction of transport infrastructure (roads, ports and airports allowing the arrival of migrants, equipment and inputs, as well as the flow of production), ii) the allocation of land to any individual or company undertaking to develop it with or without the support of loans at very attractive rates granted by the two public banks set up for this purpose, BASA (*Banco da Amazônia SA*) and SUDAM (*Superintendência do Desenvolvimento da Amazônia*), and iii) numerous tax advantages granted to big companies, and national and international economic groups for any establishment.

In part to secure the national territory against the possible extension of the Araguaia guerrilla, the military government preferred to allocate land to companies from the Sudeste states, with priority given to São Paulo and Minas Gerais, via attractive financial incentives based on tax exemption for all investments in Amazonia (Veiga et al., 2004). The land unit allocated was approximately 4500 hectares. A few big companies committed themselves to several units, even several dozen units, as shown by the land allocation map drawn up by Paragassu in 1973 based on 1968 cadastral data. These land allocations concerned only part of the land, most of which remained under the control of the state of Pará or the federal government. In addition, in various regions made accessible by the opening of tracks, private investors, with or without the support of public authorities, have also embarked on settlement projects to receive small migrants in search of land, particularly in Paragominas Region.

It should be recalled that all the authors agreed that there are three main factors at the root of colonization: the need to secure the national territory against the views of neighboring countries and guerrillas (*integrar para não entregar*: integrate so as not to be forced to give); the exploitation of soil resources but also and above all of the subsoil; and the economy of agrarian reforms by giving land to those excluded from the modernization of agriculture in the rest of Brazil (*dar terra sem homem aos homens sem terra*: give land without men to landless people). BASA and SUDAM were created in 1966 to finance colonization, both in the public and private sectors.

In its various successive versions, the National Development Plan of Amazonia aimed above all at occupying areas considered empty, along with their physical, economic and social integration, in particular through building four major roads, and their networks of secondary roads providing access to the deepest parts of the forest massifs: three north-south roads, i.e. Belém - Brasília or BR210, Cuiabá - Santarém or BR163, Cuiabá - Porto Velho - Rio Branco or BR364, and one transverse road, opened in 1972, the Trans-Amazonian Highway or BR-230. Subsequently and as expected, roads became the entry routes for thousands of settlers (Nascimento, 2007). They played an essential role in the life and economy of the border while directly influencing agrarian settlement programs.

1970S: BEGINNING OF COLONIZATION

Colonization was carried out in a differentiated way according to the regions, which is well illustrated by the three study areas of Southern Pará, Trans-Amazonian Highway and Paragominas. In Southern Pará, faced with the complexity of settling in Amazonia, especially long and difficult access by land and to the allocated land, often inhabited by Amerindian or Caboclo communities, many companies reconsidered their intention to settle there. They took the land, then abandoned or transferred its rights to anyone, sometimes to persons who had already received funding from BASA or SUDAM. Early small-scale migrants took advantage of this opportunity to recover temporary land titles at low cost. Some did not hesitate to settle in public lands and appropriate large areas. It had been a 'shooting match for land control' to use the expression of Uztarroz and Sevilla (1990). The authorities let it happen as the occupation of the Amazonian area was the main objective of colonization. In addition, everyone could benefit from BASA and/or SUDAM funds when they justified the exploitation of their land through deforestation, between a quarter, a third and a half of the land, depending on the case. Forced to clear forests and develop their land to obtain bank support, many settlers opted for cattle ranching, especially since the supply chains for plant products were still inefficient because of the isolation of the region.

Along the Trans-Amazonian Highway, an integrated settlement plan provided opportunities for the establishment of small settlers on areas of about 100 hectares, farms of 500 hectares, and ranches of 3000 hectares or more. Waves of migrants arrived in the early 1970s motivated by propaganda coordinated by the authorities, but above all without a future for them and their families in the South, Southeast and Northeast (Walker and Homma, 1996; Le Borgne - David, 1998; Caldas et al., 2002; Porro and Wood, 2002; Veiga et al., 2004; Pacheco, 2009a; Carvalho, 2010). Faced with settlement difficulties, many migrants returned to their home regions before the end of the first year. The others cut down and burned small plots of forest to plant food crops (rice, maize, bean, cassava) for self-subsistence and sale, then perennial crops (cocoa, but also pepper and coffee). The agronomic results were relatively good. On the other hand, the marketing of crops was a real constraint, particularly because of the very bad road infrastructure.

Paragominas Region, also located on one of the main roads (Belém - Brasília), benefited from the proximity of Belém City, regional capital and consumption center, on one hand, and the neighboring state of Maranhão, on the other. Isolation was less pronounced than in Southern Pará or the Trans-Amazonian zone. Access to services was simplified, as well as shorter, more competitive and therefore making a priori the area more profitable for producers. Paragominas Region is characterized by the diversity of the forms of colonization encountered, especially since it is crossed by rivers near which long-standing communities resided and were directly linked to Belém by river. The soils are less rich than those of the Trans-Amazonian region. Moreover, pasture establishment usually followed slash-and-burn farming

and the region quickly became a major livestock center, especially since it served as a relay for livestock from the south of the State to be slaughtered and consumed in Belém.

1980S: FIRST STEPS, FIRST SUCCESSES, FIRST MISTAKES

The frontier was organized around food/perennial crops, small dairy and/or beef farms, family farming along the Trans-Amazonian Highway, cattle ranching from the very small to the very large, in Southern Pará and Paragominas, with subsistence farming in the interstices of ranches and in marginal areas. In addition, these last two regions had been experiencing major logging, marking the advances of deforestation, itself linked to the establishment of new pastures and land strategies. In these regions, any parcel that was no longer in the forest was changed into grazing land, productive or degraded, or was invaded by forest regrowth. Even on the Trans-Amazonian, more than 80% of the cultivated area was grazed and partly degraded.

New waves of migrants fleeing hardship in Southern regions arrived attracted by the perennial crops on the Trans-Amazonian, mainly cocoa, coffee and pepper, and logging jobs in Southern Pará and Paragominas. A violent drought episode in the Northeast encouraged the departure of new migrants to Amazonia. Public institutions remained in place even if, for the same number of staff, they had difficulty meeting the growing demand from newcomers, who were often poor and inexperienced.

A slaughterhouse was built in Paragominas, in the very heart of one of the main cattle production basins, with the aim of transporting meat by road to Belém and exporting it directly to the urban centers of the Brazilian Northeast. It gradually changed the situation in the livestock sector as it paved the way for the relocation of agroindustries to production areas, relocation made possible by the improvement of the road infrastructure.

The preponderance of grazing in the deforested area of most of the colonized regions, which have become largely degraded, was one of the factors behind the various social and environmental movements against deforestation, the destruction of Amerindian societies, and poor development at local and regional levels. Public authorities responded with a policy of non-intervention. Even if they had wanted to, they did not have the financial, human and political means to control better the current dynamics, a bit as if the colonial machine was racing with the main impact of deforestation, whose rate was constantly rising. However, looking back it is the time when today's elites have begun to emerge, in the midst of debates and conflicts over deforestation and unbalanced development. Some timid political measures have been taken, such as BASA and SUDAM public funds, which are now, in theory, reserved for the recovery of degraded pastures, modestly called degraded areas, and no longer for increasing deforested areas.

1990–1995: TEENAGE CRISIS

At the turn of the 1980s and in the first half of the 1990s, the collapse of food and perennial crop prices worldwide had a strong impact on family agriculture in the Amazonian regions where it had been the basis for its development, particularly along the Trans-Amazonian Highway. Many operators were ruined. Many migrated to cities in search of employment, often in expanding logging, or further along the border. They sold their land to those who had been more successful, thus creating real small land estates. At that time, thousands of hectares of cocoa, coffee and pepper were uprooted and replanted in pasture because livestock farming appeared to many – large and small producers, technicians and experts – as a lesser evil, at least in the short term, because of a regional market for meat and milk that was both profitable and expanding. However, this required another skill that was not always available, as well as larger areas cultivated by families, and therefore to the detriment of the forest, which was therefore cut down and burnt. At the time, it was estimated that about ten hectares of cocoa produced an income equivalent to 200 hectares of pasture.

To meet the demand for livestock and pasture and in response to the crisis in crop markets, the government agreed that the Financiamento do Norte (FNO), a special fund for family agriculture initially intended for the development of perennial and fruit crops, should gradually become a livestock financing mechanism. It has thus significantly contributed to the expansion of deforestation in family agriculture and to the development of livestock farming among this population.

At national level, the power of the new democracy was marked by political and financial scandals that led the Collor government (1990–1992) to resign. Inflation was at its highest, around 1000% per year. The social divide widened, both in urban and rural areas, as the richest became richer while the middle class and the poor became poorer. Trust was gone. The D system or *jeitinho* became the rule. Tired of successive economic failures, few believed in 1994 that the Real Plan led by Fernando Henrique Cardoso government (1995–2002) would succeed; similarly, only a few more believed that the Seleção (Brazilian football team) would reach again the firmament.

1995–2005: THE CARELESSNESS OF AMAZONIA YOUTH MAKES DEFORESTATION A GOOD BUSINESS

The 1990s have been a tragic decade for deforestation because rates reached record highs and above all many actors lived from it, directly or indirectly. Alongside family farming, which drew its meager livelihood from the natural resources of its land, ranches were taking advantage of the growing regional demand for meat, as well as exports to the urban centers of the Northeast, to increase their surface areas, herds and therefore production. The sector organized its supply, production, marketing,

slaughter and distribution networks. Gradually, these networks structured the frontier, by increasing deforestation and transforming the area into pasture. Poccard-Chapuis (2005) referred to this period as “the networks of conquest”.

The scientific community and non-governmental organizations (NGOs) were also mobilized against deforestation through their own networks operating locally, nationally and globally. Deforestation was in the news. It kept coming back in national and international media, to the great displeasure of local actors. Even those who were a priori against deforestation benefited from the media and financial spin-offs it generated. Their actions focused on the limits and flaws of development resulting from colonization, proposing alternatives that unfortunately were not always successful when applied. This was the case with the responsibility placed on international forest groups, which immediately disengaged from their wood supply, leaving it to unscrupulous smallholders who had no restraint in entering indigenous reserves and other lands hitherto relatively protected from deforestation.

As for the control of deforestation in the hands of public authorities relayed by a few NGOs, they did not resist corruption in the face of the colossal sums at stake. Besides, many who refused the deal paid with their lives. In addition, even if the State wanted to control deforestation, it would run the risk of causing a drift, Colombian-style, with armed militias sprouting up, with political and financial ramifications, and the local population support, as it mainly lived off deforestation. The atmosphere was becoming mafia-like.

However, Brazil in the new millennium, an emerging country entering the big league, had been accepting this Amazonian gangrene more and more badly. It was a little as if the infernal machine of colonization had been going too far and shattered other regions and sectors of activity, especially with regard environmental issues. The situation is all the more complex because the country's growth has been based largely on the exploitation of the Amazonian subsoil resources and its hydro-energy.

2005–2015: ADJUSTMENT BY THE STATE...

WHICH DECIDES TO WHISTLE AT THE END OF THE PARTY

Brazil's emergence on the international scene following a decade of growth and the arrival of Lula's government (2003–2010) with teams with progressive visions changed the situation in Amazonia by opening new perspectives in which civil society and public institutions were engaged. Satellite images made it possible to monitor deforestation in near-real time and, above all, to make this known, and thus better target responsibilities. Control has been strengthened with substantial human and financial resources implemented by public authorities. Corruption became more difficult because people, methods and the context as a whole, were changing.

The new context created alternatives to deforestation, some of which were old, more prevalent, such as intensification from integrated agriculture-livestock systems and forest plantations on already deforested land. Research and teaching had

previously received substantial funds to imagine the paths to sustainable development, a notion that has become the leitmotif of political discourse and development programs. Attitudes were slowly changing, but the general impression was that what could have been done a few years back in terms of environmental impact could no longer be done, especially for deforestation.

In this new context, many were beginning to think of mechanisms based on unimaginable scenarios just a few years before. Thus, according to Barreto et al. (2008), launching appropriate incentives to increase livestock productivity and compliance with environmental legislation, based on subsidies and payments for conservation and reforestation, would be one of the necessary measures to make livestock farming more sustainable in Amazonia.

In this positive shift from a vicious circle based on deforestation to the beginning of a virtuous spiral based on sustainable development, the first public policy measures calling into question the land resulting from colonization had the effect of a bomb. Unimaginable a few years before, the settler had to justify his lands and what he had done with them. In the first instance, the public authorities reminded large-property landowners or their descendants that they were not the owners but just the managers of a public good for which they were held responsible for maintenance and use. Recreation was over; the new rules of the game were set by public authorities and their social and societal support; each family had to present its environmental balance sheet, face the consequences and propose an appropriate way out of the new regulations in force.

Some social groups quickly understood the new situation and the implacable need to comply with it, as in the case of Paragominas' governance which, with the Município Verde (Green Commune) initiative, allowed the municipal community a way out from the top – even became a model – when the municipality was stigmatized for its action in deforestation, at least at both regional and municipal levels. In addition, each family in the large landowner group benefited individually from the new dynamics at municipal level. Even if sanctions should not be reduced, a lower-cost outcome seemed possible as long as there was compliance with the new rules. In light of the highly publicized success of Município Verde in Paragominas, other municipalities, also pilloried for their environmental impacts, followed suit in order to get out of the black list of deforestation municipalities as soon as possible.

DISCUSSION AND CONCLUSION

Omnipresence of the State and public authorities

Nowadays, in Brazilian Amazonia, nobody mentions the absence of the State and public authorities. On the contrary, many prefer the previous period and would do better without the current government control over land and environmental issues.

However, less than a decade ago, such statements were made by various groups of actors in response to what they considered to be the weak or non-existent action of the State and its institutions in the region (Pacheco, 2009b). Thus, the most frequent statements were: "The State has abandoned us" or "We can only rely on ourselves."

The diachronic reading we propose here shows, on the contrary, the omnipresence of the State since the beginning of colonization, even if it is less visible at certain periods than at others. This confirms the results obtained by Tourrand et al. (2007) for the south of Pará State, which, based on 1999–2001 data and the life trajectories of different settlers, compare the colonization of the region to the game of Monopoly, where public authorities play the role of the bank.

In periods of low visibility of public authorities, the criticism was less about their absence, because institutions were always present, than about the non-application in Amazonia of the norms and rules in force at national level. Thus, economic actors demanded above all a road infrastructure to sell production (Walker and Homma, 1996). The local population also demanded social health and education services appropriate to their needs (Sayago et al., 2004). The demands of the scientific community and NGOs concerned the ineffectiveness of controls and therefore the absence of sanctions for offenders when all the instruments were already in place, particularly in the Forest Code, as shown by Treccani (2001) concerning illegal land allocation. The allowed deforestation norms of 20% or 50% are a good example of the cacophony at all levels of power and the low efficiency of its instruments, even if they do exist. It is clear that, less than two decades later, the situation is the opposite with a strong and visible presence of public authorities.

In addition, the efforts made by public authorities over the past decade to improve living conditions in rural areas are important, particularly those concerning family farming communities. Firstly, there are financial assistance measures such as retirement to which all operators have access from the age of 60 for men and 55 for women. Pensions have considerably changed the economic situation of rural families because, in addition to providing a fixed income for older people and thus better integrate them into the local economy, they have enabled them to withdraw from agricultural activities and to pass them on more easily to their children. Secondly, there are scholarships to help the poorest families, especially to send children to school, and thus to reduce in the long term the flow of young and newly excluded people. At the same time, the government has launched programs targeting basic services such as access to electricity and communication networks. A large-scale land regularization program targeting family farming has also been launched, especially since land title is often an essential document for accessing public aid and financing. Finally, technical assistance has also been reorganized, including the financing of private institutions to compensate for the shortcomings of the public assistance system.

Livestock remains a pillar of local development that is increasingly integrated at national level

Although strongly criticized from the beginning of colonization for its social (Ianni, 1978; Schmink and Wood, 1992) and environmental (Hecht, 1989; Kaimowitz et al., 2004) impacts, livestock remained throughout the period one of the pillars of local development, from Santiago (1972) to Carvalho (2010). There are several reasons for this. A main one is the plurality of the herd functions, its multifunctionality, as it is adapted to the region and to the frontier context, a source of income that can take several forms (milk, cheese, meat, skin, breeding stock, calves), or represent security (as it is easily marketable), safe savings, a guarantee, an investment fund (Veiga et al., 2004). Livestock reduces the vulnerability of families in all its forms. Pocard-Chapuis (2005) highlights the efficiency of the cattle sectors and their roles in the construction of territories, particularly through the multifunctionality of livestock farming, but also through economic activities and job creation. Moreover, Veiga et al. (2004) show that even the expansion of grain cultivation in Eastern Amazonia at the beginning of the 21st century was initiated by herders and built to support the livestock sector by recovering degraded pastures. In addition, the latest work on the integration of crops, livestock and forestry continues to position livestock as one of the major components of tomorrow's rural Amazonia.

At the same time, livestock benefited from almost all the public policy measures implemented during colonization, starting with BASA and SUDAM funds for pasture establishment on ranches and their recovery, financing for family agriculture, as well as other mechanisms for the development of the dairy, meat and skin agroindustries (Veiga et al., 2004). Similarly, public investment in road and transport infrastructure promoted livestock farming throughout the period. Paragominas' location near Belém and along the Belém - Brasília road is a good example (Burlamaqui et al., 2013). Almir Gabriel's victory in 1996 in the governance of the Pará State was due to the votes of the south of Pará, where he had helped rebuild the roads.

In addition, livestock farming in Amazonia continues to be integrated at national and international levels through marketing networks in which its products have already been well established, but also through livestock support structures, in particular private and public academic and research institutions in the Southern regions that are increasingly investing in Amazonia. The national livestock governance, both programming and regulation, and the various think tanks are gradually departing from the dual vision of 'Amazonia and the rest of Brazil' of livestock farming by integrating the Amazonian dimension of livestock farming at national level, while seeking the most appropriate technical and financial mechanisms to increase its sustainability.

Livestock policies are evolving toward more flexibility and participation

The diachronic analysis shows a change in the adequacy between livestock policies and the expectations of decision makers, and the needs of local populations. Thus, at the very beginning of colonization, the obligation to clear a quarter, a third or half of the land in order to obtain a loan worked in favor of livestock farming, but at the expense of natural resources. Moreover, this measure was not called into question for years. Then, in the face of the environmentalist movements of the late 1980s, the redirection of BASA and SUDAM loans from the establishment to the recovery of degraded pastures seemed more like a second best than a real public policy to reduce deforestation, especially since ranches were the first beneficiaries of these loans. The evaluation of loans for family farming is controversial, because of the interests of the agents in the beef sectors, supervision and health control.

Recent measures have led to a significant reduction in deforestation through the participation of downstream stakeholders in the beef sector. At the same time, they highlight the land situation of large farms by questioning the mismanagement that prevailed during the last three decades of the 20th century. In addition, they require the same large operations to take into account their environmental liabilities.

It is therefore clear that the political framework for livestock farming in Amazonia has changed considerably, especially since the economic context is also changing significantly, as shown by three fields of study. Indeed, the prospect of Belo Monte dam on the Trans-Amazonian Highway radically changes the regional situation with the unprecedented influx of a workforce estimated at several thousand households, creating a new demand for products and services that is also unprecedented. In Paragominas, the soybean boom, and more broadly the boom in grain exports, with a total area multiplied tenfold in a decade, is gradually putting cattle farming at the second place in the regional economy. A similar scenario exists in Southern Pará, but with a boom in milk production that benefits family agriculture, a boom that we knew was coming since the turn of the millennium.

In conclusion, the policies of the Amazonian frontier since the beginning of colonization have always been very close to or coincided with livestock policies, mainly because of the livestock major role in family, collective and territorial dynamics at local and regional levels over the past half-century. Initiated under the military government, they have gradually integrated the principles of democracy, in particular through self-monitoring by sector and participatory methods, to achieve convincing results, as shown by the measures to control foot-and-mouth disease, livestock movement and, in the process, deforestation, for which livestock farming was one of the first drivers. As the colonization phase moves away, it is logical to assume that the path already mapped out will continue toward greater accuracy, coherence and coordination of public action, including public policy measures, toward greater sustainability of territorial development.

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Livestock farming and public policies in Rio Grande do Sul, Brazil

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INTRODUCTION

This chapter brings the history of the land occupation in the state of Rio Grande do Sul (RS), Southern Brazil (Figure 1) by describing the formation and transformation of breeding farms and livestock production. It considers how such evolution has been influenced by public policies and environmental conditions. Since the initial occupation by European settlers, the social, economic and cultural formation of the State was significantly marked by livestock. Major transformations occurred over time, and livestock farming began to interact more with cropping activities, leading to greater diversification of production patterns.

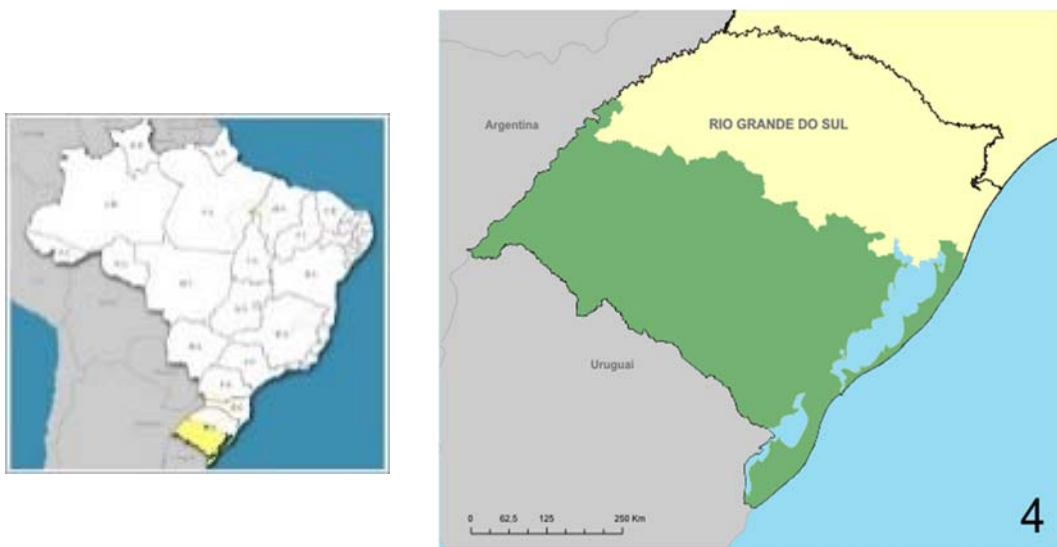


Figure 1: The state of Rio Grande do Sul, Brazil, and the Pampa area (in green on the right-hand map) at the borders with Uruguay and Argentina. Source: <http://mesometadesulrs.com/>

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LAND OCCUPATION - VARIOUS BEEF CATTLE FARM TYPES

Several authors, especially Waquil et al. (2016), described the land occupation process in the state of Rio Grande do Sul, in particular in its Southern half, which corresponds to the Pampa biome. Called Campanha (Campaign), this region is covered by grasslands, usually with bushes and small trees growing along the creeks and rivers. The Northern half, called Planalto (High Plateau), is the southern end of the Atlantic Cordillera, which was traditionally covered by the Atlantic forest biome. The objective of this review is to present the main changes that have occurred in the State history, which contributed to establish the livestock activity in the region, by identifying the effects of public policies (or lack of them).

The Rio Grande do Sul occupation by Europeans occurred late in relation to the rest of Brazil. According to Pesavento (1994), Fonseca (1983) and Santos (1984), the first European occupation occurred around 1620, by the Spanish Jesuits from Paraguay who, escaping from the *bandeirantes* (groups of hunters looking for natives for slavery), settled in the northwestern part of the State bringing along Christianized natives and cattle. According to Reverbel (1986), the Jesuits were those who made an important contribution to the economic establishment of the State with the introduction of cattle that composed the “basis of livestock production in Rio Grande do Sul”.

Jesuit villages called ‘Missions’

According to César (2005), the Jesuit villages, ‘called Missions’, were “vast, natural, and undivided breeding lands” where cattle dispersed. The unexplored nature, rich in quality native fields and with no human care, allowed the herds to scatter throughout vast areas and reproduce freely. Reverbel (1986) states that cattle found in the exuberance of Rio Grande grasslands the “most favorable conditions to their survival and proliferation”. Thus, the livestock activity began in Rio Grande do Sul without the need for intense work and nature was mainly responsible for herd development.

By 1640, according to Pesavento (1994), the Jesuits, persecuted by the *bandeirantes* from São Paulo, retired to the other side of Uruguay River (Argentina’s territory), taking the natives with them but leaving the cattle behind. Torronteguy (1994) and Pesavento (1994) wrote that in 1682 the Jesuits returned to Rio Grande do Sul. They began building the ‘Sete Povos das Missões’, where they established ranches aiming to produce leather for commercial purposes. According to Camargo (1999), the introduction of cattle and ranches by the Jesuits and the natives greatly contributed to the constitution of the economic structure, the formation of the Gaucho ethnic type, and the definition of future territorial boundaries.

Latifundia, called *sesmarias*

According to Pesavento (1994) and Ferreira Filho (1958), the colony economic pole, which up to then revolved around sugar, moved to Minas Gerais area following

the discovery of mines there. Mining concentrated dense populations, leading to an internal market emergence, both through meat consumption, in the form of dried and salted meat called *charque*, and through the horse demand for transportation. Thus, the Portuguese settlers became interested in a different type of occupation of Rio Grande do Sul.

It began in 1732 by the distribution in the State of *sesmarias*, lands to plant and cultivate granted to farmers by the king of Portugal. The *sesmarias* expanded over about 13,000 hectares. According to Pesavento (1994), their distribution in Rio Grande do Sul was mainly bestowed in return for the military services rendered in the name of the Crown. This may have been the first public policy for the region and it was intended to enhance and preserve beef cattle breeding.

Kliemann (1986) states that granting *sesmarias* promoted the creation of large properties. This socioeconomic organization through the emergence of large cattle farms marked not only the economy, but also the whole civil society organization based on a “family and communal complex”, and the policies based on “the power emanated from the land possession and military activities” (Kliemann, 1986).

Torrenteguy (1994) adds that the need to confront the invading Spanish troops increased the distribution of *sesmarias* to officers. This fact reinforced the existence, at the farm, of an owner who was, at the same time, military chief. The goal was to defend the lands from Spanish occupation. Thus, the farm structure in this period was a mixture of pastoral exploration and defense fortress. This led to the constitution of a farmer-soldier type, which made it more difficult for cattle productive systems to establish themselves economically, as the fighting disturbed the farm productive structures.

Thus, the *sesmarias* were properties covering large areas with little labor and extensive cattle breeding. There was no stimulus for technical progress pursuit nor for public policies to consolidate investments in the productive sector.

According to Fontoura (2004), a *sesmaria* had about 10,000 cattle head, a foreman and 10 cowboys. Farm reproduction did not require large investments and was ensured through cattle sales on the market. The farm highest cost was the labor force (Freitas, 1993).

Franco (1952) and César (2005) report that, only after 1801, the Campanha region settled down with the attribution of *sesmarias* to the military commanders. As the latter complained about instability problems near the borders, they received two, even three *sesmarias* (26,000 or 39,000 ha) constituting larger farms. Franco (1952) observes that the Campanha “remained deserted although all its fields had already been donated and were already owned.” Reverbel (1986) refers to this region as a “populated desert”.

These large farms practiced extensive livestock breeding as they did not use productive techniques and let cattle roam freely in the native fields (Pesavento, 1994; Laytano, 1983). The pasture natural fertility determined the production variations from one region to another. According to Freitas (1993), the production was not fully sold and varied between 6% and 10% of the herd total. Santos (1984) reported that a herd of 1000 cattle head produced around 250 calves per year.

For Ferreira Filho (1958), the large farms became the main support of society as they gathered relatives and friends, and protected people. Santos (1984) further states that they engaged not only in the economic activities of the farm, but also in developing a power defense to secure their territories and possessions.

Mercantile ranches

César (2005) and Laytano (1983) report that farmers in the Campanha managed to obtain a greater economic importance in the course of the 19th century. The *charque* industry grew in Rio Grande do Sul at the end of the 18th century, bringing about commercial interest in the cattle industry. According to Pesavento (1994) this prompted Southern livestock economic development as well as strengthened patriarchal clans.

The livestock expansion in the State (with the herd increase and the commercial relations established with the plants that processed *charque* [*charqueadas*] in Pelotas) was extremely damaged by the context of political instability, and by the wars and small-armed conflicts of the 19th century. According to Ferreira Filho (1958), farmers had to face more than once losses or setbacks because of disagreements over land and political autonomy. The countless incidents and wars throughout the 19th century made this region an unprecedented battle field.

In addition to these violent events in the region, two other events had significant repercussions on economic and political aspects. The first was the ending of the *sesmarias*, which froze the land structure that had been in place. According to Torronteguy (1994), the areas that were already occupied could not be challenged and, from then on, those who wanted lands could only acquire them through the occupation of unproductive lands. This was the second-established public policy, although it did not directly aimed at benefiting livestock.

The second event, addressed by César (2005), Franco (1952), Torronteguy (1994) and Pesavento (1994), had repercussions on the farms' economic and social constitution. It concerned the enclosure of fields with wires that were used in Rio Grande do Sul from the end of the 19th century onward (César, 2005). After 1870, the enclosures spurred livestock farming as they improved management and simplified tasks (Franco, 1952). Gonzaga (1980) states that the livestock production lines became much simpler, reducing the need for labor and opening up the possibility of productive technical changes. Moreover, according to César (2005), Torronteguy (1994), and Gonzaga (1980), field enclosures represented the end of open fields,

the end of the wild cattle, and the end of work possibilities outside wage labor for the gauchos who roamed the Pampa, leading to the impossibility of survival outside the capitalist order.

These changes are the initial points that differentiated the ranch from the farm (Xavier, 1952). According to this author, the ranch was a “family and communal complex applied to cattle breeding that constitutes this region’s main economic development pillar.” Moreover, the ranch was linked to the rural type of production that corresponded to a certain way of life. The ranch is presented as “arising from the community formed around a family – the stallholder/farmer.”

The farm was understood as the “simple rural property exploitation without communal or family ties” (Xavier, 1952). There was also a transformation trajectory of the ranch into a farm that stretched over time “in a series of technical overruns and commercial ties”. In other words, the author argues that there was a difference between the ranch and the farm. The ranch extended beyond commercial exploitation and constituted a way of life. The farm was a commercial production unit with various degrees of production and commercial interactions, which did not include the non-economic factors that characterized relationships in the ranches. The ranch then gradually transformed itself into a farm. This marked the irruption of capitalism into the ranches, although they left an enormous cultural, economic and social heritage that has had an impact on farm management. This change did not occur homogeneously.

Capitalist ranches

The capitalist ranch made changes in its own constitution, work methods, wages and commercial relations. According to Xavier (1952), with the field enclosures and area divisions following inheritance, it was already possible that only the foreman and a few cowboys could perform the tasks. The ranch became, according to the author, a “labor hive aimed at the mercantile economy, and the natural economy disappeared by the progressive withdrawal of the rancher family transferred to the urban centers”, a change that gradually turned the ranch into a farm.

Fontoura (2000) writes that the Campanha ranches had a wealth period between the end of the 19th century and the beginning of the 20th, linked to the *charqueadas* development, until the arrival of the meat refrigeration industry. According to Pesavento (1994) the farmer supplied raw material to *charqueadas* and was thus dependent on the prices offered by the *charqueadores*. In this way, there was no incentive (nor need) to make large investments and changes in the ranch productive forms with regard to more technology and productivity. This discouragement caused inadequate sanitary conditions, leading to high mortality rates in cattle. It remained as such until the installation of the multinational meat industry, around 1917, which bought the *charqueadas* and replaced them by the refrigerating system. However, some changes had been made in the ranch productive aspects with the introduction of European breeds and the appearance of the first anti-tick baths.

AGRICULTURE EVOLUTION AND CHANGES IN THE RANCHES

World War I provided a euphoric period for the livestock industry in Rio Grande do Sul, creating a demand for its products, triggering exports to Europe and improving prices (Pesavento, 1994). The greater cattle value was a stimulus for a period of improvements and investments, giving a boost to breeding methods and increasing productive changes in ranches.

According to Fonseca (1983), Rio Grande do Sul in the postwar period, besides being prominent in cattle breeding, also began to excel in sheep farming. It had the largest sheep population in the country with around four million head. Nocchi (2003), and Gonçalves and Garcia (2004) assert that from this period up to the 1980s sheep farming acquired great economic and social importance in the ranches, and the revenue obtained from wool sales counterbalanced ranch expenses.

The postwar period was set in a new economic-financial crisis, re-articulating the European economy, with a decline in meat consumption, causing the slaughterhouses to reduce slaughter and prices (Pesavento, 1994). The Campanha ranches were those that had the best and the largest number of cattle, but they also ended up being the most hurt (Fonseca, 1983).

Thus, there was a growing differentiation between the south and the north of the State, with the continuity of beef breeding in the south, within an economic and environmental rationality of its own. Rocha (2000) explains this rationality by stating that the beef breeding permanence in the southern half of the State, with its extensive systems, reflected, in addition to an economic activity, a cattle ranch culture in almost every rural area of the South. Thus, beef cattle livestock remained the main activity during the 20th century in the South, although rice was also grown in areas where its cultivation was possible.

During the 1940s and 1950s, extensive livestock breeding was carried out predominantly in a native field, where the rancher placed as many cattle as the field could withstand (Pesavento, 1994). The low ranch profitability led to its de-capitalization and this led to low capital investment. This vicious circle caused a poor performance. Cattle trade was carried out with the butchers from foreign capitals, who kept prices constantly low.

The technological evolution in livestock farming did not occur generally among producers (Alonso, 1994). In any case, technological advances only involved management practices, sanitary improvements and the adoption of European breeds.

Heidrich (2000) states that in the 1950s there was an increase in cropping areas, especially in the Plateau (Planalto, north of Rio Grande do Sul), with the substitution of the natural Atlantic Forest by mechanized wheat cultivation and later soybeans. In the South the agriculture also expanded from leases of parts of ranches that had been dedicated only to cattle.

In the second half of the 20th century, the effects of public policies became more pronounced, with the intensification of rural financing granting, especially since the National Rural Credit System (SNCR) implementation in 1965, and the Minimum Price Guarantee Policy (PGPM) extension. However, this funding was not distributed equally, as it benefited grain production activities in the south and southeast of the country. Thus, Tambara (1983) emphasized that, despite the grain crops advances, most of the Southern farms had maintained beef cattle as their main activity, and some of them had been making progress in some technological production aspects.

According to Fontoura (2000), ranches and beef cattle breeding split into two types in the 1960s: traditional livestock (most of the producers) and business livestock (a small group of producers who used modernized techniques). The author adds the differences between them can be perceived in their management types and the applied productive cycles. In traditional cattle livestock, the average age at slaughter was 4.5 years (long cycle), whereas in commercial livestock it ranged from 16 to 24 months (short cycle).

Jansen (2006) writes that between 1965 and 1975 soybean crops accounted for most of the rapid increase in production of Rio Grande do Sul, representing almost two thirds of the national production. This further emphasized regional differences between the north and the south of the State with regard to production practices and activities.

The agriculture modernization process was consolidated in the North following mechanization growth, chemical use, and specialization of subsidized credit activities, resulting in increases in production and productivity (Jansen, 2006). The changes in beef cattle breeding during the modernization process, although allowing for an increase in the number of animals per hectare, were not sufficient for a significant increase in producers' income.

Fontoura (2000) contends that the modernization process in Rio Grande do Sul did not take place in the same way as in the cropping systems. He states that most ranchers did not control credit instruments, were afraid of investing in crops (fear of risks), and were unaware of modern herd and grazing techniques. He adds that many cattle ranchers, in this period, got out of business because of their inability to reimburse credits. Beside their loss of equity, this has resulted in cattle ranchers being denied access to credit funds associated with the risk of new investments, which is still the case today.

Ranches of the late 20th and early 21st centuries present very diverse formats, ranging from modernized to more traditional units with regard to management, production and marketing. Some of them have not gone through the process of agricultural modernization and did not adopt modern production and commercialization practices. Fontoura (2005) further states that land division (especially by inheritance) has contributed to accelerate the economic deterioration of the ranches. In the 1980s

and 1990s, successive economic plans adopted by the Brazilian government to control inflation impacted traditional livestock farms, which thus reduced expenditures and investments. Fontoura (2005) also asserts that the Real Plan (financial policy in 1994 aiming to stop the huge inflation) and the relative inflation stability brought a new disruption in beef cattle breeding, as diversification was no longer enough to avoid de-capitalization. The author also describes the emergence of a new category of ranchers in the Southern Hemisphere, who are liberal professionals (doctors, dentists, lawyers and small urban entrepreneurs). They have started investing in beef cattle breeding, almost as a leisure activity, transferring resources from other activities and keeping, for the most part, the business management according to traditional livestock learnings.

21ST CENTURY RANCHES AND FAMILY BREEDING FARMS OR RANCHES

The relationship between the property size and the land available for livestock has changed significantly, as land division after successive inheritance progressively decreased the property size (Severo and Miguel, 2006). This reduced profits from the livestock activity in the extensive production systems. Therefore, increasing incomes became possible mainly by intensifying livestock production.

The division gave rise to a significant group of small-scale cattle breeders who started to work with family labor and maintained the traditional breeder culture. In general, the reduction in land size did not bring about an intensification of the activities nor an increase in diversification. Cattle ranchers continued to breed beef cattle in small areas in the inherited ways of the extensive *sesmaria* ranch.

A diagnostic study presents the situation of beef cattle breeding in Rio Grande do Sul at the beginning of the 21st century (SEBRAE/RS, SENAR/RS and FARSUL, 2005; Miguel et al., 2006). The results show that most of the beef cattle farmers in Rio Grande do Sul had made but little advances in production technologies and commercial relations. The study points out that a majority of breeders had a 'traditional cattle rancher' profile, as their motives for practicing the activity were tradition (26%), satisfaction (25%) and safety (14%), rather than search for profit (only 8%). In addition, most of the properties (70.9%) were family inherited.

Ranchers' main investment projects consisted in purchasing more land (35.4%), more livestock (25.6%), reinforcing their identity with the activity, and pursuing land expansion for the same activity. The study highlights their desire to remain in the activity (85%) and for their children to take over (68%).

Concerning ranch management of the 21st century, the study shows that beef cattle breeding economic returns are significantly lower than economic returns from cropping activities. Thus, the producers who can associate livestock and crops have a more favorable economic situation.

Regarding ranch production, many crosses between European and zebu breeds have been observed, without the aim to standardize a final product. Production indicators point to herds with low birth rates and low weaning. About 16% of the producers who have cattle keep the bull at the rodeo all year round (a practice used in the time of the *sesmarias*).

Concerning cattle feed resources, most herds are fed year round with native pasture without any supplementation, but with a high number of animals per hectare. This may indicate some technical consistency in the adjustment criteria, with this decision being attributed to other factors (e.g. cattle as a reserve commodity).

According to Miguel et al. (2006), cattle ranchers' conservatism also manifests itself in their marketing actions, as they always favor little bold and innovative criteria that benefit security, reflecting "a reaction to the past when many bad experiences had taken place." Moreover, the combination of these technical, commercial and investment actions ends up causing the poor economic results of most farms.

Miguel et al. (2006) further state that only their "non-economic motivations", such as their attachment and pleasure to carry on tradition, associated with the lack of soil for other land use, explain their persistence in the activity. These reasons may be why 62% of the interviewed producers claimed that if they had financial resources left over, they would invest in livestock and land purchase, which contradicts the general complaints on the livestock crisis and the financial returns.

Finally, the trajectory of Rio Grande do Sul shows that a large part of the beef cattle industry was not modernized, maintaining productive and commercial forms similar to the past. Only about 15% of producers practice the activity in a business way (Miguel et al., 2006). The others (using hired or family labor) develop traditional productive forms. These productive forms are driven by decision-making processes that take into account other values, expectations and ambitions such as security, stability, tradition and personal satisfaction, not necessarily profit pursuit.

The ranches, cattle breeding and the environment (Pampa) forged a differentiated type of family farmer. Despite the *sesmaria* transformation into smaller ranches where large-scale production is no longer possible, beef cattle breeding remained the main activity. It decreased (in some cases ended) because of the hired labor need, but the main activity did not change. Although beef cattle breeding had been considered as an activity that required larger areas or intensified activity, livestock ranchers continued to breed extensively in small areas.

Family farmers have survival forms, and production and reproduction logics similar to the traditional logics describing family farming. Despite this, they are not recognized as a social category and they are perceived as economically unviable and inexorably condemned to extinction (according to the prediction also made for family agriculture).

FINAL CONSIDERATIONS

Based on this brief review, the livestock importance in the social, economic and cultural formation of Rio Grande do Sul is verified, as well as its evolution over time. However, in the last decades, public policies have been much more directed to farming/cropping activities, but have also had effects on the productive forms of cattle breeding, leading to greater diversification. Even with these changes, the main motivations for livestock husbandry remain associated with safety, tradition and personal satisfaction.

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Livestock public policies in Uruguay

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INTRODUCTION

The world population increase, the change in consumption habits, the loss of biodiversity, and global warming make up a series of global and urgent challenges, which are different but interconnected. The analysis of these problems requires the consideration of physical, biochemical and social phenomena that interact at different scales in an intricate way. With this background and a perspective of sustainable development, our objective is to generate knowledge that makes it possible to understand and communicate the conditions, the possible forms and the consequences of livestock ecological intensification, and its interaction with the territories in which it is based. From a scientific viewpoint, our contribution refers to the interactions between 'livestock and territory' in relation to 'ecological intensification' (Bonmarco 2013) taking into account the challenges of "sustainable development".

The contribution of Uruguay (Figure 1) to this ebook was of particular interest, given the inescapable importance of the country's livestock activity, the characteristics of its ecological conditions, its internal organization and its international insertion. Livestock activity provided more than 80% of the exports throughout most Uruguay's existence and even earlier. With four cattle head per inhabitant, it is the country with the largest livestock activity in the world. This chapter relates specifically to the agricultural sector evolution in general and that of livestock in particular in Uruguay since the end of the 1960s, proposing for its analysis three major stages: i) 1960–1980, "more of the same but differently" describes a period where there is a gradual awareness that livestock is unable to promote a satisfactory development for the whole country; ii) 1980–2000, "new activities are consolidated", especially the plantation of eucalyptuses and pines, livestock gradually makes room for other activities; and iii) 2002 onward, "globalization is imposed" with the material and political progress of international / global entities, i.e. corporations and environment, or family farming concerns. To carry out this work, a bibliographic brief review and a series of interviews and workshops with diverse stakeholders were taken into account.

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Figure 1: Map of Uruguay

BEFORE THE 1960S

In Uruguay, the cattle population grew before the settlement of European conquerors, and from very early on it has been a source of products for remote destinations, in an evolution that was ruled by the industrial revolution. Following the Jesuits' expulsion in 1764 (Morales, 2012) the model of private land ownership intensified with the appropriation of its products, and was fully consolidated 100 years later.

Toward the beginning of the 20th century, the traditional view in Uruguay – as in many other Latin American countries – was that extensive livestock farming was an archaic and residual activity, which should be replaced by agriculture as an inescapable expression of progress. This led to a somewhat enthusiastic development of agrarian sciences and a territorial organization model of small owners, who lived and worked with their families on the farms, as the ideal of a territorial, economic, social and political organization. Unlike the territorial expansion on non-colonized areas that occurred in Argentina, Australia or North America, Uruguay's agricultural frontier has been reached very early. Therefore, the effort focused on promoting the dominant 'ideal type', associated with the political movement locally known as *batllismo*, in the face of an organization resulting from the agrarian structure developed during the colonial period and the 19th century.

One of the earliest expressions of that effort was the Colonia Lavalleja formation in 1862 (Montes, 2010), of the same model applied at other latitudes at the same moment. It consisted in the settlement of dozens of families in an area near the Northern border that had to be protected and secured.

In the early 20th century, the formation of Rural Development Societies was encouraged (one was founded in each railway station). They were organized at national level in 1915 with the creation of the National Commission for Rural Promotion, which has been since associated with that ideal of more or less collective working families settled in small-scale farms carrying out intensive farming without resorting to hiring employees.

In 1921 (INC, 2014), the Department of Colonias in the Mortgage Bank was formed with a mission stating that "Every *colono* is required to inhabit the adjudicated farm and work the land for himself", which constitutes a direct antecedent to the regulation defining family farming that took place 88 years later. In the late 1940s, it was transformed by law into the National Institute of Colonization.

Agricultural activities were mechanized at the end of the period (1945–1955), when the number of tractors was multiplied by seven. Until then, for the most part they were carried out using animal draft, even though mechanization had made headway during the entire period. Despite the fact that mechanization was promoted as a source of progress, several authors and public spokesmen emphasized the character of livestock in the country (Mullin, 1935). Mentions were made of the climatic variations and the poor aptitude of the soils – especially when compared with those of Argentina – to sustain a productive agriculture. The convenience of an activity was measured – and still is – by its insertion possibilities in the international market; agricultural products did not show the conditions to do so during this period, even when they had various state support.

The meat and wool production that prevailed from a social viewpoint of territorial extension and economic importance allowed territory occupation in an economically viable manner; it was the source of foreign currencies necessary to exchange them notably for machinery and oil, whose importance had increased throughout the century. The dairy production has rapidly integrated the industrial stage. A national cooperative (CONAPROLE) was created in 1935 to mediate between producers and consumers and offer hygienic-sanitary guarantees, even though in 1948 cows were still being milked for direct sale to the population in the center of Montevideo. The native forests were a source of firewood and charcoal, and forests' plantations were almost nonexistent. The industrial structure was the link to overseas markets for meat products, it was almost non-existent for wool, and it supplied the domestic market with milk, wheat, oilseeds and other products.

Some sectors, linked to the political leadership, proposed at the end of the period two development models with different foundations: an industrial development to supply the domestic market and eventually export, or livestock intensification that

would improve the country's international insertion. The 1950s were particularly agitated with ardent defenders of each of the two alternatives. Eventually, a new actor helped to tip the balance toward livestock intensification: the financing of international organizations, in the present case the World Bank. It is interesting to note that crop intensification, which occurred some decades later, was not included in the list.

1960–1980 “MORE OF THE SAME BUT DIFFERENTLY”

At the beginning of this period, a series of studies resulted in a comprehensive development proposal (CIDE [Development Studies Interdisciplinary Board]), and the creation of the statistics and analysis government offices (DIEA [Agricultural Statistics Office], DINACOSE [Livestock National Office], NAC [National Meat Institute]), which continue today to make Uruguay a country that is distinguished by the availability of data related to the functioning of its society and dynamics.

These years were marked by a violent social crisis, including the installation of a civil military government in 1973. With regard to an agrarian policy, a general withdrawal of the State from direct economic activities, e.g. cereals storage, slaughterhouse administration, was noted. This set the basis of an economic organization model that is still in place today. The turning point occurred in August 1978, when the State put an end to its fixing the price of cattle for slaughter and withdrew from a series of administrative measures that regulated meat production and trade.

New ways to use the land were tested, such as crop livestock rotations in time and space, a technology that is reputed to be typically Uruguayan and that arises from the integration of essays and various technological advances proposed by different actors. One recalls that the desire to boost farming modernization and intensification expressed itself by the creation in 1962 of the Center for Agricultural Research, which has been present across the country and has specified the country's objectives to develop based on its agricultural sector. Rice cultivation, geographically and technologically dissociated from the rain-fed agriculture that dominated the landscape until then, came out in force.

With regard to cattle, the period was marked by the promotion of the 'New Zealand model' promoted by the World Bank with the enthusiastic support of the successive governments, leaders of organizations linked to cattle ranches, and cattlemen. The foundation on which it was based was that "natural pastures are not good for Uruguay" (Mac Meekan, 1951) and should be replaced. At the end of the period, in 1980, it was estimated that almost all farmers had tested the new technology proposal based on loans administered by the Banco de la República (Alonso and Pérez Arrarte, 1981). At the same time, it became obvious (Jarvis, 1981) that the potential for change in livestock meat and wool, in a context of high economic and political instability, and with a great variability of ecological niches, was very

limited. Traditional natural pastures had been replaced in 12% of the total area by sown pastures. This data remained unchanged for 35 years. The proposal appeared with strong advantages to be introduced in the rain-fed crops and dairy production areas, which in the end have been its main contribution.

The international context was particularly unfavorable for the temperate climate products offered by Uruguay, especially beef. The USA, favoring its allies in the South Pacific, had set up the 'foot-and-mouth disease circuit', which, with inferior products (basically lean cows), doubled prices and was much more stable than the one faced by Uruguay. The foot-and-mouth disease market, in turn, had to absorb the enormous surpluses that at liquidation prices overturned the new European Economic Community. This left Uruguay with very marginal markets for its meats, and made impossible its access to international markets with products such as wheat or sunflower. This situation manifested itself especially when the political crisis was at its worst. In 1974, meat and wool exports that had constituted more than 80% of the total exports for about a century were not enough to pay for the needed oil import. This caused serious constraints on people's daily life and, of course, compromised the country's development. International firms were not in the least interested by the local slaughterhouse industry, in contrast to what had happened at any other time. In this period, the meat packing industries were handled by the State (initially), and by local entrepreneurs.

This period was also characterized by the beginning of urbanization and the rural exodus that continues today. The rural population reached its peak around 1955, and from then on declined more or less rapidly, in association with its much reduced access to services and generally noneconomic social interactions. The number of farms also decreased and concerned almost exclusively those with less than 100 hectares.

Some environmental, ecological, conservationist concerns have led to indigenous forest protection legislation, industrial forestation promotion, and cultivation standard promotion aimed at soil conservation. Social concerns have been expressed via actions to end the era of *rancheríos* ('huts'), task that was entrusted to the Movement for the Eradication of Unhealthy Rural Housing (MEVIR), financed by a tax on the sale of agricultural products.

1980–2000: CONSOLIDATION OF NEW ACTIVITIES

One of the characteristics that describe this period is the State's complete withdrawal from market regulation. The 1978 measures were followed by the State's withdrawal from the wheat market in 1982, and a series of less relevant but symbolically important measures such as the allowance of semen imports, restricted up to that time to farmers belonging to an exclusive organization, or the export of live cattle around 1992.

It should also be noted the consolidation of agricultural activities other than meat and wool, such as milk, rice, barley, wood and other forest products, honey, and citrus, which had the potential to be dynamically included in the international market. Unlike what was attempted in the 1950s, these were not typical industrial products, such as textiles or household appliances, but agricultural products with or without some industrialization.

New foreign corporate economic actors slowly emerged and anticipated what was to come at the beginning of the 21st century. Initially in citrus orchards, with Arab investments, then very clearly in forestation, based on a new forestry law approved in 1989, corporations were present, with organizational models that not only dissociated the ownership and management of farms, but also separated those affected by the changes, the local inhabitants, the national society, from the beneficiaries, who were increasingly faceless foreigners, such as the various acronyms that were shown as forest plantations owners. It was not entirely new. They had been represented by the English presence in the production and meat industry at the end of the 19th and the beginning of the 20th centuries, but their presence acquired a dimension that would only grow from then on.

From the livestock technological viewpoint, efforts are still being made to set up crop and livestock rotations that promise to increase meat production and stabilize agricultural incomes. If we focus on livestock public policies, we can say that it maintained its secular definition, as Piñeiro and Moraes (2008) wrote: "Policies for the agricultural sector during the 20th century have been closely linked to the national international insertion style." In the case of livestock, from this period onward they aimed at ensuring the sanitary quality of products, certifying compliance with commercial demands, and in general facilitating and promoting foreign trade. An important change is the permanent decline in wool and sheep production, despite some efforts to develop sheep meat products that could mitigate the effect of the decline in the wool price. Another notorious fact is the gradual reduction in the slaughter age of steers, which is an indicator of the improvement in physical efficiency, much praised by a sector that has been accused of secular stagnation, which has also highlighted the increase in beef production. Some technical complexities that are not analyzed here cast doubt on the importance of this process, and recent estimates (Bervejillo and Bertamini, 2014) indicate that "when the total agricultural product is disaggregated into extensive agriculture, meat and wool, dairy and forestry, it is possible to see that the great driver of global growth has been extensive agriculture followed by forestation and dairy farming, with beef and wool as the great pendulum [...] the meat and wool livestock [...] has remained stagnant in the last 30 years as a result of the crossed combination of an increase in beef production and a lower sheep production." These authors also report a livestock growth that varies according to the method used from null to + 1% per year for the period 1983–2013.

Rain-fed crop productivity increased after having been stagnant for decades. This was also the case for milk. In both cases there were drastic decreases in the number of farms, a process that had already been fully described in 1958: 'the technological windmill' (Röling and Wagemakers, 1998) explained how those farmers, unable to reinvest in a sustainable way to increase productivity, abandoned the activity when production increased and the price of products decreased, a process well exemplified among others by the wheat and milk production in Uruguay during this period. This has had different manifestations in extensive livestock farming, which fulfills at microlevel patrimonial functions that can be approached by different family organizations, constituting an activity among others within a 'family activity system'.

2002: LIBERALIZATION IMPOSES ITSELF

The beginning of the millennium was characterized by a major economic and social crisis (unemployment reached 20% and Uruguay has a weak social security system), which did not end like some similar crises after an institutional breakdown. A cumulative set of circumstances resulted in a fairly high level of indebtedness in the agricultural sector, the shutdown of beef markets because of the outbreak of foot-and-mouth disease, a depressed market for agricultural products, a series of consecutive years of climatically unfavorable agriculture, along with a brutal tension in the country's payment system, with the collapse of banks and losses of deposits by savers, etc. These were the results of tensions accumulated at least since the previous decade.

Following immediately the onset of the crisis, two broadly announced phenomena, whose arrival never seemed to materialize on the Uruguayan scene, appeared. Firstly, China quickly appeared as a commercial partner. It became the main trading partner for almost all products globally by the middle of the 2010s. Secondly, genetically modified organisms promoted a type of large-scale agriculture that in the south of South America formed unique dynamics at global level. In Uruguay, the phenomenon is minuscule compared to what happened in its big neighbors, Brazil and Argentina, and even Paraguay. However, there is a situation that could be unique in history. For the first time the productive structure of an agricultural product, i.e. soybean, is similar to what has been observed in other sectors; only a few actors represent a very large portion of the global activity. In the case of Uruguay, 10 companies account for 50% of the production, a situation unheard of up to now in terms of agricultural production. In our analysis, and in terms of social impact and environmental sustainability, it is important to highlight that livestock has been progressively excluded from areas with good agricultural potential, in which it had always been present.

Uruguayan producers, pressured by debts, sold or rented their lands. This phenomenon is related to the ongoing social changes. Given the absence of long-term

family projects concerning their farms, producers tend to sell or rent their land and quit the farming sector. In addition, according to the new model, the organization of the companies requires skills and involves taking risks that only in some cases can be met by Uruguayan 'agricultural entrepreneurs'. The other side is the emergence of gigantic agricultural companies, which manage areas up to 5000 times larger than those average farms (180,000 hectares when the average area is 360 hectares).

Public policies of this period are characterized by the attempt to reconcile different dynamics and aspirations. Promoting exports by maintaining a socially inclusive functioning that takes care of natural resources is a motto that characterizes the Government's discourse. In this context, extensive livestock gains some prominence because it is the main activity of family farming according to the official definition. The State's actions that promote international inclusion are expected to continue. International funding struggles to put climate change on the agenda, and other techno-bureaucracies promote actions related to family farming. There are advances in labor legislation. With the agricultural surface area increase, new conservation land rules have emerged whose actual application remains in dispute.

With regard to livestock, little has been done other than implementing a very sophisticated individual traceability system to improve the competitiveness of Uruguayan beef and its inclusion in markets. In addition, the agricultural sector is challenged by inaction against the foreign takeover of the refrigeration industry, rice processors, or the development of the cellulose and wood industry. Concerning major Uruguayan exports such as beef, bovine hides, milk and dairy products, soybeans, barley, rice, wood, cellulose, only milk has remained managed by national actors. However, the recent arrival of the global dairy processor LACTALIS raises questions as to whether this situation will last.

The definition by the World Organisation for Animal Health (OIE) of a unique sanitary status for Uruguay ("free of foot-and-mouth disease with vaccination") and its validation by the USA allowing the re-entry of Uruguayan beef into its market are probably the most significant event of the period where livestock operations are concerned. The real effects of the proposals for differentiation of Uruguayan products – highly publicized by the administration – are very controversial.

CONCLUDING REMARKS

This article briefly presents the case of a country with a small population in relation to its capacity for producing food for people. This situation implies a tight, permanent interaction with the international arena as the natural destination of its products, where commercial and other kinds of interests are carried out by different stakeholders. At the same time, it shows the ancient and still ongoing controversy around subjects such as the convenience of family farms, the omnipresence of the private propriety with all its consequences, the growing awareness

of the ecological consequences of human activity, and a social and technological evolution with some permanent traits: a pragmatic equilibrium among conflicting goals.

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Sheep policy in the colonization of Argentine Patagonia

F.R. Coronato¹ and J.F. Tourrand²

INTRODUCTION

In the second half of the 19th century, Europe imported raw materials to support the growth of its industry, which in turn produced a demographic surplus. The countries of the Southern Cone were part of this globalized system as suppliers of commodities and receivers of migrants and capital. In the midst of the process of building its territory, Argentina led from 1879 to 1884 a military campaign that evicted the Amerindians from Patagonia, according to the classic process of border expansion.

After the indigenous population was decimated, Patagonia was colonized by sheep moving southward from the plains of the pampas, and northward from the Falkland Islands. The national division of labor allocated the fertile pampas to cereals and cattle, and Patagonia to sheep rearing. Thus, on the vast arid plateaus, where a few Native American tribes remained, sheep eventually thrived despite predators such as pumas and foxes. Above and beyond, it was necessary to occupy rapidly the territory to counter the Chilean expansionist vision.

Patagonian rangelands had a low-carrying capacity of at most one sheep per hectare. These figures were largely overestimated, both by the legislators and the first breeders, whose references were those of the pampas and the Falklands, where rainfall levels were three to four times higher. A century later, the result of colonization by sheep is a serious degradation of the rangelands on almost two thirds of the territory, with many abandoned farms. The number of sheep reached a peak of 22 million around 1950 and declined regularly since then. As a result, the Patagonian ecosystem is a large demographic void with less than one inhabitant per square kilometer; the population is concentrated in very few urban centers.

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Diachronic analysis

At the beginning of colonization, Patagonia was more a colony than a national territory. The settlers had few political rights and were somehow second-class citizens. They did not elect their representatives, who were appointed by the central government located thousands of kilometers away. Land speculation started even before colonization, since in 1878 Law 947, called Ley del Empréstito (Borrowing Act), allowed financing the military campaign of the following years by selling the lands which they were going to conquer from Native Americans. Although check-plotting 2500 hectares could be applied to the homogeneous Pampa, it could not be applied to the heterogeneous Patagonia. However, the absence of fences at that time made it possible to overcome partially the problem.

Danckwerts et al. (1993) described well the Patagonian case: “The interaction of spatial heterogeneity with temporal rainfall fluctuations increases the complexity of pastoral systems. In arid rangelands, this results in pulses of productivity varying in space, time and magnitude. In these conditions, the traditional response has been transhumance in order to take advantage of such pulses. Typically, nomadic systems can withstand higher stocking rates than settled pastoralism due to better use of space. Permanent or settled grazing systems would be unsuited to manage these rangelands.”

Unfortunately, for Patagonian ecosystems neither legislation nor regional customs have considered sheep keeping. The shepherd as a manager of livestock/rangeland interactions has never existed in Patagonia, except in the far northwest (a region with a strong indigenous base), where goat and sheep transhumance still exists today. Far from the pastoral system, sheep farming in Patagonia has been developed for and by the capitalist market economy with public policies oscillating between liberalism and state discretion.

UNBRIDLED SHEEP COLONIZATION AT THE TURN OF THE 19TH CENTURY

The occupation of Patagonia under liberal legislation began with the formation of latifundia on the best rangelands, often in British or German hands, but also French and Spanish. Although Bandieri (2005) points out the many failures of the process, Alberdi's motto (1852) “To govern is to settle people” was in full force. Even before the military conquest, the Argentinian government relied on sheep to settle people in the area and gave 600 sheep to the Welsh colony established in Central Patagonia in 1865, with the instruction to increase the number of ewes whose consumption was prohibited (Dumrauf, 2008). This was a failure as were other tries promoted by the government in the 1880s. A few years later, when sheep began to thrive under private impetus, the government insisted on the allocation of sheep and supplied every relay along the telegraph line of the Atlantic coast with two hundred ewes and four Merino rams. The employees

of the telegraph were in charge of shearing, monitoring lambing and managing the consumption of these small flocks (Rodríguez, 2003).

Starting in 1903, in an attempt to curb real estate speculation and mend agronomic mistakes, Law 4167, called Ley de Tierras (Land Act), required a prior survey of the lands to be granted, and favored a differentiated distribution according to their potential. Three granting levels of public lands were introduced: 1. The lease-grant, a lease of five years, renewable, which gave the right to request the purchase of the land; 2. The simple lease with annual payment of a grazing tax per sheep; 3. Free occupation. Only the first level gave the right to purchase and inherit. This law succeeded in regularizing the sale of public lands, favoring emphyteutic leases, at the end of which the tenant, who had invested in buildings, wells, tanks, fences, etc., could buy up to half of the plot, in a limit of 20,000 hectares.

The sheep stock increased six fold between 1885 and 1914. Patagonia was a huge free zone; the international border between Argentina and Chile did not hinder the traffic of sheep flocks, even less that of assets. There were not many people; the Patagonian society was built from the sheep industry. At the top of the scale were the landowners and the stockbreeders organized in *sociedades rurales* (rural societies), and at the bottom were shearers, ranch workers, and workers of the wool or the meat freezing plants, regrouped in *federaciones obreras* (labor federations). Between the two groups, or rather indifferent to both, the government practiced laissez-faire.

CLOUDS OVER THE SHEEP

Driving thousands of cull sheep to the slaughter plants on the Atlantic coast raised clouds of dust. Besides World War I that fostered sheep husbandry to feed and clothe soldiers and make explosives from lanolin, other clouds were piling up over the Patagonian horizon. The opening of Panama Canal in 1914 cut Patagonia from the interoceanic navigation route. The city of Punta Arenas on Magellan Strait (Figure 1), until then the real economic core of Patagonia, began to decline. The war also stopped the building of railways, which rendered obsolete the 1908 law for the development of national territories. At the same time, the payment of a fee for the simple occupation of public lands was introduced in 1913, and the end of the free zone was acted.

The interventionist trend intensified in 1916 when a new grassroots government suspended the sale of public lands once the leases expired. Despite the latifundium system in place since 25 years of colonization, public lands accounted for more than three quarters of the territory at the end of the 1920s (Fisch, 1932). It was the end of the dream of becoming the owner of the land on which one had worked and invested for years,

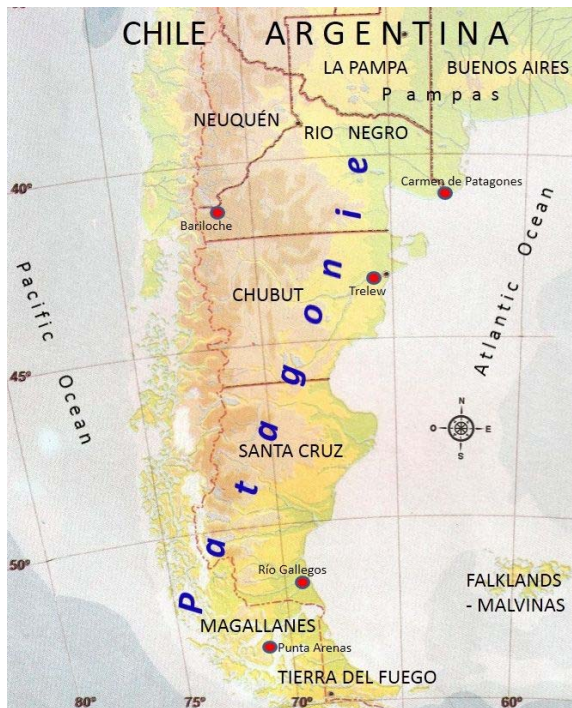


Figure 1: Map of Patagonia

and passed on to one's children. To the distress of tenant settlers, leaseholders and occupants, appeared the inspector of the Office of Lands and Colonies (Oficina de Tierras y Colonias), whose reports were a valuable source of information on the social and land tenure situation in those years. In addition, the postwar crisis led to the collapse of the price of wool and meat, while the costs of production remained high, especially as customs duties were reinstated for imported inputs and exported wool and mutton, and because the grazing tax quintupled in a few years.

The gap between the sale price and the production cost had soared and was the cause of the 1921 rural workers' strikes. The revolt was repressed in a bloodbath by the army, causing 500 to 1000 victims. Moreover, the precarious land tenure of many settlers discouraged any durable investment on their part, and fostered instead the search for immediate profit. This shortsighted range management overstocked plots which caused their degradation. At the same time, the sheep was losing ground as the main economic driver, to the benefit of oil discovered in 1907, whose exploitation since 1922 has been in Patagonia the spearhead of the country. The Great Depression of the 1930s worsened the situation as the center of gravity of wool and mutton production gradually shifted to the north of the region and its ports. It also marked the first irruption of the military into the government of the country.

In 1933, the introduction of import quotas for Argentinian meat by the United Kingdom weakened the mutton sector. Two organizations were supposed to improve the performance of the sector: Corporación Argentina de Productores de Carne (CAP, private origin), and Junta Nacional de Carnes (created by the State). However, they have never been able to solve conflicts of interest between mutton producers and meat-packing plants, caught in turns between English and North American capitals (Gorla, 1998). For its part, the wool sector kept its momentum, causing further sheep overstocking in the already degraded rangelands.

THE MILITARY SET THE PACE OF SHEEP

Despite the turmoil in the sheep industry in Patagonia, the flock continued to grow and eventually occupied the entire territory in the late 1930s. The last rangelands put into production were obviously the least suited, i.e. the highest or the driest or the remotest, and they were those where the indigenous population was also the most present. Sheep had spread over the whole of Patagonia, coexisting with the oil in the center, the cattle in the north and west, the goats in the northwest, and guanacos, pumas and foxes everywhere. All these competitors hardly slowed down the expansion of sheep, which reached more than 17 million head.

During World War II, the presence of Argentina was strengthened after the coup d'état in 1943. The military who seized the power considered Patagonia too exposed to foreign influences, especially English capitals as well as Chilean farm workers or Jewish emigrants. A military jurisdiction was established around San Jorge oil basin in Central Patagonia. Social and labor laws were enforced, such as the status of the rural worker, which satisfied the demands that had led to the fiercely repressed strikes of 1921. The custom taxes were abolished south of parallel 42 and the status of free zone revived the economy. However, with regard to sheep, the nationalization of foreign trade via the Instituto Argentino de Promoción del Intercambio (IAPI) and requisition of livestock (up to 8% of the herd) (Coronato, 2010) did not favor production.

With the decline of the meat sector already mentioned, the predominance of the Corriedale breed faded in favor of the Merino, a better wool producer. Overall, the regional sheep flock peaked in 1952, with 20.4 million head whereas the rural population was just a few tens of thousands of people. This reflected the very extensive character of the production, since a single worker could handle 1500–2000 sheep. On the other hand, even though sheep occupied the entire territory, their relative weight decreased in the regional economy because of new production activities, such as fishing, coal, in addition to oil. Besides, sheep farming became limited by the emergence of synthetic fibers which competed with wool.

In 1958, four (out of five) of the old national territories of Patagonia became as many provinces within the Federal Republic. This constituted a major change in terms of governance with an administration that thus became closer to the territories. The new administrations resumed the sale of public lands, suspended for forty years, allowing settlers and long-term tenants to become owners of the plots they occupied. At the same time, the opening up of oil extraction to private companies has resulted in Argentina's energy independence and in an economic boom, particularly in urban areas close to oil fields, intensifying the very secondary role of sheep at regional level.

FROM THE 1960S ON: SHEEP ON TIPTOE

The change of governance stemmed from the creation of the provinces came along with an increasing involvement of small and medium sheep breeders who had become owners. They rejuvenated the *sociedades rurales*, believed and invested in technology, especially in genetics, all of which led to the creation of the Instituto Nacional de Tecnología Agropecuaria (INTA) in 1956, with the aim to "encourage, stimulate and coordinate the development of technical agricultural research to improve agricultural enterprise and rural life."

However, it soon became obvious that the most challenging problem lied in the severe degradation of most of the rangelands, especially in the driest areas, a degradation that seemed irreversible. Patagonia paid a high price to the exaggerated optimism of the beginning of colonization, which overstocked with sheep these fragile rangelands. The checkered paddocks restricting the mobility of sheep in heterogeneous rangelands have only exacerbated the problem. Although sheep were the first driver of colonization of Patagonia, they were largely mishandled and eventually led to a serious degradation of their own support base, the rangelands.

There is thus a beginning of the awareness of the decline of sheep farming in Patagonia, quite paradoxically when the provincial governments start to act through a series of rural management organizations (e.g. Consejos Agrarios, Institutos de Colonización) along with INTA. In addition, the decline of the mutton sector linked to the world market continues. The slaughterhouses and freezing plants that had been vital to the ports of the Atlantic coast for decades have been closing one after the other: Puerto Santa Cruz in 1962, Puerto San Julian in 1967, Rio Gallegos in 1970, Puerto Deseado, etc.

The colonization of Patagonia by the means of sheep, which started at the turn of the 19th century, thrived until the 1920s, was progressively challenged by new activities later on, peaked in the mid-20th century, eventually began to decline in spite of well-intentioned public policies implemented yet too late. As evidence of the decline, early

companies had been selling their *estancias* (large estates) to Argentinian investors, especially since these companies (often of British origin) feared expropriation. They were only a few, about a dozen, but they covered several hundreds of thousands of hectares. The high rate (94%) of the deficit farms in the province of Chubut provided another sign of the decline in 1980. As a result, the percentage of small- and medium-sized farms receiving subsidies increased from 21% in 1947 to 42% in 1960, and up to 70% in 2002 (Baeza and Borquez, 2006).

Public policy measures have gradually been implemented to address the issue of range-land degradation. For example in 1980 Law 22,154 (Reactivación Económica para el Sector Agropecuario de la Patagonia) aimed at revitalizing the sheep sector in Patagonia, and was followed the year after by Law 22,428 (Fomento a la Conservación de los Suelos) to finance soil conservation (Castro, 1983). Argentina has also appealed to the international community for technical collaboration, including in 1977 during the first United Nations Conference on Desertification (UNCOD) in Nairobi, Kenya. A few years later, the German Gesellschaft für Technische Zusammenarbeit (GTZ) teamed up with INTA to set up the Lucha contra la Desertificación en Patagonia (LUDEPA) project to combat desertification, as well as the Prevención y Control de Desertificación en Patagonia (PRECODEPA) project, which brought together INTA, regional universities and provinces. Remote sensing greatly benefited these initiatives by allowing a better socialization of socio-environmental issues in Patagonia.

SHEEP IN EXTREMIS: GIVING-UP AND LEAVING

Despite technical advances and institutional mobilization, the situation did not improve as the decline of sheep farming continued, with the added risk of the still struggling national economy. Thus, starting in the 1980s many smallholders abandoned their lands that no longer allowed them to survive, despite government subsidies. Isolation in rural areas, which is a serious problem particularly for education and health, was aggravated by these abandonments. Community life dwindled, pumas and foxes proliferated putting more pressure on the few flocks still in production. Moreover, urban centers were faced with the arrival of a rural exodus, with newcomers looking to integrate other activities than those they had been used to.

Apart from the economic issues, abandoning a settlement started from scratch three or four generations ago was a sad socio-environmental circumstance. Admittedly, it concerned the most disadvantaged areas from a climatic viewpoint. In any case, it marked the epilogue of the ovine cycle for a sheep breeder forced to make the decision of abandoning his land, as well as for the society which endured it. In Santa Cruz – the most affected province by land abandonment – there were 300 deserted farms (out of 1260) in 1991, and more than 500 in 1997 (Andrade, 2002). The trend continued at

a slower pace as they were 600 in 2014. According to Andrade, the ranchers did not feel at all responsible for the degradation of their rangelands because of their inadequate management or that of their predecessors, instead they blamed a low rainfall.

Del Valle et al. (1997) estimated that a quarter of Patagonian rangelands had a severe level of desertification and that 10% more faced very severe desertification. In other words, a century after the beginning of colonization, a third of the steppes of the region had become unsuitable for sheep farming, which corresponds roughly to the abandonment zone. Conversely, according to Noy Meir (2005), wetter rangelands, located further west on the foothills of the Andes or southward near the Strait of Magellan, make it possible to produce in a sustainable way. The condition to this is adopting precautionary management methods of the pastoral resource, i.e. to stock the paddocks below their carrying capacity, to rotate grazing to allow the regeneration of forage, and to control predators. This requires human and financial investments that the latifundia of these areas seldom have. In other areas, small and large ranches tried to carry on, hoping that rainfall would improve in the future. Argentina's crisis at the turn of the millennium did not help, as the price of wool did not cover the cost of shearing!

SHEEP, GET UP AND WALK

Despite the situation resembling a flight in some areas, it does not spell the end of sheep in Patagonia. A regional flock of ten million head and a production of 30,000 tons of wool are not negligible and could become the basis for a much hoped-for renewal. The size of the flock is the same as it was a century ago. The used area is four times larger, taking into account the degraded and abandoned lands. Yields have increased significantly thanks to genetics. In addition, the latest public policies especially seem to have limited the aggravation of the situation. In 2001, concomitantly with Argentina hitting rock bottom during the economic crisis, the Ovine Act (Law 25,422) for the revival of sheep farming marked the beginning of the recovery of Patagonia's rural world.

A national program to improve public action in rural areas was implemented in Patagonia in 1993. It aimed to diversify productive activities in ranches through alternative production in addition to sheep farming. Although limited to farms with a minimum agroeconomic capacity, these alternatives were pork rearing, ovine cheese production, of guanaco shearing (the wool price was 20 times higher than that of sheep), fruit and floriculture. All these activities had been almost nonexistent in Patagonia until then, but any of them could succeed in retaining people on the land and thus rebuild communities.

Particularly in the sheep sector, a significant effort has been made to manage rangelands in the long run, in the absence of recovering them. INTA offered various management methods depending on the topography and the water resource of the rangelands.

Various non-governmental organizations integrated in international networks – e.g. International Federation of Organic Agriculture Movements (IFOAM), The Nature Conservancy (TNC) – have proposed original initiatives, such as the Organización Internacional Agropecuaria (OIA) and OVIS 21 (www.ovis21.com). In a rather conservative environment such as that of sheep breeders, OVIS 21 offered a holistic rangeland management that attracted some of the most daring breeders. The method relied on the detailed monitoring of herds and rangelands in order to adapt production to the resource. One of OVIS 21 goals has been the regeneration and sustainable management of six million hectares. In 2013, the threshold of 1.6 million hectares was reached, which caught the interest of local actors, especially policymakers.

At the same time, a major action has been carried out in the wool sector with the PROLANA program (www.prolana.gov.ar), designed to improve shearing, the quality of the classification and the packaging of wool, in order to optimize sale conditions. Although it was established in 1994, PROLANA became effective only in 2001. Since then a quarter of the farms had already joined the program. New hope has risen in the meat sector, in which recovery has also begun with the rapid increase in lamb and mutton exports. These sales quadrupled between 2000 and 2005, exceeding 8000 tons and stabilizing since then; Seventy percent of them came from Patagonia, which has benefited from its status of foot-and-mouth disease-free zone. As the European Union import quota (23,000 tons) is still far from being reached, it is hoped that the trend will continue.

Southern Patagonia regained its vocation to export sheep products because of the favorable conditions of the international market for meat, and above all the improved sanitary and organic conditions of regional production. However, these do not compare with the gigantic slaughterhouses and freezing plants that regulated the life of Patagonian ports in the early 20th century. Instead, current settlements are much less massive and polluting, and bury themselves among other modern industrial units on the edge of cities. It even looks like they have become a light, portable industry that can respond more flexibly to the volatility of the global market. To respond to this market, the traceability of products and controlled designation of origin (CDO) was applied both to meat (Carne Ovina Patagónica) and wool (Lana Camarones), specialties that are making headway to replace the commodities of the past.

SHEEP BLEAT IN MAPUCHE

Public action to rescue sheep farming, shared by many institutions at all political levels, has a particular flavor when it concerns Native-American-owned minifundia, as they have remained for too long on the fringes of the productive sector. Heading in this direction, the program PROLIJO, an offshoot of PROLANA, has been applied exclusively in the central-north area of Chubut, where Native American breeders prevail (Albaladéjo,

1990). The minifundists of Southwest Rio Negro have also organized themselves, even on an ethnic basis, such as the Federación de Cooperativas Ganaderas, or the Cooperativa Ganadera Indígena. The indigenous question is highly sensitive in Patagonia, and public action to resolve the land tenure issue of Amerindian communities has been on the agenda. The National Constitution and those of the provinces recognize their community rights on their ancestral lands, even if it does not necessarily mean the common property of the land. About one million hectares so far have been granted to Native American communities in the province of Chubut.

Thus, the official support for sheep breeding to the less fortunate in a region where economic alternatives are limited, along a modest infrastructure development have improved the living conditions of people and therefore the permanence of the inhabitants in the countryside, as well as conditions to continue an activity strongly anchored in the local and regional identity. Proyecto de Desarrollo Rural para la Patagonia (PRODERPA), launched by the Ministry of Agriculture with funding from the International Fund for Agricultural Development (IFAD), intends to improve the productive infrastructure but, as other programs, it is not limited to the sheep sector alone, as previously mentioned it aims at diversification at farm and community levels.

CONCLUSION

Public policies related to sheep husbandry in Patagonia are inseparable from those concerning land tenure, on the one hand, and Argentina and world geopolitics since the end of the 19th century, on the other. Together, they have shaped the organization of the territory and agrarian history of Patagonia.

Firstly, there were the Argentinian and Chilean government policies supported by the British to dislodge Native Patagonians, which is considered as a genocide by some scholars. Secondly, the liberal legislation at the beginning of colonization led to the formation of immense properties on the best rangelands. These ranches of tens of thousands of hectares were stocked with tens of thousands of sheep, often beyond their carrying capacity, which progressively caused the degradation of a large part of the territory. The opening of Panama Canal in 1914 was a major geopolitical alteration, which cut off Patagonia from the major navigation routes, to the detriment of the regional economic development.

During the early times of the colonization process at the end of the 19th century, Argentina, rather passively, allowed local actors to work in sectors, meat and wool industries, and to form rural societies and labor unions. The visibility of the state increased throughout the 1930s, then was reinforced during World War II, especially during the national populism period (1943–1955), perhaps because of the particular sensitivity

of the military to the concept of territory. Social and interventionist policies were implemented, but the land issue was not addressed, much less the Amerindian issue, even though Chilean Patagonia experienced its agrarian reform in the 1960s and 1970s.

Once the territories became autonomous provinces, ownership of the land was granted to many settlers and a series of sheep farming policies were introduced. But it was too late; despite this rather positive public action, the sheep sector continued to decline, mainly because of the degradation of rangelands. As a region, Patagonia avoids the complete fall because of its other resources such as oil, coal, fishing, later tourism, which are also targeted by public policies.

It is only with Argentina's economic crisis at the turn of the millennium that new more promising alternatives have been explored involving institutions, local governance, civil society, and international cooperation. They put the issue of range management and Native American land on the agenda and open up new perspectives. According to Oliva (2002), from punctual solutions in the 1970s and 1980s, public action shifted to wider strategies taking the environmental issue as a whole. The same can be applied to the social and Native American issues. The new context provides a chance for sheep to continue to graze in Patagonia, if all goes well, for a long time.

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Policy and livestock in the Andes: Recent history in Ancash, Peru

L. Oscanoa¹ and J. Recharte²

INTRODUCTION

Soil erosion, water deficits, damage to biodiversity and melting of glaciers are together a significant part of the challenge for sustainable development in the Andean region of Peru. Facing this challenge requires policies grounded in detailed studies on the Andean socioecosystems, especially regarding the dynamics of adaptation to the diverse ecological niches, including rangelands which cover the main part of the area, and the role of livestock in the adaptation strategies. In response to this challenge, the successive governments have carried out actions which mainly affected the poor peasant families. However, the policies implemented over the last decades seem disengaged from the reports of Andean studies and have been insufficient to reduce the vulnerability of rural communities.

With its central location in Peru and its history of land use, the Ancash region appears as an area representative of mixed crop-livestock production systems and provides a scenario to analyze the relationship between research on these systems and the broader social context of Peru (Figure 1). Research results of complementary disciplines conducted in the region enabled us to assess the dynamics between, on one hand, rangeland management, water, biodiversity and livestock systems, and, on the other hand, examples of rural policies targeting this region and similar ones in the country. Using the example of the Ancash region, this chapter analyzes the public policies implemented over the past decades and their effects on livestock management. Due to their multifunctionality, livestock production systems are central to understand issues of sustainability in rural communities. It is also important to note that historical events, such as the agrarian land reform of 1969 and subsequent establishment of Huascarán National Park over large parts of the expropriated haciendas (state lands), affected policy programs involving among others agricultural credits, watershed management, South-American camelid repopulation or even the contemporary process of mining expansion in the heart of pastoral socioecosystems.

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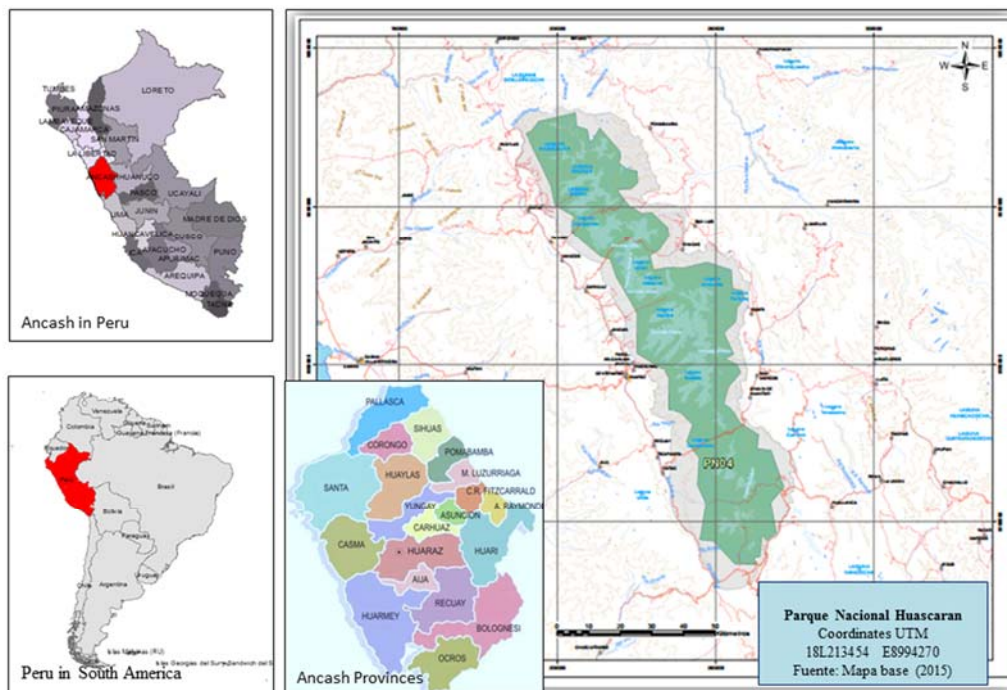


Figure 1: Ancash location in Peru

Other stakeholders that have some influence on the region include the National Service of Natural Protected Areas (SERNANP), a public and technical agency of the Ministry of the Environment supervising Huascarán National Park in both the central and buffer areas, the Ministry of Agriculture and Irrigation (MINAGRI), and diverse nongovernmental organizations (NGOs) such as the Center for Studies for Development and Participation (CEDEP), the Mountain Institute (TMI) and URPICHALLAY which have implemented numerous projects under diverse visions that aim to improve the well-being of rural families. The projects implemented by NGOs have for example promoted the acknowledgment of cultural traditions among herders, the reintroduction of South-American camelids, and technologies to improve the sustainable management of natural pastures based on research at local farm level (e.g. use of fencing and rotational grazing, infiltration ditches, revegetation with native species). Both national policies and local projects by governmental or nongovernmental agencies have impacted livestock production, rangeland management, and the ecosystem services provided by high Andean pastures.

Furthermore, in the specific case of Peru in contrast with other Andean countries, the Sierra region is geographically removed from the centers of power and policy-makers located in Lima, and closer to economic and social interests of the coastal regions of the country. Farmers and herders of the Sierra have been politically isolated and have remained unknown and marginal to the central government. For example, soil erosion is extremely high on Ancash Mountains: around 45 tons

per hectare per year (Vázquez and Tapia, 2011). Practical evidence shows that there are indigenous solutions such as replanting native species that quickly increase the retention of rainwater in rangelands (Oscanoa, 2015). In spite of relevant evidence, the government and institutions in the past have not allocated the resources to protect rangelands, although these play a key role in retaining water for farmland irrigation in highland and coastal regions, in addition to their role in meat and dairy production for national markets and rural families' consumption.

This chapter analyzes the contrasting results of successive political norms applied around Huascan Park, a land mainly belonging to families organized as peasant communities. A set of three successive policies are presented to give an overview of the past four decades: rural credit programs, the Sierra Verde (Green Highlands) Project, and Program of Repopulation of South-American Camelids. The impact of these policies on natural pastures, water resources, smallholding economy, and the generation of alternative technologies is discussed.

RURAL CREDIT PROGRAMS

Before addressing the case of credits aimed at alleviating rural poverty in Peru, it is important to mention that approximately ten million people live under conditions of poverty with more than half (54.1%) residing in the highlands, more than a quarter on the coast, and around 17.5% in the Amazonia (Rivera, 2012). Moreover, Rivera considers that highland people are more prone to chronic poverty because their income is low, volatile, and they lack access to financial and institutional facilities to respond to fluctuations in income. Since the 1960s, the successive governments have applied various credit programs targeting the poor in the highlands, like subsidized credit, zero-interest credit and revolving funds. It is very difficult to assess the effect of these programs because of the absence of data and information on their evaluation by the beneficiaries.

Subsidized credit

The Agrarian Bank (Banco Agrario or BA) was created in 1931, but it has become the main source of funding for agriculture in Peru only since the 1960s. Its role increased from 1969 after the agrarian reform. In the 1980s, BA was the source of more than 90% of formal credits disbursed to the agricultural sector. Credit was provided at subsidized interest rates far lower than those charged by commercial banks. This system led to an accelerated de-capitalization of BA at the end of the 1980s and early 1990s, a problem compounded by a hyperinflationary process. Thus in 1990, while the annualized inflation rate was higher than 7000%, the interest rate on BA credits was around 260% per year (Alvarado, 1993). Alvarado considers that BA collapse meant, among other things, that the agricultural sector remained without sources of formal financing. Before BA became insolvent, President Alberto Fujimori's government launched the creation of small rural banks managed at local

scale, and revolving funds as alternatives to the lack of funds for the rural sector. These alternatives never worked well and, unfortunately, there has been no effective system of credit adapted to the conditions of the Peruvian Sierra.

Zero credit or no-interest credit

During the Aprista government of Alan Garcia (1985–1990), interest-free loans or zero-interest credit were promoted in order to support areas of extreme poverty in the Andean. PROCODER (1993) indicates that this credit represented almost 50% of the loans granted in the highlands until 1989, with potato cultivation concentrating around 80% of the amount attributed to the zero-interest credit. Potato marketing is one of the main sources of income for poor families in the highlands. However, according to the same source, in 1987 only 7.5% of farmers with less than five hectares received this no-interest loan. Moreover, evidence collected in Puno area indicates that recipients of these credits invested the funds outside the agricultural sector, using the money for a more profitable trade. In the case of Ancash region, like many others in Peru, farmers were expected to invest these funds in a context of terrorism led by the 'Sendero Luminoso' movement, a situation in which investing credit in farms was dangerous (Chamba et al., 2018). For example, a peasant community that controlled more than 20,000 hectares received the zero-interest credit to reintroduce alpacas, a proposition that was almost impossible in the context of extreme violence (Chamba et al., 2018).

Revolving funds

Revolving funds are money or inputs that are lent to beneficiaries as working capital, which are then returned in cash or products equivalent to those provided at the end of the productive cycle. This lending model did not show capacity to be self-sustaining and to scale up in the case of Ancash. The main problem with this practice was that the beneficiaries received the funds as donations and thus the pool of original resources dwindled. Without linking loans to productivity and increased net income, the sponsoring institutions were limited to coercive actions to sustain their own projects (Alvarado, 1993).

In Ancash, for example, the revolving fund for alpaca breeding consisted in a loan to each peasant community to purchase 100 females and 10 males, and to pay it back with the production of alpacas once they reached reproductive age. The young alpacas were then loaned to other communities. The alpaca breeding loan by the sponsoring institution of the revolving funds also included technical assistance, specific training for breeders, support in animal health, and marketing. However, in spite of the subsidized technical support, the initial herd usually decreased due to mortalities from diseases, predators, inadequate management and reluctance to return the young alpacas. Central to these problems were the lack of adequate economic and institutional analyses by the sponsoring organizations, and the reluctance of the communities to return the loan. Retrospectively, the lending of alpacas to

families in contrast with community-managed herds proved more sustainable as families put more effort into implementing technical recommendations and reimbursing loans.

Alvarado (1993) noted that the two basic criteria of self-sustainability of the financial model and the level of coverage of the selected population did not work in these loan programs. In the case of Ancash, loan programs were not sustainable because of the low understanding of the contexts by both the governmental and nongovernmental organizations that sponsored the programs. During the period of these loans (1980s and 1990s), the Andean communities did not have the financial tools to find their way out of poverty. From a methodological perspective, participatory approaches are a more appropriate way to understand the context of small farms living in conditions of poverty and thus to design loan programs that work for them (Rivera, 2012). For example, in the alpaca repopulation program, when external agencies supported local initiatives that added value to products, there were greater chances of sustainability than in top-down projects. In our experience, small breeders valued horizontal relationships with external technicians, which resulted in a better performance of loan programs and the emergence of breeders' pride as a cultural factor indirectly supporting the loan system. In the end, poor rural communities in the highlands that received these loans used them as a tool for survival in a complex context.

SIERRA VERDE OR GREEN MOUNTAIN PROJECT

Developed since the early 1990s, the Sierra Verde Project illustrates the interest of the Peruvian State in high mountain areas in order to control water provision to the coast using inconsiderate technology and showing little regard to the importance of understanding the context. This way of approaching landscapes and smallholders in the highlands without proper understanding of local conditions and interests has continued in the context of glacier recession due to climate change in newer programs such as the Sierra Azul (Blue Highlands).

Origins of the Sierra Verde Project

The National Watershed Management Program (PRONAMACHS) of the Ministry of Agriculture was launched in the 1980s. The program made a series of adjustments that went from an emphasis on soil conservation to integrated management and conservation of watersheds (PRONAMACHS, 2006). Historically, the management of microwatersheds in highland Peru was conducted through local water management institutions. Large parts of rural infrastructures associated with irrigation, e.g. terracing platforms (*andenes*), irrigation canals, communal water reservoirs or artificial wetlands (*bofedales*), were of pre-Columbian origin (MIMA, 2004; Lane, 2009).

In the 1990s, the Sierra Verde Project aimed to reactivate the productive potential of the Andean area in three years and on two million hectares. This government

program was among the first ones to focus on conservation of rainwater, but narrowly focused on technical solutions, investing significantly in tractors to build thousands of ditches in the fragile alpine belt. In places such as the upper basin of Santa River in Ancash, the only result after nearly two decades is a landscape with visible scars but no real impact on the hydrology of local watersheds nor in the base flow of the larger basin.

In the following decade, PRONAMACHCS (2006) transitioned into work at the level of microwatersheds (MIMA, 2004), which were used to organize PRONAMACHS' activities. Despite this effort, new comprehensive water legislation in 2009 did not support decentralized management of subwatersheds and called for centralized models at the level of large basins. Thus, the management of these large basins lacked understanding of diverse local contexts and did not integrate a multidisciplinary approach to design regulations and policymaking. To a large extent, the role of grasslands and pastoralists in securing water for these basins remained invisible. The more recent development of models and simulation techniques in Ancash have shown the important functions of high-mountain ecosystems (Oscanoa, 2015).

Agroecosystem and watershed management at local scales

Ecological and socioecological approaches to landscape management have recently gained ground in the sphere of governmental and nongovernmental agencies due, to a large extent, to the dramatic realization that the rapid recession of glaciers in the context of climate change requires nature-based, integrated solutions and multidisciplinary tools. It also requires flexibility; watershed management needs to adapt according to the size of the watershed. Managing large basins has to include the interactions between small and micro watersheds, in particular as it is easier to describe and assess the complexity of factors in smaller-scale watersheds (MIMA, 2004). From a management perspective, these two levels are clearly complementary, yet watershed policies in Peru have ignored decentralized management for many years.

PRONAMACHS selected seven pilot sites to test microwatershed management. Participatory methods to design agreement with local populations were used in order to involve a greater number of families. Although the program also incorporated concepts of respect for ancestral knowledge and customary water management institutions, the implementation of these concepts proved to be extremely difficult. One reason was the fact that the resources allocated to manage each microwatershed were not sufficient (MIMA, 2004).

According to PRONAMACHS (2006), the weak transmission of soil conservation practices in rural areas was the result of the top-down model applied for many years. The new strategy consulted the rural community to decide on the desired future landscape, and considered the diverse local constraints, capacities and available alternatives. In the next step, the rural communities worked to implement this future

landscape with the support of technicians from governmental and nongovernmental institutions. The local strategy thus integrated the desired landscapes, the constraints and capacities of neighboring communities, especially those that shared the same watersheds. This process was strengthened with the participatory planning approach, the respect for cultural traditions and a growing business vision in response to feedback from beneficiaries during its development. The institution mainly acted as a facilitator of interactive learning (PRONAMACHCS, 2006).

While PRONAMACHCS focus on soil conservation and improvement of irrigation systems has also opened the way to preserving ecosystem services, its recommendations related to pasture management have continued to be centered on the planting of exotic forages in natural pastures and irrigation associated with the use of fences, ditches and infiltration furrows as well as reforestation with native species. The organization uses hydrological balances to evaluate the impact of these technologies at watershed scale.

Mountain cultures perspectives

Participatory monitoring systems are a necessary component of collective learning processes, in particular monitoring impacts as perceived by program beneficiaries (MIMA, 2004; Oscanoa, 2015). Geographic information systems (GIS) are also powerful tools now incorporated in the program to facilitate the elaboration of thematic maps through detailed data from the tabular management on natural resources, production systems and socioeconomic components. It is expected that GIS-aided simulations of potential interventions may support decision-making at the scale of microwatersheds and facilitate participation of local stakeholders (Oscanoa, 2015; MIMA, 2004).

Concurrently to this idea of using GIS and models was the interest of attracting young leaders to the Management Committee of the microwatershed (MIMA, 2004; Oscanoa, 2015). However, the reality of the countryside in Ancash and other regions of Peru shows a strong out-migration of young people, especially of young men (Alata et al., 2018). It is also important to involve young women and focus on generating competitive economic activities to attract young couples back to manage livestock in the high Andes.

REPOPULATION OF SOUTH-AMERICAN CAMELIDS

The national Program of Repopulation of South-American Camelids was also developed in the early 1990s as a response to poverty alleviation among farmers and herders of the Central Andes. The Ancash region was one of the sites selected by the program.

Program origins

Early research and extension projects that called attention to the lack of research and support for Andean South-American camelids were the Program of Sheep and South-American Camelids of the National Agrarian University La Molina, Lima, Peru (POCA) founded in the 1960s, and the Small Ruminants Collaborative Research Program conducted in the 1980s. POCA was a reference to decision makers that established the National Council of South-American Camelids (CONACS), the agency that launched the initiative of alpaca repopulation in Central Peru. The project was led by an NGO, the Center for Development Studies and Participation (CEDEP). Working together, CONACS and CEDEP generated diagnostic studies about the farming systems based on llamas and alpacas grazing in Ancash rangelands and designed revolving funds to finance the repopulation, strategies for marketing of alpaca products, and the provision of inputs, technology transfer and monitoring with participating communities. CONACS was dissolved in 2007 and its functions transferred to regional governments. While there have been some attempts to promote national legislation to support the development, protection, conservation and sustainable use of South-American camelids (Condori, 2015), this is a resource that remains largely marginal among national priorities.

Strengthening the smallholding system in the high Andes

Alpacas and llamas were reintroduced in regions such as Ancash where they existed until approximately the 17th century (RECAP, 2007). The objective of the program was to complement and strengthen the traditional crop-livestock farming system with the animal component based on sheep and cattle. One of the challenges was that farmers applied cattle management practices to alpacas. For example, in the upper areas of Chavín in Ancash, breeders would attend to their alpacas only once or twice a week to conduct a head count of their herd. In response to the request of local 'Alpaca Committees', changing this habit required the training of breeders by CEDEP. During this process, the trainers observed that the infiltration ditches built under the Sierra Verde Project sometimes contained polluted water that killed animals or made them sick, with significant losses for producers. The first lesson was, again, the critical importance of integrating herders in the design of development programs; the second lesson was the need to understand the broader context in which producers have to function, including the loss of water provided by glaciers and other impacts emerging off climate change in grasslands.

CEDEP implemented 12 modules in Ancash. Each module consisted of colored alpacas, 100 females and 10 males, with animals coming from the best breeding centers in Southern and Central Peru. Oscanoa et al. (1997) have identified some of the valuable technological aspects of this program, i.e. building of an experimental center to transfer alpaca and llama production technologies, the partial maintenance of the genetic quality of alpacas in the region with a breeding bank of 125 alpacas with the best genealogical records available in CONACS, methodologies to recover

degraded natural grasslands based on low-cost irrigation, enrichment of grasslands with native species with nutritional value for alpacas, and the use of llamas to enhance tourism and reduce the use of donkeys, mules and horses that have significant impacts on rangelands. The latter initiative was fostered by herders who were also mountain guides organized as the Association of Auxiliary Mountain Service Providers (ASAM).

Sustaining an alpaca germplasm conservation bank proved to be one of the most difficult tasks of the program because of illegal exports of llamas and alpacas via Bolivia and Chile as stopovers before reaching the final markets in the United States, Australia and other countries (Oscanoa et al., 1997). As a result of this market context, animals of lower genetic quality were introduced via the program, compromising the productivity of herds.

Another aspect of alpaca production that was explored by this program was the unique food properties of alpaca meat for human health such as a low intramuscular fat content, a high protein to fat ratio, and an omega 6 to omega 3 ratio that is nutritionally healthier than that in other ruminants' meat (Salvá et al., 2009; Ozmen and Aktumsek, 2011). According to Valenzuela et al. (2011), omega-3 polyunsaturated fatty acids have been shown to be effective for the treatment and prevention of both cardiovascular and neurodegenerative diseases, cancer, inflammatory bowel disease, rheumatoid arthritis and ischemia / reperfusion injury. Forages such as grass and legumes are rich in such acids and are a useful natural strategy to improve the nutritional value of ruminant products. A high proportion of lipids in forages is found in the chloroplast and studies suggest that the polyphenol oxidase enzyme in red clover helps reduce dietary lipids and thus increases the delivery of n-3 polyunsaturated fatty acids through meat and milk (Kim et al., 2009).

Scientific advances confirmed that South-American camelids grazing at high altitude produce valuable nutrients (omega 3), which help control deadly diseases in humans (Valenzuela et al., 2011). In consequence, there is substantial evidence to rethink national policies that underestimated rangelands in highland areas and the potential to develop South-American camelids as a source of high-quality meat, and thus economic opportunities for mountain communities in the Andes.

Impacts and sustainability of the program

Between the mid-1980s and the 1990s, Peru went through a long period of economic, social and political crises, and an increase in terrorist attacks across the country (Oscanoa et al., 1997). In this context of social violence, the attacks to the visible leaders of the alpaca repopulation program, e.g. Alberto Pumayala and the destruction of a center for the dissemination of alpaca and llama management technologies (CEDTA) developed by CEDEP, were events that deeply affected the program sustainability. The period of civil violence in Peru also contributed to the out-migration of young people and herders. Elders took on more prominent roles in herding groups in the Andes, and the institutions that were key to managing common pool

resources such as grasslands were deeply eroded and lost capacity to undertake collective actions (Osorio, 2013).

In spite of the exceptional potential of South-American camelids to provide high-quality meat and fibers, their reduced impact on soils, and the opportunity they represent to improve families' incomes in the high Andes, the agrarian policies in Peru have not recognized this potential wealth. The impact of the repopulation program was limited by i) the low integration of alpacas in the existing agropastoral systems of Ancash, even when much effort was applied by CEDEP to support communities that adopted this species new to them, ii) the very limited access to markets and the design of programs without proper understanding of the economics involved, iii) the climate of violence generated by terrorism, and iv) the lesson learned once more that programs designed with insufficient participatory approaches miss understanding the objectives of producers, and the social, economic and political context in which they function.

CONCLUSION

Diverse national policies aimed at farmers and herders in the high Andes have shown a primary focus on the protection of natural resources, especially the conservation of watersheds to protect the availability of water for irrigation in the coastal plains of Peru. These policies and projects have usually been very remote from the objectives and conditions under which smallholders of the high Andes conduct farming and herding. They failed to recognize the multifunctionality of livestock systems for farmers and the need to support applied research and actions to help enhance the potential of livestock production in the area.

The examples presented here show their systematic failure to integrate the expectations and objectives of smallholders in the design of the needed interventions. Smallholders living in rural communities manage 15 million hectares of rangelands in Peru. Rangelands are clearly considered as marginal lands by national decision makers in terms of their economic potential for food production, compared to more lucrative activities such as mining. Only recently there has been a reevaluation by policy-makers of the strategic importance of this ecosystem for water security in the context of climate change.

In all these examples, the difficulty to build sustainable programs seems to lie in the lack of a more effective participatory planning in the design of policies and projects that therefore appeared to be constructed from a top-down perspective. The policies have not been designed with the genuine understanding of the context and the social demand of farmers and herders. Policies that address the high Andes seem to be biased by more powerful economic and political interests such as the need for agroexport in the coast or mining.

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History of livestock policy in Mozambique

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INTRODUCTION

Mozambique covers a vast territory with different agroecological conditions and food resources, and very favorable animal genetic resources for the livestock activity (Figure 1). The livestock breeding tradition and animal-draft use in agriculture, the economic value and social role that different species play in the lives of Mozambican rural families, the extensive and fertile natural pasture areas, and the existence of a market with a strong demand in livestock products constitute real opportunities for the livestock sector development.

Concerning livestock production, particularly cattle, Mozambique can be divided into three broad zones: South, Center and North. The family farming sector plays a very important role in livestock production. However, trypanosomosis represents a major obstacle to cattle breeding, as about two thirds of the country's total surface is infested by its vector, the tsetse fly or *Glossina* (Dias, 1969; 1970; Mazuze et al., 2008).

The livestock production history can be characterized by three main phases: the colonial period, the period, when the country immediately endured an armed conflict that lasted about 16 years (1977–1992) with dramatic consequences for the sector, and the period after the armed conflict. This chapter will address several aspects related to the various transformations that the livestock sector underwent during the periods.

BRIEF HISTORY OF LIVESTOCK PRODUCTION

Morgado (2004) argues that livestock species have existed in Mozambique for a relatively long time as he reports their presence before the arrival of navigators led by Vasco da Gama around year 1492. There is a correlation between the livestock distribution and the human population distribution, water availability and the absence or reduced presence of tsetse flies, mainly in the central regions of the country.

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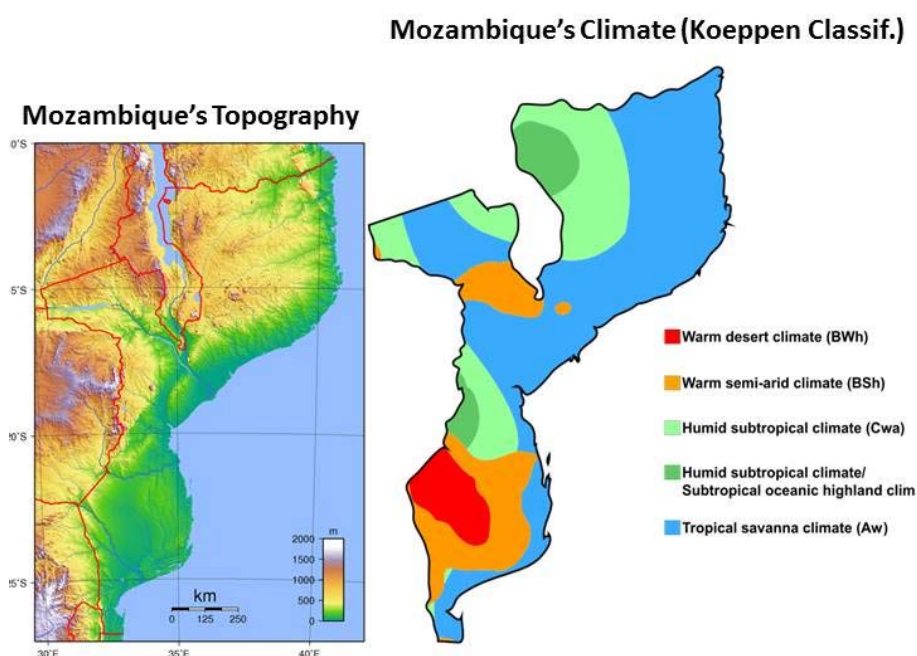


Figure 1: Location, topography and climate of Mozambique

Anthropological and archeological studies as well as the reports of some historians cited by Morgado (2004) recount the domestic animals' migration or entry in the country. For example, cattle, goats and sheep would have been introduced in Central Mozambique during the immigration of Bantu peoples, arriving from Katanga Plateau in the Democratic Republic of Congo (ex-Zaire), and Asians. It should be noted that goats and cattle settled in Tete Province (Central Mozambique) and Gaza Province arid land (Southern Mozambique), because the vegetation there meets their nutritional needs, and disease factors are reduced due to a lesser parasite pressure (helminths and blood parasites). Hence, these two areas held the largest herds at the time.

The occurrence of rinderpest (*peste bovina*) in 1896 and theileriosis (due to *Theileria parva*, *febre da Costa Oriental*) caused a considerable cattle reduction in Tete. Recovery occurred following Angone peoples' migration to the north, as they escaped from invading Zulu peoples from the south, which also produced the Mashona (or *Bovino de Tete*) crossbreed, and the zebu breeds from Zambia produced the bovine Angone that is relatively tolerant to theileriosis (Morgado, 2004).

European and American breeds were introduced after the emergence of companies in Zambezia in 1892. During this period, crosses were carried out between Hereford and White cattle. Zebu (mainly Brahman) breeds were introduced from Brazil and Africander breeds from South Africa. In 1969, the Aberdeen Angus breed was introduced in the Penhalonga area of Manica Province's highlands. Very recently, after peace was restored in Mozambique, the Tuli and Mashona were (re)introduced from Zimbabwe (Morgado, 2004).

Dairy cattle breeds, especially the Holstein Friesland and Brown Swiss, were introduced in the milk basins of Umbelúzi (Maputo Province), Vanduzi (Manica P.) and Beira Town (Sofala P.) in 1958, 1970 and 1980 (Morgado, 2004). However, in 2008, as a tentative to encourage dairy production, the Jersey breed was introduced by the society Land O'Lakes (Serviços Provinciais de Pecuária de Manica, 2008).

While en route to India, the Portuguese introduced pig farming in Mozambique. According to David Livingstone, cited by Morgado (2004), the first swine herds were severely affected by tsetse in the Zambezi and Chire rivers regions (Dias, 1970). Ferrão (2001) reports that swine had been reared in Nampula (Northern Mozambique) even before the Islamic incursion in the country.

The swine commonly bred in Mozambique is the Landim. It is black and reared by small producers in rural areas mainly in an extensive production system with few inputs and without much health and feed care (Quembo et al., 2014). Exotic breeds crossed with the local breed are reared by larger producers in a semi-confinement system also in areas near villages (Morgado, 2004). The Large White and the Landrace are some of the commercially exploited breeds in intensive or semi-intensive production systems at the periphery of large cities, in the urban areas of Maputo, Beira, Nampula, and, to a lesser extent, in Chimoio, Gaza and Inhambane, according to the Food and Agriculture Organization of the United Nations (Dias, 2007). The main constraints of swine production in Mozambique are the recurrent outbreaks of African swine fever, which have a very negative impact on pig farm development in endemic areas (Penrith et al., 2007; Quembo et al., 2014).

Livestock production is a relevant activity in the agrarian sector, because of its role in the poverty reduction strategy and its growing contribution to the country's socio-economic development. Animal husbandry represents a source of income and an economic reserve. It helps diversify peasants' livelihoods as it contributes to the production systems balance through animal draft and manure, increasing agricultural production. It also provides food security to families, and plays a social role in

rural communities. It is estimated that about 86% of the herds of the country are family owned, the remaining 14% belonging to the commercial sector (CAP, 2011).

POTENTIAL FOR LIVESTOCK PRODUCTION

South zone

This area is located south of Save River, representing about 20% of the country's area, covering Inhambane, Gaza and Maputo provinces. The climate, except for the coastal regions and Libombos Mountains, is semi-arid with on average 350–800 mm annual rainfall, occurring mostly in summer (October–April). The average annual temperature is 22.7°C on the coast and it increases when progressing inland to reach 25.5°C in Pafúri. The relative humidity decreases from 70.6% on the coast to 63.9% in Pafúri border region with Zimbabwe and South Africa (Mozambique National Meteorology Institute - INAM).

Topographically, this territory consists mostly of undulating plains, whose altitude rises smoothly from the coast to the interior, presenting only one significant elevation, Libombos Mountains. These mountains extend from the south of Maputo Province on the borders with South Africa and Swaziland, to Mapulanguene area, with an altitude of 300–600 meters, and a peak at Namaacha at 800 meters. The vegetation is predominantly arboreal and shrubby savanna, with a dominance of *Acacia* spp. and *Colophospermum mopane* in cattle areas. It is the best natural pasture in the Southern zone, made up mostly of mixed and sweet pastures.

Central zone

The Central zone has very diverse agroclimatic characteristics. It extends from Save River to the north of Zambezi River. Rainfall levels highly vary, with 1000–1400 mm per year in most of the zone, and over 2000 mm in Manica and Tete highlands. The greatest limitation to livestock breeding is the presence of tsetse and trypanosomes, which requires the continuous use of prophylactics against trypanosomosis, thus increasing production costs particularly for small-scale farmers (Dias, 1969; 1970).

The area is mostly covered with mixed pastures, i.e. grazing pastures in the highlands and sweet pastures in Tete Province dry lands. The pasture areas in this zone can be subdivided into three plant formation types: i) Zambezi Valley flood plains, and Quelimane and Beira coastal areas, with high average annual temperatures (24–26°C), rainfall around 1000 mm, covered with several grass species, and tree and shrub savannas with sweet pasture grass; ii) The highlands of Manica and Tete (Angonia) provinces, covered with forests and grazing areas dominated by *Hyparrhenia* spp., where tsetse infestation is considered to be low (Dias, 1969); the annual rainfall is high with above 1500 mm, and average annual temperatures are below 24°C, i.e. its climate is humid tropical, influenced by altitude; and iii) Tete Province dry lands and the north of Manica Province (medium altitude) with mainly savannas

with good quality pastures; the temperature is very high, with an average above 26°C, and the humidity is low.

North zone

This North zone covers Niassa, Cabo Delgado, Nampula provinces and the north of Zambezia Province. It is mostly covered by miombo woodland forests and pasture grass. Although rainfall is good (800–1200 mm), the dry season is very long, with a high density of tsetse flies (Dias, 1969; 1970). As one consequence of the war, the livestock, especially cattle, drastically decreased between 1982 and 1993, with serious consequences to farmers' families and severe losses to livestock enterprises. Meat and milk production decreased significantly and import levels increased in the main consumption centers. Herd recovery (through the Livestock Rehabilitation Program implementation, introduced by the Ministry of Agriculture) was therefore the livestock development strategy central objective. Subsequently, the national herd and meat production have steadily increased since mid-1990s in the entire country.

LIVESTOCK PRODUCTION AND SPECIES

Beef cattle and small ruminants

In the national market for animal products, beef production has been growing rapidly in recent years. This growth is also notable in the contracts for meat supply with some butchers and supermarkets, especially in the cities of Maputo and Matola, and in smaller cities in the Central region.

Livestock marketing at family level has been mainly carried out in fairs, and Marara District (Tete Province), Magude and Moamba (Maputo P.) host the most popular and relatively well organized fairs. However, some companies have developed a system where small producers are supplied with calves, or empty or gravid cows.

Cattle numbers have been growing in recent years, from about 1,256,000 head in 2005 to about 1,860,000 in 2013 (DNSV, 2014). This growth is in part due to livestock repopulation as well as to the effects of breeding programs, through the introduction of improved bulls and reintroduction of the artificial insemination program. Improved health programs (vaccination campaigns) and veterinary technical assistance services are other important factors in this growth.

Small ruminant production is dominated by goat breeding, with a current stock of over 4.6 million head. Tete Province in the Central Region of the country has the largest flock. The goats often belong to the Landin local breed and are mostly reared by small producers. The commercial production is still embryonic. The goats are chiefly crossbreeds between the Red Goat Kalahari (originating from South Africa) and the Alpine (originating from Europe) introduced by few private companies in Barue District (Manica Province), Namaacha District (Maputo P.) and Lichinga

(Niassa P.). However, the potential for goat production on a large scale is still under-exploited.

Dairy cattle

The ongoing dairy program in the country was launched in 2008 with the purebred dairy cattle introduction in the provinces of Maputo, Gaza, Inhambane, Sofala and Manica, aiming to increase production. The total herd increased from 1680 to 2350 dairy cows between 2009 and 2013 (DNSV, 2014). Milk production increased from around 1,760,000 liters in 2009 to about 2,024,000 liters in 2013 (DNSV, 2014). This increase has been linked to the general improvement in herd management with an emphasis on feed management, milk production and processing training for producers. As a result of the increase, in Nhacoongo a small milk processing plant with a capacity of 650 milk liters per day and in Beira a milk factory with a capacity of 6000 liters per day were built (DNSV, 2014). More recently, a private dairy farm was established in Manica with a herd of over 450 cows and an average daily milk production of 1025 liters, in association with a milk processing plant specializing in cheese, yogurt and butter (report of the Departamento de Pecuária de Manica, 2018).

Poultry

Poultry production has been growing in the country in recent years. Domestic chicken production grew 1217 fold, i.e. from about 4600 tons in 2005 to about 56,000 tons in 2013 (DNSV, 2014). The current chicken meat production is 75,100 tons. The creation of a poultry credit contributed to this growth, worth about 30 million meticaís (around 400,000 US\$), and about 150 poultry farmers became beneficiaries. This credit was intended to provide domestic producers with the capacity to compete with chicken importations from various countries, including Brazil, the largest chicken exporter at a relatively low price compared to domestic production. Import controls through the Poultry Working Group (GTIA) also contributed to the growth, which included the public and the private sectors, via quotas for imported poultry meat based on volumes to protect domestic production.

Livestock breeding expansion

There are ongoing programs for the implementation of the expansion of livestock breeding, called 'formicarius colma' (or 'galinha-do-mato') and 'vondo'. This initiative aims to provide the population with more diverse sources of high-value animal protein alternatives. The wild species livestock program for the so-called Zambia chicken includes strategies to introduce artificial or solar incubators to incubate Zambian chicken eggs in order to reduce egg loss in the bush caused by predators or other reasons. With this alternative, Zambian chickens can be produced and fed without compromising Landim chicken production. In rural areas, Landim chickens are used as 'incubators' of Zambian chicken eggs, which in a way compromises the Landim breed existence.

LIVESTOCK ASSISTANCE AND ANIMAL HEALTH

Assistance to livestock is guaranteed by a veterinary service network present in each province. Its mission is to coordinate livestock agents' activities in the various districts. These agents are also responsible for providing assistance to small domestic animals: they not only ensure vaccination of chickens against Newcastle disease but also of canines against rabies. The Ministry of Agriculture and Rural Development has developed measures aiming at the protection of animal and public health, through annual mandatory campaigns of anti-tick dipping using dip tanks or treatment corridors.

A network of veterinary laboratories helps with diagnoses of animal diseases via activities that include disease surveillance with a focus on parasites, viruses and bacteria, and necropsies. Thus, there are three regional laboratories located in Manica, Nampula and Gaza provinces, in addition to a central laboratory that serves as reference laboratory for the country. The laboratories in Manica and Maputo also carry out quality control tests of animal-origin food for human consumption as well as animal feed rations.

CONCLUSION

In general, animal production has been increasing in Mozambique as a consequence of the implementation of restocking programs. It mainly concerns dairy cattle, poultry and goat production, promoted by the private and the public sectors, and non-governmental organizations. However, veterinary services for disease control remain challenged by small-scale farmers who are disinclined to change their practices.

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Livestock development policy analysis in Benin

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INTRODUCTION

Benin (ex-Dahomey) was one of the French colonies in Western Africa. It is located on the West Coast of the continent between Nigeria in the west and Togo in the east. Benin is a country of the Gulf of Guinea, stretching from north to south, with a surface area of 114,763 square kilometers and a population of about 9.1 million inhabitants in 2011 (FAO, 2012). It is located in the tropical zone between the Equator and the Tropic of Cancer (between latitude 6° 30' and 12° 30' N, and longitude 1° and 30° E). It is limited in the north by Niger River which separates it from Niger, and in the northwest by Burkina Faso.

As in most developing countries, Benin's economy is mainly based on the agricultural sector, which includes over 70% of the population (Tidjani et al., 2006). Livestock occupies a prominent place with regard to food self-sufficiency, especially products of animal origin. This sector contributes up to 44% of the agricultural gross domestic product (GDP) and 12% of the national GDP (MAEP, 2011). However, the livestock development policy implemented in Benin has changed over time. Up until now, political decision makers have been adopting various strategies for livestock development that set the bases to meet the necessary means to boost the livestock subsector, considering its importance for the local and national economy. All the measures to develop the livestock subsector have thus been implemented by the successive public administrations. The present work was carried out using reports from organisms in charge of the development of the agricultural sector including cattle breeding, and university dissertations that address the problematic of cattle breeding development in Benin, with the aim to analyze the various policies implemented to improve cattle breeding. The work focused on the breeding history and the presentation of the implemented livestock development programs.

HISTORY OF CATTLE FARMING

The Beninese agricultural sector has been undergoing major changes in relation to the various administrations that have succeeded one another since the arrival of

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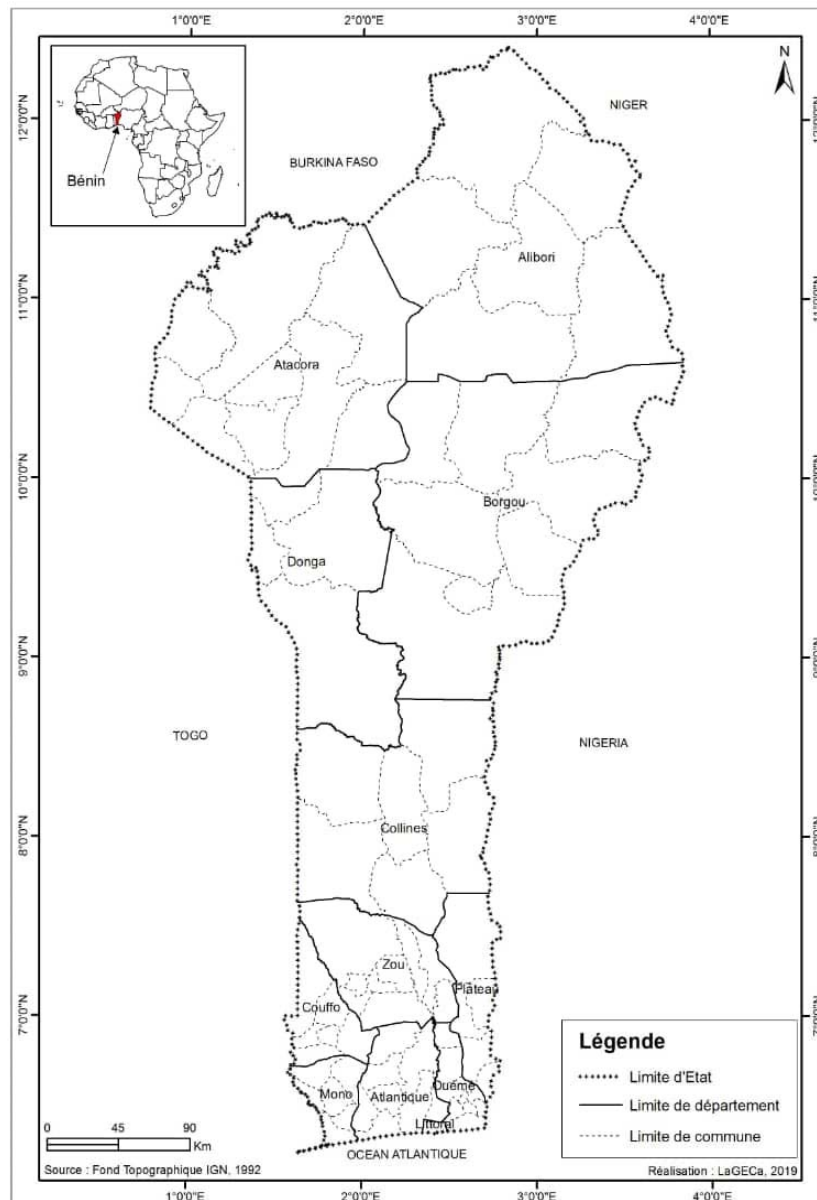


Figure 1: Map of Benin

French settlers. Animal production has been involved in the successive changes. The chronology of the transformations in the livestock subsector since the beginning of the 20th century (Dahomey) until today shows that livestock services evolved along four major periods identified based on their denominations, guardianship and policies implemented by the public authorities (Beninensis, 2018).

Colonial period

During the colonial period, the livestock subsector was run by the colonial administration. The different orientations given to cattle breeding were based primarily

on animal health and husbandry, which was an area of priority defined by FAO for all countries of the French West African group. Thus, as in most African countries, the colonial structure responsible for animal production was created in 1908 under the name of 'directorate for the control of epizootics and zootechnics'. Emphasis was placed on animal health because of the abundance of forage resources in the country during this period.

The implementation of this livestock subsector development strategy required setting up a local presence of the administrative organization. Administrative structures were thus set up in the six departments of Dahomey at the time. These departments corresponded to the breeding areas, which were headed by veterinary inspectors or African veterinarians, who reported to the National Directorate of Livestock and Animal Industries.

At a lower level (subprefectures), the livestock subsector was divided into livestock stations in the districts and villages. Management was entrusted to livestock assistants and livestock handlers. These agents were recruited after the junior high school degree (BEPC) and trained in Bamako, Mali, or in the field. Vaccination was at the core of their activities and skills. They traveled across the country on foot, horseback or by bicycle to raise awareness among breeders and vaccinate their animals. During the various vaccination campaigns, cattle herds were vaccinated against rinderpest, contagious bovine pleuropneumonia and anthrax. Most of these activities were concentrated in the north, which had the largest livestock population, and were managed by the Parakou breeding station for Borgou Department in the East, and Natitingou for Atacora Department in the Northwest.

Animal husbandry studies have also been carried out by the colonial administration for a better knowledge of the local breeds aiming to improve them. In this context, two farms were created to provide a framework for conducting research: in 1952 Okpara Farm in Borgou Department, and in 1958 Kpinnou Farm in Mono Department in the Southwest. Okpara Farm was originally an exhibition establishment where Borgou breeds were reared. Kpinnou Farm had facilities designed to improve porcine species. All these processes initiated by the colonial administration led to the creation of the first National Directorate of Livestock and Animal Industries (DNEIA) in 1959 on the eve of Independence.

From the Independence in 1960 to the 1990 National Conference

Independence was proclaimed on August the 1st, 1960. Until 1972, the country faced a period of instability with successive military coups that ended with the arrival of General Mathieu Kérékou. Dahomey became People's Republic of Benin in 1975, then Republic of Benin at the National Conference of 1990. The periods of instability did not enable notable restructuring of livestock services.

The successive powers have been mainly concerned with safeguarding settlers' legacy in the development strategy of cattle breeding. As in colonial times, control of

epizootics and other priority diseases was DNEIA's main activity. The persistence of major epizootics such as rinderpest, contagious pleuropneumonia and charcoal conducted livestock authorities to focus interventions on: i) protection of national livestock through large campaigns, ii) application of animal health and food inspection measures mainly in the traditional meat subsector, and iii) control of activities on livestock farms (Hestin, 2012).

With General Kérékou in power there has been a political will for the development of the livestock subsector with measures more important and more ambitious than those of the past. The livestock subsector was restructured along a Marxist-Leninist approach, which became the new political direction for the country. Benin underwent major changes as it became state controlled. In the new policy, the Ministry of Rural Development and Cooperative Action (MDRAC) was responsible for the implementation of state policy in rural development. New general directorates, provincial and regional action centers for rural development (CARDERs) were created: Bétécoucou Farm in 1973 and Samiondji Farm in 1975, financed by the United Nations Development Program (UNDP). The creation of the (public) Animal Resources Development Company (SODERA) and the Ministry of State Farming and Fishing Farms (MFEFP) followed.

Each body had a well-defined mission. The six CARDERs controlled and coordinated the activities of the animal production divisions. The missions of Bétécoucou Farm were to develop and promote Borgou and Samiondji cattle, to develop the endangered Lagunaire cattle breed, and to breed animals for tillage by animal draft (Yousao, 2015). SODERA was involved in the promotion of cattle fattening. It controlled all the farms (except Samiondji) and animal product marketing. It was liquidated at the time of the Conference of the Forces of the Nation in Cotonou in February 1990. CARDER agents depended on MDRAC and those of the breeding and farms of the livestock management and animal industries within MFEFP.

In 1977, the Animal Production Development Project (PDPA) was launched by the Beninese government with the assistance of UNDP and FAO. Financed by the African Development Bank (BAD), it had three main objectives: i) increase the productivity of the national cattle herd by introducing breeding heifers with higher genetic merits, ii) increase meat production to meet the needs of a growing population, and iii) support crop-livestock integration through the development of animal draft and the supply of draft oxen. Results were not entirely satisfactory. The project enabled the production of steers for sale, but marketing was very limited in the case of plow oxen and non-existent in the case of heifers (BAD, 1989, quoted by Assogba, 2017).

In 1984, a new readjustment placed DNEIA, the National Directorate of State Farms and the six CARDERs under MDRAC's authority with new orientations. DNEIA's objectives were the health protection of the national herd, the application of legislation in the field of animal husbandry, the organization and control of livestock movements, the inspection of all animal-origin products, and public health protection.

The National Directorate of State Farms was in charge of coordinating all the activities of state farms, including monitoring the evolution of their programs and assisting them in their dealings with institutions (Hestin, 2012).

The various strategies implemented as part of the development of the livestock sub-sector have significantly increased the number of cattle, which more than tripled between 1961 and 1990, from 321,609 to 10,800,000 head (FAOSTAT, 2016). Vaccination campaigns in pastoral areas have improved the health status of animals and reduced mortalities caused by outbreaks of epizootics. The range of grazing areas also expanded. The traditional production system was marked by the mobility of pastoralists to the central areas of the country during the lean season. On state farms the production system improved a lot with the installation of forage plots.

However, this political orientation showed its limitation during the economic collapse of the system in the 1980s. State budgets displayed an imbalance between personnel, operating and social expenditures, and investments. This situation led to a steady decline in the share of the budget allocated to agriculture. Facing recession and financial difficulties, the government implemented the Structural Adjustment Program (PAS): freeze on civil service recruitment in 1986, incentive to quit jobs, job reduction. Financial contributors, who supported PAS implementation, demanded the disengagement of the state from production and marketing. Liberalization of animal health services, privatization of the national veterinary pharmacy (PHARNAVET) and payment of benefits by breeders were at the basis of the structural adjustment program. This was the first disengagement of the state from the livestock sub-sector. Livestock producers became thus responsible for the vaccination of their herds (MDR, 1994).

PERIOD FOLLOWING THE 1990 CONFERENCE OF THE FORCES OF THE NATION

Following the economic recession of the 1980s, the country organized the Conference of the Forces of the Nation in February 1990. Thereafter, Benin opted for economic liberalism. The Letter of the Development Policy Statement (LDPDR) was signed in May 1991 and the Agricultural Services Restructuring Project (PRSA) was implemented in 1993. It is noteworthy that LDPDR marked a turning point in agricultural development, especially that of livestock farming as it is still known today.

The general objective of the letter was to increase the productivity of the national herd by improving traditional breeding, diversifying and modernizing farming systems, producing and promoting the accelerated development of short-cycle farms. The specific objectives were: i) seek further integration of livestock and agriculture while ensuring sustainable exploitation of natural resources, ii) help rural people manage their farms and land on their own, and iii) improve the financial profitability

of livestock farming. To this end, privatization of the veterinary profession was initiated and the state withdrew from the activities of production and marketing of livestock products to exercise only its regulatory functions (MDR, 1994).

To promote further the new orientation, an agricultural-sector roundtable was held in September 1995, and the Strategy and Plan were implemented. In addition, to promote visibility of the achievements, actions for the livestock subsector (SPAÉ) were launched. The development strategy of the livestock subsector thus defined was based, on one hand, on the development of traditional livestock systems for cattle, small ruminants, pigs and poultry, and, on the other hand, the development of animal subsectors: milk, modern poultry and swine in periurban areas; traditional cattle, small ruminant, and traditional poultry throughout the country; and traditional pork production in the south, center and northwest.

The actions carried out for livestock breeding were: i) setting up an artificial insemination center, which also provided animal health monitoring services on a cost-recovery basis and worked in partnership with the University, and other structures of the national agricultural research system; ii) strengthening breeding farms for brood-stock selection and crossbreeding to improve performances, and providing a relay through private livestock farms to increase quality-animal production; iii) ensuring decent sanitary conditions in the farms; iv) building the capacity of producers and their organizations to implement climate-change adaptation measures; v) strengthening health and epidemiological surveillance at national level, and improving control by developing the analytical capacity of the national veterinary laboratory; vi) continuing pilot actions in the introduction, reproduction and dissemination of improved cattle, sheep, goat and swine spawners; vii) supporting private poultry farmers with day-old chick production; and viii) identifying and implementing tax incentives for pastoralists and agropastoralists, and mobilizing the necessary financial tools for the importation of improved strains.

Under the 2005–2015 Livestock Action Plan, priority actions were identified within the Strategic Operational Plan: i) control of epizootic diseases; ii) intensification and diversification of livestock products; iii) integration of crops livestock; and iv) promotion of livestock farming according to the agroecological potential of the country (MAEP, 2014).

With this new political orientation, the role of the state was limited to the implementation, monitoring, control, and regulation of the rural development policy, and environmental protection. For its expansion, this orientation required training and informing producers, as well as advice on farm management and support to professional organizations; the state set up collaborations with other actors in the rural private sector (veterinarians and livestock technicians), non-governmental organizations (NGOs) and professional associations (Assogba, 2017).

The implementation of this political strategy impacted the rural sector in general, livestock breeding in particular. The first consequence was a personnel reduction

with people voluntarily resigning from their jobs in the public service. Rural development personnel were strongly affected by this decision. District livestock stations, once managed by local herd health monitoring officers, shut down, and pastoralists had to travel much farther to benefit from veterinary services at communal level. To mitigate the closing of stations, the government launched a vast program of training breeders, especially young ones, to identify diseases early on (project to alert in a timely manner the specialized technician in animal production (TSPA). As a result of this program, the breeders often treated their animals themselves since the TSPA was not available. Immunization coverage was also directly impacted from the lack of personnel. The private veterinarians were considered too expensive by the breeders. Their role was limited to the sale of pharmaceutical products, leaving the treatment to breeders, which could lead to the non-compliance of the dosage, the recrudescence of epizooties, and cases of resistance to common conditions such as trypanosomosis.

Faced with this situation, the breeders set up several socio-professional organizations, i.e. the Communal Unions of Ruminant Breeders (UCOPER), within the Union Department (UDOPER), within the National Ruminant Breeders' Association (ANOPER). Their role was to assist the breeders. With the new agricultural policy, the focus was on cotton crop, which had been almost the only cash crop in the country. Its development was supported by the introduction of tillage by animal draft and renewed enthusiasm for livestock breeding. Much of the income from cotton crop was invested in cattle purchase, which were in most cases entrusted to Peul breeders recognized as professionals in the field. Some farmers preferred to keep their draft animals with them. Livestock markets became more dynamic and provided sources of funding for the activities of pastoralist associations and for local communities that levied taxes on the sale of animals.

With this new orientation, Benin benefited from donors' support for the development of livestock through the financing of various projects including the Livestock Development Projects (PDE) and the Support Project for the Milk and Meat Subsectors (PAFILAV). This was promoted by the new institutional organization for the development of the livestock subsector. The new institutional environment involved several actors, namely the state, professional breeders' organizations and private structures.

STATE STRUCTURES RESPONSIBLE FOR THE ADMINISTRATION AND MANAGEMENT OF CATTLE FARMING

At the top of the new organization chart for the administrative management of cattle farming in Benin, as presented by Assogba (2017), is the Ministry of Agriculture, Livestock and Fisheries (MAEP), the main structure responsible for the administration and management of cattle farming in Benin. This task is entrusted to the Department of Livestock which works in collaboration with CARDERs and PAFILAV.

Directorate of Livestock

The Directorate of Livestock prepares and monitors the implementation of the Government's livestock policy. It is responsible for defining the State's policy on animal health and production, veterinary public health and ensuring its application. The missions of the Livestock Department are i) ensure food security for rural and urban populations regarding animal origin food, ii) ensure animal health protection, iii) diversify and intensify animal production, and iv) implement the conditions for sustainable livestock development and its integration into the market economy.

It is organized in four technical services, and one administrative and financial service as follows: Animal Health Service (SSA), Animal and Livestock Feed Control Service (SCDAAB), Support Service for the Development of Productions and Animal Sectors (SADPFA), Monitoring and Evaluation Service (MSS), and Administrative and Financial Service (SAF). Three technical support structures and livestock development projects are under its supervision: the slaughterhouse of reference of Cotonou-Porto-Novo, the laboratories of Bohicon and Parakou, and the National Center for Biological and Veterinary Products (CNPBV). The director of livestock coordinates all activities of the livestock subsector.

Decentralized services

There are six regional centers for agricultural promotion (CeRPA). They constitute the third level of decentralization (commune level). On average, they include around twenty field agents, i.e. specialized technicians and animal production consultants. Their duties cover operational aspects of animal production. Their activities include informing on the legislation and training in the field breeders, public and private actors, and local communities. They thus ensure the implementation of decisions, organize the control of epizootic diseases, coordinate actions of health protection, organize the control and inspection of food of animal and fish origin, and ensure the control and monitoring of the sanitary quality of local and imported food products.

Professional breeders' organizations

Agricultural professional organizations, in full emergence in the various subsectors, NGOs as well as local authorities assert themselves more and more as essential actors in the comanagement of the livestock subsector. The private sector through individual operators or various professional associations plays an important role in the institutional system of livestock farming for the organization of upstream and downstream activities of production (input supply, marketing, provision of services, etc.).

The professional organizations in Benin include three national networks grouped into a national platform representing farmers; it is a member of the Network of Farmers Organizations and Producers of West Africa (ROPPA): the Federation of Producers Unions of Benin (FUPRO), which brings together six regional producer's

unions (URP), which are themselves the emanation of 77 more established subprefectural unions (USPP), today called communal unions of producers (UCP); the group of farmers, which brings together specialized organizations such as ANOPER; and the chambers of agriculture (a national chamber since 1989 and six interdepartmental chambers since 2002), which were marked by a significant lack of means, and thus there are very few left in today's landscape of the agricultural economy.

Benin, after this new political orientation, has benefited from the support of technical and financial partners such as the African Development Bank to accompany this new vision through the implementation of livestock development projects: the Project for Livestock Development (phases 1, 2 and 3); and more recently the Support Project for the Milk and Meat Subsectors (PAFILAV).

LIVESTOCK DEVELOPMENT AFTER THE PERIOD OF DEMOCRATIC RENEWAL

Livestock Development Project

The Livestock Development Project (PDE) concerned all breeding subsectors and a loan agreement was signed in February 1998. Its activities began in 2000. PDE intervention zone covered 15 communes located in four regions: Borgou, Zou, Ouémé and Mono. PDE aimed at strengthening food security, improving pastoralists and agropastoralists' livelihoods, and reducing poverty through the development of sustainable livestock breeding based on better resources and integrating breeding and crops. To achieve these objectives, the project relied on the completion of the second phase of the Animal Production Development Project (previous project) made up of a sanitized genetic capital and a zootechnical database of the characteristics the local cattle breeds, the Borgou and the Lagunaire.

PDE was implemented in three phases. According to the final report of its implementation (MAEP, 2006), at the end of Phase 3 (June 2006), this project enabled some agropastoralists to settle, to place breeding nuclei and draft animals on sedentary farms, to improve the health status of animals through vaccination and deworming, and to update the map of the distribution of major animal diseases in Benin by the veterinary laboratory of Bohicon on the basis of available epidemiological data. The project also enabled the development of fodder crops for the production of legume seeds to sell to farmers on credit. It contributed to the improvement of dairy production of local cattle breeds through artificial insemination and the introduction of Girolando exotic dairy cows on Kpinnou Farm with substantial results (Hestin, 2012). This experiment allowed an average production of 7.5 liters per day and up to 19 liters in some cows subjected to a feed supplementation test (Youssao, 2015). This nucleus produces subjects that the project places on the private farms from which the network of dairy farmers of Benin is organized.

Support Project for the Milk and Meat Subsectors

PAFILAV was identified in June 2007 by a mission of the African Development Bank, following a 2005 request from the government. The project is part of the 2006–2011 Development Strategic Guidelines (OSD) focusing on production as defined in the Poverty Reduction Strategy Paper (PRGS 2007–2009). It includes the Sector Reform Performance Contract (CPRS), a priority action program aiming at improving productivity and agricultural production. The project loan agreement was signed for a six years' period and was launched on January 1st, 2010, with the main objective of reducing the deficit of animal protein, imports, poverty and precariousness through the increase of milk and meat production on state farms, and by providing breeders with efficient dairy and meat animals. The implementation of this new policy aimed at restructuring the livestock subsector to contribute significantly to the improvement of animal health through sanitary prophylaxis and by carrying on the activities of the epidemiological surveillance network started in the colonial period. This contributed to a significant increase in the number of livestock without contributing to the increase in the productivity of local breeds. Estimated at 1,500,000 head of cattle in 1991, the national herd comprised 2,222,000 head in 2014 (FAOSTAT, 2016) for a production of 24,000 tons of meat and 33,000 tons of milk. In spite of this increase in production, the national demand is far from being satisfied (Assogba, 2017).

CONCLUSION

The various political strategies implemented have made it possible to restructure sanitary monitoring and epidemiological surveillance, which have improved the health status of livestock, and led to a substantial increase in the national cattle herd. The productivity of local breeds is still a challenge. The new political orientations must include increasing the productivity of our native breeds through well-elaborated feeding and genetic improvement programs implemented by the various actors of livestock breeding. The initiatives under way through PAFILAV project which aim to place breeding nuclei with breeders must continue. The breeding program applied to the local Borgou breed, and the Gir and Girolando exotic breeds to increase beef and dairy performances, as well as the introduction and dissemination of the practice of artificial insemination must be strengthened in association with breeding programs specializing in our breed either for milk or meat production. The policy must also take into account the improvement of the cattle-breeding system, which is traditionally dominated by seasonal movements of livestock during a period of the year. The establishment of fodder plots should be encouraged.

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Livestock policies in Senegal from 1960 to 2012

Effects and impacts on pastoral systems in the Sahel zone

Adama Faye¹

INTRODUCTION

In Senegal, livestock has always been a determining activity and a differentiating factor in rural areas. Since the colonial era, public policies have influenced livestock-farming relations and their impact on the environment. At independence in 1960, the agricultural policy focused on the promotion of cash crops such as groundnuts. Pastoral livestock farming has become more restrictive, and the relationship between farmers and pastoralists has become more conflictual. This breeding system has now been the subject of renewed interest. The image of a breeding system adapted to climate change is acknowledged. The role of livestock is reassessed: contribution to household income, food security, jobs in value chains, poverty reduction, anticipation of humanitarian crises, etc. This review of livestock policies seeks to highlight their effects and limits to guide better future actions. Three periods stand out: 1960–1972 after the independence, the crisis of agriculture from 1973 to 1984–1985, the liberalization from 1985 subdivided into structural adjustments from 1985 to 2000, then liberalization and globalization.

THE COLONIAL LEGACY

The role assigned to Senegal was to produce raw materials for the metropolitan industry and to import its products to finance the cost of its administration and development. Also, the groundnut crop integrated and deconstructed traditional systems. A new peanut economy developed, resulting in social (Diop and Diouf, 1992; Copans, 1972; 1988) and spatial reorganization (Ba, 1986). It relied on building ports, roads and railways, the colonization of transhumance lands, the introduction of technology, and the organization of producers in indigenous provident societies (SIPs).

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The official discourse summarized the achievements of livestock farming through recommendations: build health infrastructures, prevent the former devastating epizootics, and reduce contagious diseases. It became imperative to improve the environment and livestock and ensure rational husbandry. Livestock has therefore been the focus of health efforts (vaccination, in particular), the first constraint to be lifted. Then, efforts were on improving pastures, drilling boreholes, improving livestock genetics, and improving knowledge of nutritional requirements and feed quality, along with structured veterinary and animal production research. It should be noted that the colonial system of groundnut expansion moved livestock breeding to more arid areas, heightening conflicts over land between livestock and crops at the expense of complementarities.

POST-INDEPENDENCE: CONTINUITY AND CHANGE

Livestock is present throughout Senegal (Figure 1) with two dominant traditional systems and a more recent intensive urban and suburban system. Sedentary breeding prevails in cultivated lands, whereas pastoral farming is practiced in the north, in the more arid zone around the town of Linguère called The Ferlo.



Figure 1: Location of Senegal in West Africa

For a long time, the Ferlo has been populated by Fulani breeders (Dupire, 1970; Diallo, 1972) distinguished in two groups (Barral et al., 1983): the Walo Fulani who also practiced lowland farming, especially along the Senegal River, and the Dieri Fulani, who also grew rain fed crops. The first ones used to migrate to the Dieri in the rainy season, and the second ones used to move near the Walo in the dry season. Since the 1950s, mechanical borehole drilling has restructured the area and changed the routes and extent of transhumance. It is noteworthy that the colonial authority had delimited sylvopastoral reserves and peasant villages in search of new lands. It is therefore necessary to examine how post-independence public policies have reacted in relation to this legacy, and the change in the national and international physical and socioeconomic context.

Persistence of the peanut model (1960–1972)

At independence, reforms were introduced to decentralize the administrative system. The option of community development was acted with the establishment of rural animation services and rural cooperatives (Vengroff and Johnston, 1989). Regional development societies were responsible for implementing priority programs designed for the main agroecological zones according to the use assigned to them. However, the importance of groundnuts led the government to maintain agricultural and rural development as a priority. Thus, great efforts aimed at increasing peanut production by improving yields through an innovative management and research system. The cereal deficit combined with climatic hazards have made the country dependent on imports, and thus promoted irrigated crops in the Senegal River valley and in Casamance.

In 1964, Senegal passed a law whereby the state became the land owner (Pélissier, 1966). The land held by peasant families was distributed to the communities. Concerned with arable land, this law worsened the already unstable situation of transhumant pastoralists. The settlements of Wolof crop farmers expanded around Ferlo boreholes. In 1963, a religious leader received a first concession of 200 hectares.

Fulani breeders were included in the trend and began to settle around boreholes and grow crops. During this period, the state action with regard to breeding focused on health (vaccination campaigns) and pastoral water works, which generated a 5% annual cattle growth with nearly 3 million head and small ruminants reaching 2.75 million head between 1960 and 1971. Meat production prevailed and the supply of dairy products was met with milk powder imports. Milk remained an important product in farmers' consumption and income, and explained the heightened care given to dairy cows.

Crises of the 1970s and mid-1980s

The 1972-1973 then mid-1980s' droughts put the entire Sahel under pressure, both for peanut and livestock farming, causing deep misery in rural areas, even with the implementation of emergency measures for food and feed distribution. Breaking away from

the peanut priority, irrigated rice and sugar cane brought diversification in the north of the country (Senegal Valley). Concomitantly, cotton crop was encouraged in the south. The population growth increased the demand for meat and made imports necessary, contributing to the trade imbalance.

As livestock farming was becoming a major concern in public policies, development projects emerged (e.g. the Society for the Development of the Silvopastoral Zone [SODESP], Eastern Senegal Livestock Development Project [PDESO]). The objectives included meeting the country's meat demand, supplying cities with quality meat, preserving the ecological balance, improving living conditions through price stabilization, restructuring and modernizing marketing structures. For SODESP, the strategy was based on stratification and zonal distribution. The Ferlo therefore specialized in breeding. Culled young cattle were transferred for rebreeding to Doli ranch. Then fattening was carried out in urban centers using agroindustrial by-products as feed. SODESP mission was to supervise breeders' operations and buy their calves to carry out rebreeding and fattening. The interventions concerned animal health (vaccination, deworming, care at birth and during lactation), mineral and nitrogen supplementation, selling the calves after weaning, genetic improvement, and fodder production. In addition, pastoralists gained access to literacy, health assistance and credit. SODESP targeted an area of 15,000 square kilometers with 4000 pastoral farms, 200,000 cattle and 314,000 small ruminants, approximately 32,000 calves per year for restocking, 6000 reformed cattle and 47,000 sheep marketed. In 1981-1982, only 31,000 cattle belonging to 600 breeders were supervised. At the same time, however, there were transactions between pastoralists in the sylvopastoral zone and peanut farmers practicing cattle fattening based on crop by-products or animal draft.

In the cotton zone of Eastern Senegal, the five-year PDESO (1977–1982) was cofinanced by the World Bank, Kuwait Fund, the Arab Bank for Economic Development in Africa (BADEA) and the State of Senegal. The intervention area covered 1.3 million hectares divided into 53 pastoral units. The project activities consisted in developing management plans and improving rangelands, setting up pastoral water works, improving livestock management (health, genetics, feed), and assisting livestock farmers (education, health and credit). Similarly to SODESP, PDESO bought the animals and reimbursed their debts by selling them to the Senegalese slaughterhouse company (SERAS). These projects gave convincing results on production parameters and rangeland management. The breeders considered that the projects were doing well while taking less risk. A similar project funded by USAID was conducted in the west in Bakel area.

The aim of the state and of its partners was to integrate the farmers into the market to help them sell their products in order to meet the growing need for meat in urban areas. In addition to these three projects, actions have been integrated into the programs run

by regional development companies (Agricultural Development and Extension Company [SODEVA], Delta Land Development and Use Corporation [SAED], and Casamance Development Company [SOMIVAC]). Actions focused on animal draft, feed management, and health care. For example, SODEVA established a 500-fattening-cattle ranch in Nioro in 1978 using by-products as feed (cottonseed, molasses and millet). The other companies have operated in a similar way but on a smaller scale. An action carried out at various locations aimed at intensifying fodder crops. They all revolved around SERAS, including postmortem circuit and tanning.

This period marked a turning point in livestock policies, with a particular focus on pastoral farming. The financial and technical partners have supported these efforts, which, through state-owned companies, have no doubt helped to increase meat production for urban consumers and to introduce innovations in the livestock sector. But this model of production where the state was omnipresent with limited own resources appeared difficult to sustain for reasons that are examined below.

From 1985 on, the context of liberalization and globalization

Senegal, faced with the oil crisis and recurring droughts, must reform as contributors no longer wished to finance the deficit. The Structural Adjustment Program (SAP) has resulted in major break-ups, mainly the withdrawal of the state from some essential functions.

New Agricultural Policy - Its application to breeding

The New Agricultural Policy (NPA) refers to all the reforms undertaken in the agricultural sector since 1985. With the state's retreat, it aims to create an attractive incentive context for private actors.

Strategic orientations

In breeding, the zonal and intensification policy has been maintained with a number of adaptations. At domestic level, liberalization involves the removal of price control, but also the ending of input subsidies and the transfer of the activities to the private sector, including credit, as well as a reduction in public human work power and accountability. The role thus devolved to the private sector has considerably increased and become central. At another level, tax exemption for exports increased producers' incomes and ensured competitiveness on the international market.

Implementing instruments

The liberalization of the price of meat and markets was the subject of Decree No. 87-1341 in 1987, making obsolete price ceilings by region whether wholesale or retail.

However, low fixed prices benefit the consumer at the risk of demotivating production, which thus becomes stimulated by liberalization. The herders form groups at district and village levels (economic interest groups [GIEs]). These new groups are autonomous from a financial point of view. They are highly involved in the development of livestock farming, especially with regard to intensification. This new process has been going in the same direction. The reform of the cooperative movement has also been heading the same way by establishing at local scale multisectorial and multifunctional rural co-operatives instead of sectoral cooperatives.

As farmers contribute to investments and costs (e.g. water, vaccination, protection of pastures against fires), they also participate in infrastructure management. Livestock aids working for professional organizations are trained in veterinary care. The measure called for a reduction in civil servant jobs and spurred voluntary resignation from the civil service of about 40% of human resources. At the same time, the previous major programs have been maintained with higher breeders' participation and a lower one from the state. One example is the failure of one of the Agricultural and Industrial Development Company of Senegal (SODAGRI) projects that included a cattle fattening farm, a feed factory and a slaughterhouse but did not consult the main stakeholders. Access to credit has been facilitated by the National Agricultural Credit Bank of Senegal (CNCAS). However in general, the banking sector has remained reluctant to invest in pastoral matters as they are considered expensive and risky.

Effects and impacts

Two positive points are, on one hand, the beginning of organization, training and empowerment of pastoralists and, on the other hand, the export exemption that initiated the export of trypanosome-resistant N'Dama breed cattle to coastal countries (Gabon, Congo, Nigeria) with around 3000 cattle per year.

The negative points are the decline in livestock investment, the decrease in technical support staff and the lack of livestock credit. The impact has been exacerbated by the lack of consideration of pastoral crops, the priority being given to urban markets, and the lack of alternatives to pastoral feed constraints. It can therefore be considered that the New Agricultural Policy has been a set of measures designed to organize the disengagement of the state without achieving the expected socioeconomic results.

Structural Adjustment Program for the Agricultural Sector (1995–2003)

The Structural Adjustment Program for the Agricultural Sector (PASA) was concomitant with the devaluation of the franc of the African Financial Community (FCFA). It heightened the direction taken by NPA in the three areas of price liberalization, withdrawal of the state and abolition of monopolies. A major change began in 1998 with the creation of a livestock ministry with clear guidelines.

Completion of the livestock privatization policy

The completion of the livestock privatization policy resulted in different measures among which the privatization of the practice of veterinary medicine. Started in the mid-1990s with the support of the European Union (Pan-African Rinderpest Campaign [PARC] / CNCAS), it enabled veterinarians and technicians, especially young people, who formerly worked in public or para-public services and who needed a specific credit to launch a private activity, to function on a clientele basis. Later on, in 1996, there was the privatization of SERAS, which managed the public slaughterhouses in the large centers. Finally, especially in 1999, there was the liquidation of SODESP, pillar of the breeding policy since the 1970s.

Letter of Livestock Development Policy

Inspired by PASA, the Letter of Livestock Development Policy (LPDE) essentially aimed at creating an institutional, legislative and regulatory environment conducive to the revival of livestock production through the stimulation of the private sector, while maintaining the quality and sustainability of development, particularly from the viewpoint of resources. Various measures were implemented such as the Agricultural Program with genetic improvement based on artificial insemination both in dairy (Montbeliard, Holstein) and beef (N'Dama) cattle, the training of breeders in the constitution of forage reserves (e.g. mowing, tedding, silage) and the enhancement of poor fodder (urea treatment) whose impact has been limited.

The Livestock Support Project (PAPEL) was financed by ADB with pastoral development experience in the Ferlo based on pastoral units with appropriate water works and a participatory management plan of forage resources. Community initiatives could receive support from CNCAS, nearly 1.2 billion CFAF for the first phase alone, before 2000. Local capacity building was also planned, notably through functional literacy.

With regard to animal health, PARC, financed in 1999 by the European Development Fund (EDF), was replaced by the Pan-African Program of Control of Epizootics (PACE), which set up a surveillance system of priority animal diseases (rinderpest, contagious bovine pleuropneumonia, Rift Valley fever, African swine fever), including border control and support from private veterinarians. In addition, the Short Cycle Species Development Project (PRODEC), funded by the French Cooperation (1995–1999), supported rural poultry farmers with henhouse showcases, the prevention of Newcastle disease and an interprofessional poultry network.

The Village Planning and Development Project (PADV), financed by the International Fund for Agricultural Development (IFAD) and limited to the Louga region, has been involved in the development of village and pastoral water infrastructure, production

value chains and local capacity building. The breeding component of the Producer Support Services Program (PSAOP) consisted, in its first phase, in institutional reforms aimed at strengthening public service missions, particularly the control of animal products and information flow. It also aimed at decentralizing and restructuring agricultural and livestock services, in particular through training and equipment, especially for movements.

Research and development also benefitted from the policy. Programs were conducted in the south and the east (Kolda and Tambacounda) for dairy cattle and dairy cowsheds, with the Senegalese Agricultural Research Institute / Center for Animal Science and Production Research (ISRA/CRZ) of Kolda, the Textile Fibers Development Company (SODEFITEX), and the non-governmental organization Vétérinaires sans Frontières. They showed the producers the advantages of dairy cow housing in the dry season in terms of milk and manure for crop improvement. However, the results did not retain the support of the public authorities, neither did the genetic improvement trials also conducted in Kolda in the mid-1990s.

Finally, regarding breeders' organizations the major action was the establishment of Breeders' Houses (MDE) into a regional federating framework. Started in 1997, it was initially entirely run by the administration. A branch called the Regional Directory of Women Breeders (DIRFEL) was also devoted to women breeders in each region.

Effects and impacts

The privatization policy of veterinary medicine had positive effects through an expanded offer with more than 120 veterinarians and technicians installed. In addition to the improved availability of medicines, these specialists provide breeders with technical advice and training. The sanitary management of flocks improved as well as overall animal health at national level. However, the network of private veterinarians still needs consolidating. SERAS privatization, which played a role in regulating prices, has had a negative impact as all slaughterhouses whose management was given to the Slaughterhouse Management Company (SOGAS) (including those in Ziguinchor and Tambacounda in the south) have been in poor condition, resulting in a lower livestock value on the local markets.

Regarding LPDE, we note the improved availability of pastoral infrastructure in the Ferlo and in the Groundnut Basin, linked to the intervention of PAPEL and of the Village Planning and Development Project. These interventions enhanced grazing and pastoral production in general. The investment credit system with PAPEL for pastoralists and agropastoralists is also noteworthy. The dairy and manure stalls of Kaolack, Fatick, Kolda and Tambacounda are initiatives to be taken into account in order to strengthen the

integration of crops and livestock, especially as they are concomitant with the development of the local milk sector. Lastly, committed breeders' organizations can serve as an anchor for the dialogue between breeders and partners including the state for planning relevant programs.

A major problem, however, remains the lack of endogenous dynamics in which the institutions thus created suffer from a problem of representativeness and legitimacy. The concentration of public action in livestock farming in the north and center of the country limited the support to trypanosome-tolerant livestock farmers, particularly in terms of production, both beef and dairy, and did not have an effect in the subsectors. Still in negative terms, the weak coordination between national, regional and local institutions, including farmers, is a problem. The few positive actions have consisted in setting up and managing sheep and henhouses in Kolda and Tambacounda regions.

New Sectoral Initiative for Livestock Development (2004–2010)

Context, directions and strategies

The Agrosylvopastoral Orientation Law (LOASP) was promulgated in June 2004 at a time when agriculture and livestock breeding were once again grouped in the same ministry, but with a delegate minister in charge of specific livestock issues. It defined the framework of evolution of the sectors concerned and the socioprofessional status of the producers, and decided to reform the rural land. Resolutely participatory, the National Plan of Development of the Livestock (PNDE) was however struggling with regard to its implementation.

In terms of direction, the general objective of the New Sectoral Initiative for Livestock Development (NISDEL) aims to accelerate livestock development, taking advantage of the opportunities of the subsector and the socioeconomic environment of Senegal. Among its goals there are the sustainable modernization and diversification of production systems, the recapture of the internal market, the development of a dynamic to access external markets, and the reduction of poverty and malnutrition by increasing farmers' incomes.

The strategies are the sanitation of the livestock environment (food safety, animal sanitary protection, and medical prophylaxis of livestock), the security of pastoral livestock, the intensification and modernization of livestock farming, the creation of modern private farms, the Stabling Support Fund (FONSTAB), and Centers for the Promotion and Modernization of Livestock Farming (CIMELs).

Implementing instruments

With regard to modernization, NISDEL has two main levers: CIMELs/FONSTAB and artificial insemination. CIMELs are showcase centers for the results of farm research, and

they provide support and incentives for the establishment of modern farms, training, and monitoring of technical innovations. The priority target population comprises local young people, graduates, promoters and operators who are determined to modernize. Five CIMELs have thus been created: in Dahra in the Ferlo where there is a core of zebu breeds with Nelore and Gir from Brazil, and Holstein and Montbeliard bulls; in Makhana in the Senegal River valley for intensification around irrigation (forage crops and by-products); in Mbao near Dakar specialized in poultry farming; in Kolda, backed by the Animal Production Research Center more focused on trypanosome-tolerant cattle and small ruminants; and in Guerina in Casamance, former beekeeping center.

FONSTAB is the second tool for the promotion of modern private farms. Established by decree in November 2007, it is financed by an agricultural credit (CNCAS) and aims to facilitate financing at subsidized rates (5.5% for working capital and 3% for investments) for modern infrastructures, equipment and input acquisition, fodder crops, and the installation of artisanal or industrial units.

Artificial insemination aims to improve the genetic potential of local breeds by crossing with exotic breeds with high beef potential. It is also applied to dairy to reduce the bills of dairy imports which heavily burden the state budget. A national insemination campaign is organized every year in all regions. Scheduled for 3000 cows per year, the objectives have been revised and about 100,000 cows were inseminated in 2009 and 2010. The aim is to gradually build up a high-yield dairy herd with a population of 100,000 dairy cows of which 30,000 purebred dairy cows, able to produce 400 million liters of milk a year. Contracts are concluded annually with private insemination providers to whom specific objectives are assigned. Nearly a hundred inseminators have been trained.

The National Center of Genetic Improvement (CNAG) of Dahra has been operational in the meat subsector since 2005. It is the main institution guaranteeing the application of Law No 2002-24 of December 2002 related to the genetic improvement of domestic animal species, and of Decree No 2002/24 issued on the same date, which aims to improve animal species genetics. It also aims to promote local seed production, to set up decentralized seed repositories at regional and departmental levels, and to ensure quality control. Following this law, a regulatory framework has been put in place by decree in April 2007. The texts specify how to introduce and distribute genes (breeder species, seeds, embryos), the applicable standards and necessary guarantees. They provide for the establishment of an advisory committee on animal genetic improvement to make recommendations for the conservation and improvement of the genetic heritage of local breeds. NISDEL is also involved among others in health protection for all species, pastoral development, the meat subsector including downline distribution, identification in particular for the control of cattle theft.

Moreover, private initiatives in milk collection and processing have blossomed, but the links with the public policies of intensification and modernization are not visible. The dairies, whether set up as artisanal (group / individual dairies) or as industrial (Laiterie du Berger at Richard Toll) find it difficult to be regularly supplied by farmers who do not benefit from support guaranteeing continuous production all year long.

Effects and impacts

NISDEL's positive results have to be emphasized especially with regard to animal health as, with the national system of epidemiological surveillance, rinderpest and contagious bovine pleuropneumonia were eradicated. FONSTAB has not yet resolved livestock credit issues. In the same vein comes also the dairy core of crossbred cows from the insemination program. Finally, there has been the revival of livestock farming in the south of the country, especially the conservation and improvement of trypanosome-tolerant livestock, carried out with diverse partnerships.

Among NISDEL's negative results i) there is too much focus on milk in intensive production, ii) modernizing using technology excludes the majority of farmers, iii) the support for milk marketing and processing in pastoral areas is insufficient (which sharply contrasts with milk support in intensive urban and suburban areas), iv) there is a risk of genetic dilution or even loss, especially of trypanosome-tolerant livestock, v) the institutional capacity building needed to support and sustain the results of these public actions is insufficient, and vi) the coordination between ministerial structures, technical services and participating professional organizations is inadequate because the reality of breeding has not been integrated.

In conclusion, NISDEL promotes an entrepreneurial breeding based on technological change, e.g. importation of genetics and production methods. However, it has shown real difficulties in achieving the expected results in the expected time.

National Livestock Development Plan (2012–2026)

Announced in 2004 in the Agrosylvopastoral Orientation Law as the frame of reference and coherence for future interventions in the livestock sector, PNDE was only finalized in 2012. Various actors were asked to participate in the development of the sector diagnosis and the definition of strategic orientations.

Overall objective and orientations

PNDE has thus set the overall objective of "making livestock a successful sector, capable of satisfying, at least, the national demand for animal products and of ensuring the socioeconomic promotion of its stakeholders" by 2026. Extending NISDEL's guidelines, PNDE is included in Senegal's main economic and social policy documents (the Platform

for the Development of Companies in Senegal [PDES], the Accelerated Growth Strategy [SCA]), and in partnership agreements at subregional, regional and international levels.

PNDE's strong orientations include the themes of the new century such as socioecosystem sustainability, especially the promotion of crops and livestock breeding at family level, the sociocultural dimension with its family diversity, i.e. local and regional. These orientations reflect the concerns expressed by the majority of pastoralists living with their herds in different agroecological areas with various constraints and opportunities.

Strategic axes and PNDE framework plan

Four strategic axes have been defined: improve the productivity and competitiveness of the livestock subsectors; create an environment conducive to the development of livestock systems; improve animal product marketing; and strengthen the institutional framework for intervention. Similarly, the Framework Action Plan, composed of twelve major thematic programs (MTPs), provides few themes that have not already been the subject of public action. They relate to improving i) productivity by influencing animal production performance (health, genetics, nutrition), ii) upline and downline market access (e.g. infrastructure, equipment, control information), and iii) technical capacities of farmers and sector governance.

Effects and impacts

PNDE aimed to include the needs and opinions of breeders and other actors who took part in the diagnosis of the sector conducted during the elaboration process. It proposed many objectives and planned interventions in areas that have not been sufficiently analyzed. It reaffirmed securing pastoral livestock farming, but the strategy has been based on interventions implemented for years that the plan proposed to generalize. The obstacles that limited the scope and slowed or blocked the generalization of these interventions have not been the subject of an analysis that can guide the process.

The decision to adopt a pastoral code became effective in July 2013 with the development of a draft code already introduced into the promulgation circuit. One of the criticisms of this initiative was that the six-month deadline set by the ministry of livestock did not produce a code conceived in a consensual manner by all the actors concerned. The analysis that should underlie the reflection for a realistic widely shared vision has not been made.

PLACE OF PASTORALISM IN SECTORAL POLICY ORIENTATIONS

The previous review shows that Senegal has constantly tried to implement livestock policies designed to promote increased productivity and production to meet the increasing

demand from population growth and urbanization. These policies have focused on promoting intensive livestock systems through research and extension of new production techniques across all value chains, including training and governance.

The crisis of the 1970s and 1980s led the public authorities to review their proactive policy marked by the presence of the state at all levels (planning, financing, production and marketing). Traditional farming systems have thus become more vulnerable with the vagaries of climate that have led to the scarcity of water and pastures, particularly in the Ferlo.

Since 2000 and the end of the structural adjustment program, stimulus policies have been undertaken in a context of sustained population growth and rapid urbanization leading to a sharp increase in demand and the forced use of massive imports, particularly of milk powder. The imported milk powder option was reflected in common policies of the West African Economic and Monetary Union (WAEMU) and the Economic Community of West African States (ECOWAS). The gap between demand and supply has also concerned meat products (live animals) that Senegal has been importing from its neighbors in West Africa (Mauritania and Mali). Faced with this situation, the state undertook the promotion of modern, highly productive livestock systems.

The millennium goals set by the international community include poverty reduction and food security for a large part of the world's population. Their achievement is based on liberalization policies aimed at promoting rapid economic growth. In Senegal, these policies are presented in various documents, including the Poverty Reduction Strategy Paper 2 (PRSP2) that became PDES, and SCA. To contribute to these objectives, agriculture must achieve high levels of productivity that only the use of modern technologies can guarantee. The opening up of the sector to private actors able to mobilize the necessary financial resources and lead in the medium term the expected technical changes is one of the strategies of the policies. Small producers are invited to transform their production systems and make them competitive.

For Ferlo pastoralists it means to be part of a process of permanent habitat and modernization based on innovation to reduce transhumance and integrate further the market. PNDE reinforcing this breeding type can be broken down into interventions related to pastoral water works, the development and management of pastures, the training and organization of pastoralists, infrastructure building, and supply of equipment for market access. Whereas these interventions aim to reduce the movements of pastoralists, a pastoral code to ensure mobility is in the validation circuit for the enactment of a law.

At the same time, hydro-agricultural development in the Senegal River valley, attempts at forest decommissioning, and rangeland cultivation by agricultural producers in various areas continue to reduce pastoral space and restrict access of herds to livestock

traditional territories of transhumance. The interventions thus planned pose a problem of aligning the orientations of the livestock subsector with those of the overall agricultural and rural development policies throughout the national territory.

In the Ferlo, Fulani breeders are developing various strategies that include permanent settlement for some families, i.e. to grow cereals in areas surrounding boreholes and obtain plots for other crops in the irrigated schemes. However, transhumance remains essential for the majority of livestock in order to cope with the variability of pasture and water supply. The livestock maintained in this system has a decisive contribution to domestic production and the supply of meat markets. This contribution but also the insecurity that has been developing in pastoral areas explain the attention they receive from contributors. The forum held in Nouakchott (Mauritania) in October 2013 at the initiative of the World Bank and the Mauritanian government emphasized: "The vulnerability of pastoral and agropastoral communities to drought and other extreme weather events and natural disasters remains extremely high in the Sahel region. It is exacerbated by the social exclusion that these communities have historically experienced, and the intensification of competition for access to natural resources such as water and pasture. The demographic transition in the region, with increasing population density, is also fundamentally unfavorable to pastoralism. In addition, climate change is expected to exacerbate hyper-aridity and increase the surface area of arid and semiarid lands, placing increasing pressure on pastoralism and agropastoralism as a way of life. In the absence of forward-looking measures, all of these factors will lead to greater economic and social crises, with a predictable shift toward radicalization. Investments in support of pastoral systems in the arid and semiarid lands of the Sahel should be urgently increased to reduce vulnerability and food insecurity while promoting cohesion, security and conflict prevention."

This forum also reveals a program that echoes the work of the Global Alliance for Resilience Initiative (AGIR) led by the European Union. Significant financial aid has been announced (200 million US\$ from the World Bank) to translate these initiatives into programs in six Sahelian countries: Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal. The objective was "Secure pastoral assets and double the income of 16 million pastoralists and pastoralists in the Sahel." It should be noted that this forum on pastoralism in Nouakchott was followed the day after in Dakar by another forum on irrigation, where the Senegalese government set the objective of more than doubling the area of irrigated land in the Sahel from 400,000 to 1,000,000 hectares.

Even though these initiatives show a renewed interest in pastoralism, they raise questions about the conditions that the contributors and the concerned countries will set for their implementation, with the risk of marginalizing pastoral livestock farming in areas of intensive productive potential, where access to water is secured in hydro-agricultural schemes at the expense of pastoral use.

CONCLUSION

Livestock has long been treated as a minor subject in agricultural and rural development policies. The territories and basic resources of pastoralism, whose viability and performance depend on mobility, have been transferred to other uses, particularly crops (rain-fed, irrigation schemes). These policies have considered this type of farming as doomed and that it should convert to a sedentary, intensified, more productive and more open market breeding system. This conversion has appeared to public authorities and technical services as the only response to cope with the growing demand for livestock products. New initiatives aimed at strengthening the resilience of Sahelian pastoral systems will require national spatial planning, whereby Ferlo pastoralists will be attributed specific areas for their herds in the hydro-agricultural development of the river valley, and which will recreate the links of complementarity between crops and breeding.

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Public interventions regarding pastoral activities in the argan-tree area in Morocco: continuity and changes

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INTRODUCTION

Morocco has to face major agricultural development issues. In the early 2000s, production was dependent on weather conditions and rainfall, and markets and marketing channels were disorganized or chaotic with growing external trade deficits and poor infrastructures. The previous agricultural policies had failed and the government decided to build a new strategic plan, the Green Morocco Plan (GMP).

The objective of this chapter was to analyze how this new policy has been implemented in a southwestern region of Morocco with important economic, social and economic stakes, the argan-tree area. We will specifically consider the projects supporting livestock in several districts where it significantly interacts with other agricultural activities. A large proportion of the population is still poor, especially in mountains, oases and Southern arid areas.

DUALITY OF INCENTIVE POLICIES PROMOTING AGRICULTURE THE TWO PILLARS OF THE GREEN MOROCCO PLAN

Until 2008, Morocco based its agricultural strategies mainly on irrigation and increase of the production of milk, cereals, red meat, etc. The previous plans had been often unsuccessful with a loss of competitiveness and food safety, which decided the government to build an ambitious plan, a very innovative approach in Africa. GMP has become the main framework in favor of agriculture, and a national priority for the economic development of the country; one of its objectives has been to reduce the trade deficit (MAP, 2015).

GMP is structured in two pillars like those of the European Common Agricultural Policy. Pillar I refers to large farms and aims to make modern agriculture more competitive and export-oriented in a globalized world. Subsectors based on irrigation such as citrus, olive oil, dairy, sugar, poultry, red meat, gardening are enhanced.

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For Akesbi (2011), a positive aspect is that GMP has been implemented to make agriculture a national priority. However, he emphasizes that the objectives of Pillar I, based on the expertise of international American consultants, have ignored the social, economic, environmental realities of Morocco. The development of irrigation for export crops could cause the over use of water resources and thus reduce food safety in the country. Although, Pillar I covers only 20% of the lands, it is more endowed financially and represents the real priority of the government.

Pillar II is dedicated to the fight against poverty and to solidarity, and it promotes small-size farms in the ill-favored mountains and arid areas. It is mainly based on local terroir products (e.g. honey, local olive or argan oil, cheeses, mutton, goat meat, aromatic plants, saffron, prickly pears). The strategy of Pillar II is to support “hundreds of thousands of farmers to have an access to the market economy by creating adding value and the adequate management of natural resources” (Conseil Général du Développement Agricole, 2009). The target population is estimated at 600,000–800,000 families (with an average of 3.5 to 8 livestock units and less than three hectares). Its watchwords, mainly based on the directions given by the international organizations and summed up in the Millennium Development Goals, are oriented to the “transitions to food safety in a changing climate” (UNO, 2015).

The four main objectives of Pillar II for mountain and oasis agriculture are officially: i) Promote quality products, ecosystemic services and synergy with tourism thanks to the development of ecotourism by geographical indications, labels and local solidarity; a legal framework on quality and origin identification labels has thus been established (Bendriss, 2010); ii) Manage and develop natural resources for a more productive but also more sustainable agriculture; iii) Give priority to Pillar II projects in sustainable territorial development approaches; and iv) Professionalize and aggregate smallholder farms by creating cooperatives and collective organizations to give them access to the market.

The rationale behind Pillar II has been inspired both by models successfully developed in France (they “could keep on helping Morocco to develop faster and in a more useful way” and help to create organizations related to land management, payments for environmental services [Conseil Général du Développement Agricole, 2009]), and by the watchwords and methods proposed by the main international organizations (Food and Agriculture Organization of the United Nations [FAO], International Fund for Agricultural Development [IFAD], World Bank, European Union...). The strategic orientations of all these institutions have influenced the guidelines of projects by using concepts such as scaling up, business planning, policy mix, or top-down instructions such as participation, collective organization, which do not necessarily match the actual practices implemented. Developing geographical indications, scaling up pilot microprojects could be relevant but all these approaches are very new for actors, including the administration, who could face difficulties in applying them to their own contexts.

To improve coordination between the several administrations and to work at a more territorial level, Morocco has decided to reorganize its institutional framework. It created new agencies and offices, e.g. the Agency for the Development of Oasis and Argan-Tree Area (ANDZOA, created in 2010 it covers 40% of the national territory, coordinates the local actors and boosts territorial development), the Agency for the Development of Agriculture (ADA), and the National Agency for Agricultural extension (ONCA). All these structures manage projects supported by the National Initiative for Human Development Support Project (INDH) decided by the King in 2005 with an allocation of several billion Moroccan dirhams (MAD). They also coordinate projects financed by international organizations such as IFAD, the World Bank, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the European Union through the Accompanying Measures (MEDA) program with funding to support regional initiatives. The involvement of the French Cooperation in the development policy is also strong, including scientific and technical cooperation. The number and diversity of new institutional actors is not only the answer to coordination needs but could also mirror the power struggles and different approaches of the Moroccan State.

HISTORICAL, SOCIAL AND CULTURAL CONTEXT OF THE ARGAN-TREE AREA

The argan-tree area, a complex and diversified agrarian system

The argan forest is an endemic woody formation in Southwest Morocco (provinces of Essaouira, Taroudant, Agadir, Tiznit). Its surface area is officially 871,000 hectares (Figure 1) but these data are old and do not take in account the observed degradation and loss of density of the trees.

Historically, humans have occupied and enhanced this region for many centuries. The traditional agrarian system is very complex and characterized by complementarities between crops, picking and processing argan nuts, and livestock (mainly small ruminants for meat). Among these activities, picking and processing argan nuts to make oil has developed dramatically after 1990 to face the growing demand of European cosmetic companies.

Plurality of land tenures and their historical basis

Until the early 1950s, the French protectorate regime defined the agrarian policy differently from what had occurred in Algeria, as settlements for Europeans had not been developed (Bouderbala, 1999). Most Moroccan lands were ruled under a legal regime based on Islamic law, the Charia. The Dahir (royal decree) of April 24, 1919 is still in effect; it confirms a pluralistic land tenure including State properties, classic registered private properties, and traditional tribal or indigenous properties. The private *Melk* and the collective properties, among them the collective (*mouchaa*)

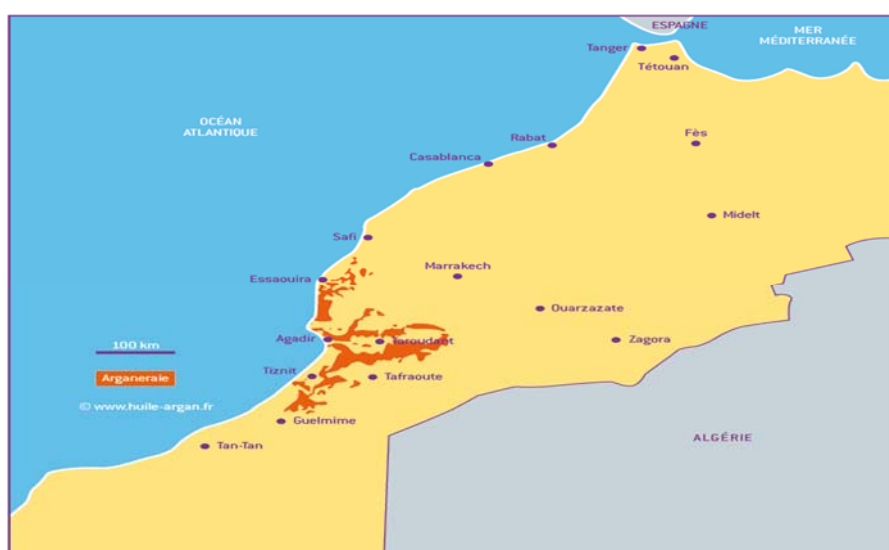


Figure 1: The argan-tree area in Morocco

rangelands and the inalienable lands dedicated to foundations and charities (*habous*), share these tribal lands.

This full tribal ownership was, however, under the supervision of the state, in this case, the direction of indigenous affairs, a powerful administration controlling politically the rural tribes. After independence, its power was transferred to the ministry of the interior that reinforced its control over the population. The tribal collectivities were governed by an assembly of notables (*jmaa*), who managed the rules of collective ownership of land and conditions for its use, including identification of people entitled to use the land, inheritance arbitration, use management with the definition of the dates of enclosure periods in the collective sylvopastoral territories subject to temporary defenses (*agdals*), litigation management. Within tribal collectivities, these customary laws were generally applied and they were different from Islamic and French laws. These collective lands also allowed flexibility to climate risks and enabled people without land rights to survive and stay in the community.

Land tenure was both a guarantee of protection but also a heritage guardianship of the memory of collective knowledge and practices (Dubeuf et al., 2013). This system and its principles remain until today within the leading role of the ministry of the interior, whose strengthened omnipotence has been politically justified by the tensions between some communities and by the situation in Western Sahara.

Present changes and transitions

The rain-fed mountain crops, and the arid and semi-arid areas have received little of the investments allocated to agriculture in Morocco. Around 75% of the poor in the country live in these regions including the argan-tree area. The literacy rate is low (around 10%) and emigration to large cities or Europe is high (Bouchelka, 2013).

Until the 2000s, most of the sylvopastoral and agricultural productions (above all argan oil but also saffron, prickly pear, carob, kid meat) were traded locally at local markets (souks), at a low price. Since then, other dynamics and tendencies have emerged. Argan oil dietetic and cosmetic qualities have attracted the industry and international companies, introducing globalized markets and competitiveness in the rural society. The development of agrotourism in Southern Morocco also introduced international standards (Bouchelka, 2013).

This development has paradoxically increased the precarious situation of rural populations with more individual attitudes, the loss of solidarity within communities, and the decreasing impact or disappearance of the *jmaa* institution when a community is de-structured. The inalienable community lands have thus been challenged, and many rights holders claim a permanent usufruct of their share of collective lands (Bouderbala, 2009).

In parallel, Morocco has faced important political changes and changed the relationship between citizens and public authorities. In 2011, the 'February 20th movement' has been the national expression of the Arabic Spring and consequently a new constitution was promulgated in July 2011, which strengthened pluralism and a more democratic organization of the Sherifian monarchy. These mutations had been initiated before these events with the emergence of a new genuine civilian society and the development of associations, collective forums, among others. These changes have deeply redirected political practices with an emphasis on partnership and participation, although some analyses considered them as a communication tool and not as factual (Planel, 2009).

CHALLENGES OF PASTORALISM IN THE ARGAN-TREE AREA AND PUBLIC POLICIES

As in other Moroccan regions of rain-fed agriculture, the rural population of the argan-tree area has kept on increasing, but climate change in this arid area (less than 200 mm per year) has increased the intensity and frequency of drought periods, and thus the degradation of many sylvopastoral areas. In addition, the organized and systematic migration of many nomadic herds from Sahara to the collective lands competes with the local traditional herds.

The argan-tree area is not a homogenous territory. Around the large city of Agadir, for instance, the traditional systems have often disappeared; the complementarity between argan oil and goats has decreased, and the preservation of the forest has to compete with other activities such as irrigated market gardens in greenhouses or tourism. In other remote regions, the argan forests have faced rural exodus and the traditional indigenous organization has disappeared. The Forest Service complains that uncontrolled herds increase the degradation of the trees. However, in the regions where this organization remains strong, like in the Berber Haha area south of Essaouira, the ecosystem has been less degraded and goats are still the main source

of income along with argan oil (Bouchelka, 2013). The herd size varies from a few head to more than one hundred according to the number of trees and lands owned by the families. Nevertheless, the performances of goat rearing are very low: no reproduction control, high mortalities, low-growing rate of the kids, bad carcass conformation, local slaughtering for local consumption without sanitary and hygienic conditions, and limited extension services. In parallel, the development of a middle class of urban consumers could expand the market of goat meat, considered as a healthier diet than mutton; this is the reason why the Administration has supported the implementation of a project to organize the goat subsector in the region.

Public policies promoting livestock in the argan-tree area

The Project of Promotion of (goat) Kids in the Argan-Tree Area (PPMVA) is a good example of the policy implemented in Morocco for remote areas. As for vegetable products, Pillar II is based on the development strategy of local terroir products or products of origin-linked quality. It has been inspired by the French experience (General Council for Agricultural Development of the Moroccan Ministry of Agriculture and Maritime Fisheries, French General Council for Food, Agriculture and Rural Areas, 2010) and procedures, which involve producers' organizations and the administration for product certification based on origin and quality characteristics.

The Moroccan laws have acknowledged geographical indications (GI), and the European Union and Morocco signed an agreement on GI in January 2015. The argan oil Protected Geographical Indication (PGI) is the first PGI in Morocco but the argan-tree area has other PGI products, e.g. olive oil, pickling Pear of Aït Baâmrane, Tyout Chiadma also certified by a Protected Designation of Origin (PDO), or Taliouine Saffron (also PDO). The objective is to organize the producers and cooperatives in a production sector, to structure the value chains and fairly improve producers' incomes.

The starting point of the project has been the awareness of the Provincial Direction of Agriculture (PDA) in Essaouira that livestock is an important part of the agrosylvopastoral system of the argan tree area managed for centuries by populations who were simultaneously farmers, pickers and shepherds. In Haha tribal area, where the traditional system has been able to carry on well, PDA decided to initiate a project to certify the kid meat of the area. It mobilized the experience of the National Sheep and Goat Association (ANOC), which had organized producers' groups and defined the specifications of other livestock GI products in Morocco (Beni Guil lamb meat in Eastern Morocco, goat milk or *jben*), to undertake a project to certify kid meat. ANOC is a nationwide professional organization, created in 1967, which mainly consists in technical interventions based on groups of professional breeders. It works with about 40 groups of sheep breeders (2800 breeders and 418,000 head) and 12 groups of goat breeders (840 breeders and 75,000 head). Although it only concerns a small part of all the breeders, ANOC is considered as a model of livestock professional organization and an example for Northern Africa countries.

This certification project was included in a larger strategic one: PPMVA. It has many other well-identified objectives to improve all the value chain that relate to the professional organization of the breeders, goat nutrition and genetics, sanitary conditions and performances of the herds, pasture management, water supplies, building a controlled slaughterhouse, and organizing marketing (Table 1). Technology transfer and training are also a priority. The project was limited to 29 rural districts of Haha Berber area. PDA estimated the return on the project to 34 million MAD (3 million euros) for 634 additional tons of meat produced, and the creation of 200 jobs (50,000 work hours) for 17 million MAD (1.5 million €) invested in five years. The number of beneficiaries targeted in the document project was 22,740.

Table 1: Budget of the Project of Promotion of (goat) Kids in the Argan-Tree Area in Morocco in 2014

Operations		Budget (MAD/€)
Breeders' organization		
ANOC groups	2 groups (12,000 persons)	1,000,000/89,000
Improvement of herd management		7,010,000/623,890
Animal health		810,000
Buried water tanks (100 m ³)	—	3,000,000
Truck for water transport	30	1,200,000
Building a pilot farm	2	2,000,000
	20	
Goat meat marketing		4,600,000/409,400
Slaughterhouse	1	2,000,000
Pilot market (souk)	1	500,000
Cutting room	1	1,200,000
Refrigerated truck to transport meat	1	700,000
Marketing organization	1	200,000
Goat meat certification		500,000/44,500
Market study	—	
Labeling		
Communication		
Technology transfer and training		600,000/53,400
Other actions		3,290,000
Total		17,000,000/1,513,000

Source: DPA / Plan Maroc Vert, 2012 ; MAD: Moroccan dirhams; €: euros

First specifications for certification of the argan kid

Difficulties, oppositions and recent development

ANOC (2010) prepared the first specifications under the control of PDA Essaouira (ANOC/ DPA, 2011). These specifications targeted initially only 114 breeders gathered

in a first group. In parallel, they proposed to extend PGI to all the argan-tree area and not solely to Haha's where most breeders came from. These specifications included a few references to the diversity of local production systems and ecosystems, and they did not mention the complementarities between goats and other activities like oil. The specifications have mainly insisted on the traceability and monitoring of the activity (birth and weight records, slaughtering certification). They also quoted sanitary and animal welfare conditions. However, the link to the origin was justified in a very general and implied way by the use of pasture without proposing specific local indicators (no references to *agdal*, for instance). By 2007, a collective mission of the French National Research Institute for Agriculture - Livestock Development Research Laboratory (INRA-LRDE) in Corte analyzed the weak points regarding the challenges of certification (Chatibi et al., 2007).

Consequently, these specifications faced the opposition of several main actors of the argan oil subsectors (e.g. the Interprofessional Association for PGI Argan Oil [AMIGHA], the Forest Services, the Network of Associations of the Argan-tree Area Biosphere Reserve [RARBA]). For them, goat farming was responsible for forest degradation and they were against the use of the argan tree words for products other than oil in the same area. In parallel, the association of rights holders of Haha argan area questioned the legitimacy of ANOC, considered as external to the area, and insisted on the traditional importance of goats in their own district, and the need to integrate the traditional organization of Haha area in the specifications. Consequently, the Administration adjourned the PGI project and entrusted the preparation of new specifications to Haha rights holders. Several discussions have included ANOC to define new specifications, a more restricted geographical area, and probably to change the name of the future quality and origin label from argan kid to kid from the Haha argan-tree area.

DISCUSSION ON THE IMPACTS OF PUBLIC INTERVENTIONS PROMOTING CROP AND LIVESTOCK AND THEIR CONCEPTUAL MODELS

Pillar II of the Green Morocco Plan to which belongs the program promoting livestock in the argan-tree area is a structured policy as defined by Muller (1990). The reports of several discussions with the actors and the analysis of the project documents have enabled specifying the impacts of these policies. At a general level, our observations have confirmed some previous ones such as the works of Akesbi (2011) who underlined its productive orientations, standardized approaches, and a rather unclear and cumbersome governance of the Green Morocco Plan with ambiguities between Pillars I and II.

For kids, the hypothesis was that a future Protected Geographical Indication label could help to increase production, improve herd management, and that this would mean professionalization and specialization. However, this approach has largely

ignored the difficulties of the local actors to appropriate this type of certification. Distrust was often perceived by medium-size livestock farmers. The latter considered that the project was originally of the top-down administration type, and that the orientations had been decided without their initial contribution. In addition, the complex and often ambiguous meanings attached to the Northern GI concepts compared to the rooted ones of *roumi vs beldi* (European vs local) and *hourr vs mzaour* (pure vs false) could increase misunderstanding (Simenel, 2010; Jabiou, 2013). The classical dominant model of progress is still present with the (wrong) belief that any technical progress or commercial liberalization would lead to social progress. The background to promote specialized models is still considered as the only efficient way, ignoring the local knowledge and expertise of small breeders, considered as ill informed.

Regarding more specifically PPMVA project for kid meat, a benefit-cost analysis of the investments in this project undertaken for a larger comparative study (Dubeuf et al., 2014) for IFAD gave interesting conclusions (Francescutti, 2014): The planned investments were appropriate for around 1500 breeders, which is much lower than the 21,740 beneficiaries announced in the project. With a target of 1500 breeders, owning medium-size herds of 20 to 60 head, the study enhanced that the project could enable easily an increase in incomes of 600 €/family only by increasing the growth rate of kids and decreasing mortalities. These observations show a lack of business planning, documented discussion and monitoring on the objectives of the project.

Another implicit hypothesis based on the aggregation around local leaders and groups of professional breeders is that this nucleus will be the basis for development of all the community. However, only the members of these groups received technical extension services and very few services were dedicated to the majority of small-size goat farms.

GENERAL CONCLUSIONS AND PROSPECTS

In spite of these difficulties, the awareness of the Moroccan government and its resolve to enhance these ill-favored areas has significantly increased; Morocco belongs today to the Adelboden Group (multi-actor think-tank on the development of mountain areas, created after the 2002 international conference in Adelboden, Switzerland). However, project governance and monitoring must be improved with a more effective involvement of the population. Although the projects are well endowed financially, the absence of well-documented businesslike approaches could lead to failure and most funding and subsidies could be wasted. A more detailed formulation of the objectives, developing prospective views with steering organizations and the ways the actors could more efficiently participate could lead to their success.

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Public policies and their effects on the livestock subsector in the Gharb plain, Northwestern Morocco

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*When you don't know where you are going to, look back at where you came from.
(South African proverb)*

INTRODUCTION

The Gharb plain is located in the northwestern fringes of Morocco (Figure 1). Its area covers around 8805 square kilometers, of which 338,000 hectares (~38%) of fertile agricultural land. It is characterized by a mild climate, as the average annual rainfall reaches 520 millimeters, concentrated from mid-autumn (November) until spring (end of April), whereas the mean seasonal temperatures vary from 13°C in winter to 27°C in summer (ORMVAG, 2011).

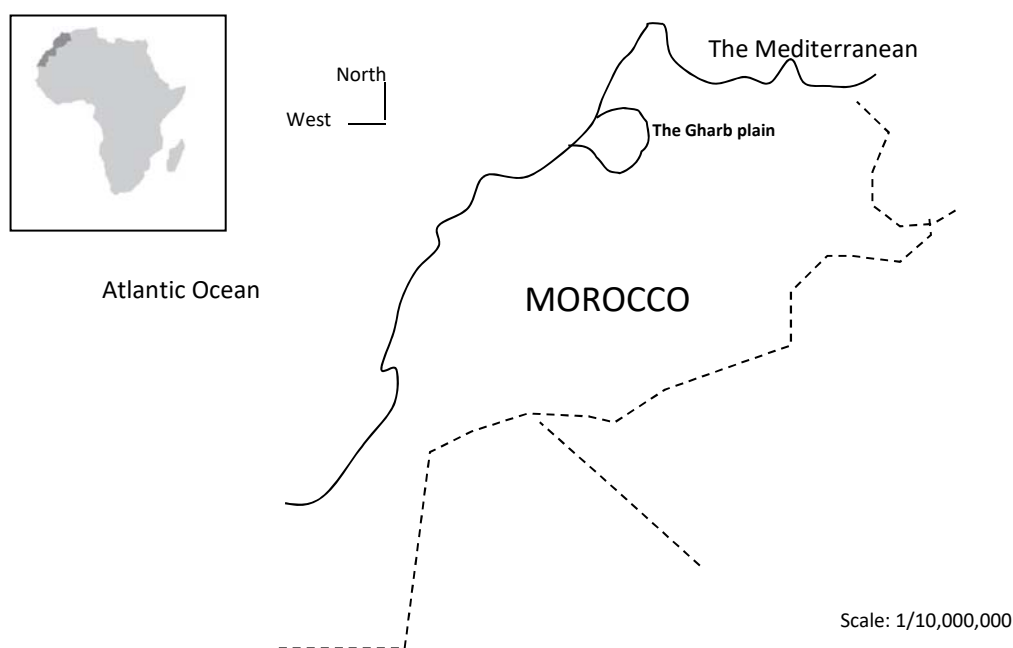


Figure 1: Localization of the Gharb plain

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With such climate characteristics, the Gharb plain was identified as one of the most favorable areas for agricultural intensification in Morocco, mainly a semiarid to arid country, and its resources were soon coveted by the settlers who arrived at the beginning of the 20th century. Nowadays, the Gharb plain has become one of the country's most important supply basins of staple food, such as rice, sugarcane and beet (90%, 67% and 22%, respectively, of the domestic production; ORMVAG, 2011). The Gharb plain is also well known for its cereals and horticultural outputs (e.g. fruit trees, artichokes, strawberries). The livestock subsector is well represented in the region, as it currently allows an annual production of 290,000 tons of milk from 114,300 cattle, of which 82% are purebred Holstein or crossbred (Local x Holstein) cows. The animal wealth also consists in a flock of 937,700 sheep and 24,100 goats (ORMVAG, 2011) contributing to an annual output of 13,600 tons of red meat.

From the beginning of the colonization era in 1912 to the current situation, the Gharb plain has witnessed several infrastructure layouts, supported mainly by public policies, which have radically transformed its original landscapes. The aim of this chapter is to present a detailed analysis of the effects of such policies on the whole agricultural activity in the Gharb plain, with a particular focus on the livestock subsector. Four parts structure the chapter. The first one briefly covers the precolonization era, when the area was mainly a corridor for trade with foreign countries with limited state intervention. The second one focuses on the colonization period, from 1912 to 1956, which can be depicted as the beginning of state-oriented policies in the region under the French protectorate regime. The third one relates to state-driven policies of irrigation infrastructure and agricultural development from the Independence (1956) until the period of the Structural Adjustment Programs (SAP) by the mid-1980s. The last one concerns the liberalization era, the progressive withdrawal of the state, and the establishment of private operators, who have become today mostly responsible for crop and livestock development.

THE GHARB PLAIN, A HOSTILE TERRITORY IN THE PRECOLONIZATION ERA

The Gharb plain was known as a pathway from the north of the country (i.e. the Mediterranean coast and cities such as Tangiers and Tetouan) to its central regions, including especially Rabat and Fes, and further south Marrakech, which were capital cities during different periods. Although Morocco is a secular country with almost thirteen centuries of history, its authority went through several phases, and sometimes the hold of the state on local political aspects could be weak. At specific times, state decision makers could even consider that some areas of the country were in a phase of anarchy characterized by disobedience to the ruling power, in contrast with areas (especially in large cities) where state rule was entirely applied.

During the 19th century, the Gharb plain could be considered as a passage area with an importance for trade with Europe, given the proximity of Gibraltar Strait (Brown, 2012). However, its hostile swamps with proven malaria foci limited its economic development, as the main activities consisted in extensive rain-fed cereal cropping associated with grazing livestock systems (cattle and sheep). The ethnic populations consisted almost entirely of Arab tribes, especially of Hilali origin (they had crossed North Africa and finally arrived in Morocco from the Arabian Peninsula during successive waves from the 11th to the 15th century), and livestock farming constituted a strategic activity to control the territory. The Gharb plain was in fact the cradle of one of Moroccan five endemic sheep breeds, known as Beni Ahsen, from the name of the regional tribes' confederation. The Beni Ahsen is believed to be the ancestor of the famous Merino sheep breed, which became later on a global player in the specific wool market. In fact, it has been established that during the Merinid dynasty which ruled Morocco from the 13th to the 15th century, sheep were exported to neighboring Andalusia (south of Spain) which was at that time under Arabs and Berbers' control. The breed, which was famous for its fleece quality and weight, is thought to have spread all across Europe and after that worldwide, as its characteristics made it a major producer of wool, especially from newly colonized South America and Australia (Flamant, 2002).

THE GHARB PLAIN DURING THE COLONIZATION ERA (1912 TO 1956)

The area did not witness a remarkable opposition to the colonial occupation, by contrast with other neighboring mountainous regions, such as the Middle Atlas and the Rif, where fierce fighting occurred between foreign armies (French and Spanish) and local tribes until the 1930s (Julien, 1978). Therefore, since the beginning of colonization, the settlers arrived to the Gharb plain, benefitting from new land regulations by the French protectorate regime, which enabled them to access vast domains (Karsenty, 1988). However, because of the lack of infrastructures and of the hostile swamps, the agricultural development proved to be difficult. In fact, the Gharb plain was soon identified as an area "liable to flooding in a subarid region" (Le Coz, 1964). In 1925, preliminary attempts to get rid of the swamps were undertaken, and the colonial authorities began investing heavily in drainage and irrigation means. This was particularly noticeable through the building of one of the first large-scale irrigation dams in Morocco, the El Kansera dam, built on the river Beht (near the city of Sidi Slimane, in the northeast of the plain) which became operational in 1935, with a capacity of 270 millions of cubic meters. Moreover, as the Gharb plain has always been characterized by a large diversity of landscapes, from its mountainous edges ('pré Rif') to the coastal area, it could host diverse agricultural systems: 'rain-fed in the hilly area' (near urban centers such as Had Kourt and Jamâa Elhouafate), 'irrigated on heavy clay soils with crop intensification' and 'horticulture on the sandy coastal area.'

The colonial authorities were keen at encouraging agricultural development to reinforce the hold on the newly colonized area. At the end of World War II a research station was built in the Gharb plain, near the city of Kénitra, with the aim to test fodder species to intensify cattle production, especially with imported strains from Europe. In this country whose livestock activities were mainly depending on rangelands, intensive fodder production was quite unknown, except in remote areas such as mountain valleys and oases. Therefore, forage species such as berseem clover (*Trifolium alexandrinum*) or ray-grass (*Lolium perenne*) were tested to intensify the output of meat and milk. Experiments were also carried out on sugar beet, cane and citrus trees, to provide the settlers with a set of high-value cash crops that would increase their incomes. However, as the independence of the country was looming, such experiments did not last too long, and their effective results could not be seen immediately. Hence, at the onset of independence, and due to the fact that the colonial power had been engulfed in two successive world wars, its legacy to the agricultural sector was quite limited (Le Coz, 1964). Innovations mainly appeared in large farms owned by foreign settlers, who introduced very little modern technologies (e.g. machinery, selected seeds, cash crops, imported cattle breeds).

Regarding indigenous smallholder farms, which represented the vast majority, there was almost no notable change, as they relied on very extensive cropping systems with a major role for cereals and livestock that grazed on poor quality roughage (cereal straws, stubble and fallow grass). Tillage was still conducted with animal draft and it usually represented a hard task necessitating a long time, given the heavy clay soils of the region (Couleau, 1968). Many smallholder farms could not afford to sow all the land they had. The colonial authorities did not have enough time to establish a specific policy related to these kinds of farms, which were significantly underdeveloped. However, by the end of the 1940s, the colonial authorities launched the Sectors for the Modernization of Smallholder Farms program to try to improve these farmers' livelihoods and avoid social unrest (Joly, 1946). This program did not have enough time to be completed, as the independence of the country was on the way. In fact, the main cereal crops average yields were still limited (not exceeding one ton of grains per hectare in favorable years) and very unstable across the years because of variable climate conditions.

IMPLEMENTATION OF A STATE-DRIVEN AMBITION FOR AGRICULTURAL INTENSIFICATION

At Independence in 1956, the country had to provide rapid solutions to many challenges. Among the most urgent ones, demographic expansion meant a growing demand for food. In order to address the challenge, the Moroccan authorities soon showed an ambitious will to develop the local production of major food chains and reinforced the preliminary attempts implemented at the end of colonization. Given

that the Gharb plain was one of the most favorable areas because of its average rainfall levels and mild temperatures, it was decided to intensify there in priority the agricultural production.

The Moroccan government officially launched from 1963 to 1968 a vast study, called Sebou Project, with the support of the United Nations Development Program (UNDP). The aim was to provide solutions to add value to the traditional agricultural sector of the Gharb plain and its neighboring fringes, which cover almost 40,000 square kilometers (i.e. an area larger than Belgium). Rapidly, the study, which was carried out by international experts, allowed identifying the importance of irrigation and drainage as necessary means to overcome water excesses and deficits. Sebou Project, with its integrative agricultural vision, also promoted the livestock subsector to a central role. It mainly consisted in the establishment of a dairy basin based on smallholder farms. Adequate fodder production had thus to be encouraged. The berseem clover crop seemed the most promising, as it proved, under experimental conditions, its adaptation to the wet conditions of the area during winter and spring (INRA Maroc, 1965). Moreover, Sebou Project stressed the need to implement an infrastructure of milk collection to allow its rapid treatment by industrial processors. The project emphasized the need to get rid of local cattle breeds, as these were not adapted for dairy intensification. It pledged the introduction of purebred imported cows in farms with sufficient technical know-how for dairy specialization, and crossbreeds between local and imported dairy strains in conventional smallholder farms. Sebou Project confirmed that the number of sheep and goats should be decreased, especially in irrigated areas, as these species would not allow converting efficiently nutrients into meat and milk, which would be provided by high quality irrigated fodder.

During the 1960s, the authorities released new laws introducing the central role of the state in the regulation and encouragement of the agricultural development. This was especially noticeable in the field of irrigation management, with the institution of the National Irrigation Office (ONI). However, the authority of such an office, with a responsibility throughout the national territory, began rapidly to disturb the traditional political organizations in many areas of the country. The issue of land reform and the discussion of the possibility for farmers organized in cooperatives to get access to small plots created a source of growing disagreement between ONI and the ruling power (Lazarev, 2012). In fact, this corresponded to a period of fierce opposition to the central power. During the legislative elections of 1963, although many urban centers voted for left-wing candidates to try to ensure the adoption of democratic reforms, the ruling power increased its hold on the entire country through a massive vote in the rural areas against any change. Such a vote was mainly guaranteed by the allegiance of local elites who largely profited from the political system by intense land seizing (Talha, 1975), and by a vast majority of illiterate people who voted conservatively. This marked opposition between the rural vote determined by local elites and reformist cities were commented upon by some political analysts who wrote that the "Moroccan fellahs (i.e. farmers)

were the throne's supporters" (Leveau, 1965). Given the increased legitimacy of the ruling power after the elections and the defeat of the opposition icons, ONI's activities were suspended in 1965. It was substituted by several regional offices called Regional Offices of Agricultural Development (ORMVA).

The Regional Office of Agricultural Development of the Gharb plain (ORMVAG) was instituted in 1966. Its main missions consisted in administering the irrigation network in the plain and managing the water resources within the area. It was given the authority to sell water to users. It was also in charge of trying to implement the agricultural development in the region, by the extension of modern practices to various crops and livestock production. For instance, since Sebou Project a specific policy was dedicated to sugar production, from beet and cane, as the area climate could support both crops. The first sugar factory was built in 1963 near the city of Sidi Slimane under ONI's authority; the supply chain (from cropping practices to processing harvests) brought about job opportunities and added value to the agricultural assets of the area, e.g. water, land, manpower.

Later on, ORMVAG was associated to the first serious attempt at increasing local milk outputs with the launching of the 'Dairy Plan' (MARA, 1975). It relied on several measures, such as the promotion of fodder crops, the implementation of crossbreeding programs between local breeds and imported cattle like the Friesian. The Dairy Plan also adopted as a top priority the building of a milk collection infrastructure. Finally, milk powder imports were heavily taxed to protect local production. This set of measures soon resulted in a significant increase in the raw milk output. Several investors from various origins, especially urban dwellers with agricultural land, launched dairy activities, as the farm gate raw milk price represented almost 75% of the milk consumption price by 1975 (Sraïri and Chohin Kuper, 2007). The national dairy policy also included the early adoption of artificial insemination as a major means to achieving crossbreeding between local cows and imported dairy cattle, which was then mainly practiced by foreign technicians, particularly from Poland and former Yugoslavia.

As the attempts at land reform were almost stopped in the mid 1960s, most of the large farms located in the Gharb plain, which were under foreign settlers' control, were purchased by Moroccan elites. This meant that farmers had very limited access to land, especially land which the French colonization authorities had classified as commons and which was used within tribal agreements. These agreements were based on a kind of annual distribution of plots to adult male tribe members. This type of organization implied that it was impossible for farmers to have access to bank loans, as they had no property right on the land they used (Tahiri, 1963). Moreover, no effort at agricultural intensification could be set up by means of investments as the farmers considered that there was no guarantee they could have access to the same plot of land in the end. ONI thus lobbied for a change in the land regulation, especially with regard to commons. However, the ruling power

did not accept such an interference of technical issues with political ones, and it soon stopped all reforms.

The settlers who had not left Morocco by the 1960s were forced to do so by 1973, after the release of a specific law named 'Moroccanization'. The central state authority took control of the remaining lands and created two companies, the Agricultural Development Company (SODEA) and the Agricultural Land Management Company (SOGETA), whose role was to exploit the large farms formerly owned by foreign settlers. The ruling power also created the Moroccan Agricultural Company (COMAGRI) with a livestock orientation, as it managed farms specializing in dairy production. However, in some of the remaining lands that used to be under settlers' control, the state tried to implement some land reforms as the pressure from farmers' organizations began to increase. The ruling power issued a specific law creating land reform cooperatives at the end of the 1960s. These cooperatives were organized as groups of farmers with ancient ties (whether family or ethnic) but they were set up on a limited area compared to the total land which used to belong to the settlers. Moreover, the law only gave them land use right, excluding them from property access right. Another aim of such a limited land reform policy was to encourage the emergence of collective actions from the farmers in the area. However, these collective actions, such as milk collection cooperatives, or collective use of equipment within land reform cooperatives, showed limited efficiency. Sometimes, they were closely monitored by the local state authorities to prevent any autonomy, which could precipitate political turmoil (Dumora et al., 2012).

The efforts to implement modern dairying in the Gharb plain rapidly marginalized the local cattle breeds as well as small ruminant flocks. The herd was therefore changed to purebred imported Friesian cattle, and crosses between such animals and local breeds. By the beginning of the 1980s, in addition to the numerous smallholder farms, the milk output came from private large farms as well as from those managed by companies such as SODEA and COMAGRI, which operated on state-owned land. However, marked difficulties to achieve a modern, intensive and profitable dairy activity soon appeared. Even in large state-owned farms, technical problems occurred frequently, as the workers in charge of the herds were not their owners. Cows and calves' high mortality rates were sometimes recorded, as well as frequent production accidents, although the average milk yield per cow could sometimes rise above 6000 kilograms per year (Hajjani, 1986; Sraïri and Kessab, 1998). The setbacks were mainly linked to quality feed shortages, whether due to seasonal flooding, or more frequently during summer, when the berseem-clover end of cycle meant a rapid drop in nutrient availability (Sraïri et al., 2015). Moreover, it appeared rapidly that the practices promoted by the intensive dairying program converged toward a massive use of feed concentrates, which were at that time heavily subsidized, especially wheat bran and dehydrated sugar beet pulps. Such practices, which tried to compensate the lack of quality roughages, could also be incriminated in the occurrence of frequent production accidents, e.g. sudden mortality of cows, low milk fat content. Another significant setback in

a sustainable dairy production consisted in the weak performances in replacement heifers' growth, implying necessary imports of females (Sraïri and Baqasse, 2000). This trend significantly reduced the profitability of many cattle farms, as their prices have kept increasing since the mid-1980s. However, as the domestic policy was determined to achieve a rapid increase in the milk output, these practices were to last a long time.

At the end of the 1970s, the cattle raw milk output continued its significant increase. It coincided with almost the end of direct raw milk deliveries to consumers in large cities. Private dairy processors were then investing massively, with state authorities' blessing, in order to implement modern milk collection circuits. In the Gharb plain, farmers were encouraged to set up milk collection cooperatives to allow them to market their daily output at a fixed farm gate price. Moreover, down-line the commodity chain, a milk processing factory, Colait Extralait, owned by a cooperative of farmers, has been operational since 1953, when it was settled by the French colonial authorities. The dairy processing cooperative headquarters are still present in the suburbs of Kénitra City, the main town in the Gharb plain.

Finally, the state intervention in the livestock subsector was also present in the research area. The Moroccan state provided Hassan II Institute of Agronomy and Veterinary Medicine, the leading institute in the field of animal sciences and veterinary research in the country, with a farm of almost 360 hectares in the Gharb plain. In this experimental station, the research and extension efforts on the herd aimed to show the usefulness of the national policy in the field of intensive dairy-ing. Several programs of crossbreeding between local breeds and imported Friesian cattle were implemented. They were soon followed by crosses between such strains and the Holstein breed, which was emerging as a global player in the field of dairy cattle genetics. Research programs also focused on better characterizing berseem-clover nutrient contents and its evolution throughout its vegetative cycle, as well as determining several local feedstuffs (e.g. straw, bran, citrus and beet pulps, molasses) nutritional values (e.g. net energy, protein, minerals). Therefore, the 1970s' could be considered as a decade of genuine progress and optimism, as the Gharb plain was undergoing visible changes to improve inhabitants' livelihoods and to contribute to the development of the country.

LIBERALIZATION ERA FROM THE MID-1980S UNTIL TODAY

In the beginning of the 1980s, a lasting drought inflicted severe damages to the whole agricultural sector in Morocco. Huge losses in animals were recorded, as the number of cattle, sheep and goats almost decreased by 30%. Moreover, the international donors informed the government that its financial situation was in serious trouble, given the significant expenses engaged in the Sahara conflict, which opposed Morocco to the Polisario Front (Popular Front for the Liberation of Saguia el-Hamra and Río de Oro), since 1975. Preliminary discussions between Moroccan

authorities and the international donors, particularly the International Monetary Fund (IMF) and the World Bank, took place to implement a severe reduction in the expenses. A Structural Adjustment Program (SAP) was imposed to the country by 1983. As a consequence, significant budget cuts were programmed, which directly impacted all the social sectors including education and health. With regard to agriculture, the effects of SAP progressively emerged, as the state authorities were forced to reduce expenses. The liberalization of the economy, which concurrently followed, almost meant the end of all kinds of incentives to the agricultural sector. Consequently, the prices of the most used feed concentrates in livestock farms soared. That was mainly noticed for wheat bran and dehydrated beet pulps, which were at that time highly available in irrigated schemes. The incentives on the imports of purebred dairy heifers were also stopped. The withdrawal of the state from direct management of dairy farms was also adopted, and therefore COMAGRI was dismantled by the mid-1980s. It was followed by the end of SODEA dairy activities in the late 1990s, as all the state-owned lands were progressively included in a program named Private Public Partnership. However, the experience of dairying was finally accepted in the area, since the demand from neighboring cities (e.g. Kénitra, Rabat, Casablanca) soared, and milk volumes went on increasing as smallholder farmers adopted the idea of diversifying their sources of income by rearing cattle of imported origin.

However, the analysis of the practices implemented by farmers revealed a wide diversity of strategies, which have to be considered as a part of the whole farming system. Very few farms appeared to be specialized in the dairy business, given the difficulties linked to such a choice in the Moroccan context (lack of know-how and fodder), and the vast majority seemed more interested in adding value, even during a short period, to the fodder biomass available in the rainy season (Sraïri et al., 2003). In addition, all the farmers considered that the integration of cattle in the management of their activities was crucial, as they produce manure, which is necessary for any crop intensification. In smallholder farms, cattle represented a real asset, as they provided employment opportunities for the abundant labor available. In some specific areas of the Gharb plain which used to be swamps, the farming systems still heavily relied on rice, as the main source of income. The vegetative cycle of this crop (sown late May and harvested in October) and its agronomic constraints required fertile soils, which could only be guaranteed by berseem clover as a previous crop (given its leguminous characteristics) combined with the massive use of manure. Cattle breeding and rice appeared complementary in the strategy of such farms: cattle as the main activity from November to May and its relationship to berseem-clover daily cuts, and rice from June to October. Cattle were the main financial asset for the farm to ensure a successful rice harvest, as strategic sales of calf crop would allow financing the purchases of strategic inputs for rice (e.g. seeds, fertilizers, pesticides).

The withdrawal of the state from all kinds of direct intervention in the livestock subsector came to its paroxysm with the end of state-managed cattle farms.

As expected, the next step was the total liberalization of milk prices across the supply chain, which occurred in 1992. Milk collection cooperatives and industrial processing units had to find a new frame to discuss these issues. Unfortunately for milk collection operators and for farmers, the liberalization automatically caused the farm gate milk price to remain unchanged, whereas milk consumption prices steadily increased, indicating that the industrial processors' margin was growing (Table 1). Such a trend rapidly induced the emergence of informal milk collection circuits, mainly to supply neighboring cities (Rabat and Kénitra) with raw milk, generally sold later on as processed traditional dairy preparations such as *raib* (yogurt) and *Iben* (butter milk) in small shops, locally known as *mahlabates*. These circuits provided the farmers and local peddlers with the opportunity to avoid delivering milk to collection centers, where the prices remained unchanged for many years.

Table 1: Farm gate and consumption milk prices in Morocco from 1970 to 2015 (Moroccan dirham)

Year	Farm gate (1)	Consumption (2)	(1)/(2) (%)
1970	0.54	1.05	51.4
1975	0.90	1.20	75.4
1980	1.44	2.10	68.6
1985	2.05	3.10	66.1
1990	2.62	4.10	63.9
1995	2.94	5.00	58.8
2000	2.94	5.40	54.4
2005	2.94	6.20	47.4
2010	3.15	6.40	49.2
2015	3.40	7.00	48.6

Moreover, as the milk collection centers could refuse, especially in the rainy season, that occasional suppliers deliver their output, these were forced to address themselves to the informal milk chain. Quality controls in this chain could be less rigorous than in official centers. Another point of disagreement which rapidly emerged from the organization of the dairy chain based on a fragmented offer (i.e. numerous smallholder farms delivering daily limited quantities of raw milk) was related to quality payment. As the delivery of milk was rapidly aggregated every day in the collection center, no accurate quality analysis on the several milk batches could be achieved. This was especially true for milk fat and milk protein contents. Such a situation created numerous conflicts between farmers and the industrial processors who purchased their milk. This was more obvious when cooperatives received fines when the collective milk tank was declared of poor quality. The emergence of informal milk circuits combined to the quality issue soon induced difficulties for the regional dairy processing unit, Colait Extralait, to keep on regular

payment to its suppliers. Added to its internal management problems, these difficulties resulted in the 1990s in the intervention at regional level of another dairy processor, Centrale Danone (leader in the Moroccan market), which began collecting milk. This was in the direct line of the liberalization of the sector, but it created a source of tensions between the two operators, contributing to the reinforcement of the informal dairy circuits.

The cessation of state intervention in the dairy chain implied that other operators would represent the sector. Therefore, since the mid-1980s, the authorities launched the idea of the establishment of professional associations. By 1988, the National Cattle Breeders' Association (ANEB) was officially instituted, with local representatives from the several regions of the country where a significant cattle-breeding activity took place. Given the interactions between the animal wealth and local political affairs, the state authorities closely observed the association. It rapidly appeared that the smallholder farms which constituted the vast majority of players in the sector and which were the most responsible for milk supplies were not very much represented in the association. The situation could be observed throughout the country including in the Gharb plain. The withdrawal of the state supervision of the cattle subsector induced a significant drop in the monitoring activities of the herds and their health. Official milk recording and annual campaigns of tuberculosis testing almost ceased in the country. The state argued that such operations had been imparted to professionals who therefore had to implement them. The technical support which used to be provided by state local services to farmers also drastically decreased. Consequently, farmers had to adopt their own peer-to-peer learning processes (Faysse et al., 2012). With the withdrawal of state intervention, the planned state-driven innovation process and dissemination extension services collapsed. Fortunately, local innovations at the initiative of farmers emerged and produced informal labor, neighbor and marketing networks that contributed to the resilience of livestock farming systems (Poncet et al., 2010).

The Gharb plain still underwent massive floods with disastrous consequences on both crops and livestock during the 1980s and the 1990s in the rainy years. The extreme weather events reminded of the vulnerability of the plain to excess water. Hence, a radical solution was to build a large dam upstream to avoid flooding. This dam, the El Wahda (Unity), was inaugurated in 1998, after another damaging flood in 1996. With its capacity of 3.8 billion cubic meters, its role was both to prevent flooding and to provide water for the expansion of the irrigated area in the plain, as a third irrigation segment of an estimated 95,000 hectares was to be set up from 1998 to 2005 (Figure 2). El Wahda dam has been able to hold major water reserves but it did not prevent other flooding episodes, especially in 2010, when the amount of rainfall in December alone exceeded 200 millimeters. Such events constituted significant blows to the achievements of a sustainable agricultural development as they forced many people to leave, even momentarily, their farms. In addition, floods caused severe losses in major investment projects in the area and severe damages to the drainage infrastructure. Therefore, investments in irrigation

and drainage have increased significantly since 2008, when the Moroccan government launched the Green Morocco Plan. They were even increased after the painful flood of 2010.

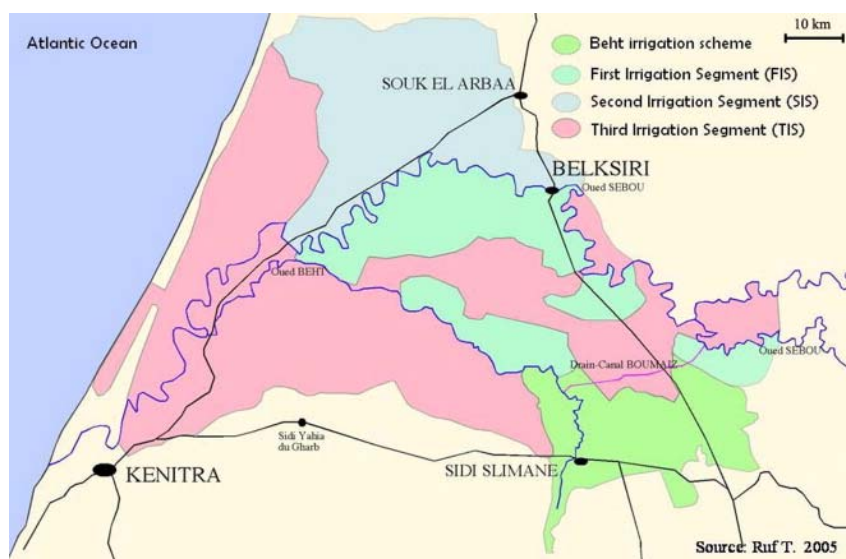


Figure 2: The successive irrigation layouts in the Gharb plain in Morocco

The Green Morocco Plan specifically targeted the high value agricultural activities, with important state incentives, especially in irrigation equipment, machinery and cattle imports. In the Gharb plain, these activities were dominated by dairy farming and citrus trees. In agreement with the liberalization trend of the economy, the state-owned lands which were compatible with valuable agricultural projects were all rented to private operators who could afford huge investments. This was the final step of the land seizing phenomenon, which began with the colonization era (Mahdi, 2014). Even the activities of the experimental farms stopped, as they were also rented out to private operators. Beginning in 2008, very large dairy farms with up to 3000 lactating cows emerged in the Gharb plain. Up to today, these projects have been managed by groups of investors having direct ties with the dairy industry, to ensure the marketing of significant daily milk outputs. Building these very large dairy farms in the Gharb plain definitely confirms that the area is the most favorable for this activity, as water scarcity has become a major threat to the sustainability of cattle farming in other regions in Morocco. As previously reported, the water footprint may amount to 1.5 cubic meter per kilogram of milk and 15 to 18 cubic meters per kilogram of beef carcass in the context of the irrigation schemes in Morocco (Srairi et al., 2009; 2016). To ensure the availability of such water amounts, dairying must first rely on 'green water' (i.e. rainfall) rather than 'blue water' (i.e. irrigation), especially in water scarce areas, as groundwater depletion can definitely ruin the implementation of sustainable dairy systems (Sultana et al., 2014).

CONCLUSION

The Gharb plain has undergone significant agrarian changes in less than 100 years, which have impacted all aspects of daily life. The most prominent one has certainly been associated with the implementation of a large-scale irrigation infrastructure which has radically transformed agriculture. Irrigation and drainage techniques have transformed former hostile swamps into large fertile areas, stopping at the same time the disastrous effects of malaria. Consequently, farmers' incomes significantly increased with a guaranteed access to land, which has led to the accumulation of capital in many parts of the plain. Irrigation has also impacted the livestock subsector in the Gharb plain, as the dairy farming activity has emerged whereas local cattle breeds and small ruminants have declined. The latter have been especially impacted by the decrease in rangelands, as well as by their significant labor needs with limited productivity, given their slow reproductive rates. The movement of liberalization which has affected the Moroccan economy since the mid-1980s has induced a massive withdrawal of the state from the regulation of the agricultural sector. This has aggravated the dichotomy between very large farms, whether on private or rented state-owned land, both formerly controlled by foreign settlers, and a vast majority of smallholder units, often relying on unstable land (especially commons), still struggling to ensure their resilience.

The assets of the region (e.g. water availability, fertile soils, diversity of landscapes, proximity to the main markets), compared with other areas of Morocco, imply that the Gharb plain will remain for a long time a land of opportunities for investors in many agricultural subsectors such as orchards (especially citrus trees), artichokes, sugarcane and beet, berries, for exports, dairying. This will however amplify the competition for land access, as illustrated by the ongoing trend of land price significant increases. Because of this growing demand on land, public authorities have begun very recently (summer 2017) to consider implementing a new policy on common land, and it is no surprise that its launching will target in priority the Gharb plain irrigation scheme. The policy will enable the privatization of these lands, which have remained for more than one hundred years under a common status, managed by tribal arrangements. Thousands of hectares will therefore integrate the land market in the near future and attract investors to finance large projects. The livestock subsector will certainly be promoted to a strategic role to fulfill the growing demand for milk and red meat and to implement sustainable farming activities.

However, numerous challenges will have to be solved, as recent changes in the social and agricultural contexts are already underlying significant tensions. The growing demand for increased wages, particularly for the work involving herds, has recently emerged and they certainly add pressure on the profitability of animal production activities within large farms as well as in smallholder units (Sraïri and Ghabyel, 2017). Moreover, issues related to water and soil pollution, especially

in areas with high animal density, will accelerate change in farmers and even consumers' perception of the livestock subsector.

These issues call for sound policies to ensure the profitability and sustainability of livestock farming, especially through an increase of its productivity, which can only be achieved by further efforts in the dissemination of good practices. The situation also requires rethinking the approaches to livestock farming activities in the Gharb plain, with enhanced focus on smallholder farms and their integration within modern and efficient supply chains, as they have proven their resilience, without almost any kind of support, in opposition to large farms, which have fully benefitted from recent state-driven policies.

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Overview on livestock policies in the Bedouin area Northwestern coast zone of Egypt

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INTRODUCTION

This chapter describes the main development policies of the Northwestern coast zone (NWCZ) of Egypt, especially those having contributed to the significant changes of the livestock sector from the past decades until today. The main goal is to understand better causes and effects of the successive policies and the main reasons for their implementation. The basis of this chapter is the doctorate thesis of Ibrahim Daoud (2016) which has been written in part as a contribution to the Springer's book entitled *Building resilience of human-natural systems of pastoralism in the developing world: Interdisciplinary perspectives*. We have chosen a chronologic presentation of the main policies, after a short presentation of the area.

DESCRIPTION OF THE NORTHWESTERN COAST ZONE

Located in Western Egypt, NWCZ is a strip of arid land along the Mediterranean coast. It is bounded by the sea to the north, the Nile Valley to the east, the Libyan border to the west and the Sahara desert to the south into which it is integrated (Figure 1). From 1944 to 1995, the average annual rainfall was around 140 millimeters with important annual variations. From 1996 to 2011, a strong 15-year drought seriously impacted rural activities. From an agroecological point of view, especially with regard to water availability, there are three main entities within NWCZ. The first extends about 100 kilometers west of the Nile Delta to the city of Ras El Hekma.

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It benefits from the Nile water brought by Hamman Canal, in reference to the city of Al Hammam located in the western suburbs of the megalopolis that is Alexandria. The second entity extends from the Libyan border to Fuka Village (located between the towns of Salloum and Ras El Hekma) on a distance of about 285 kilometers and 70 kilometers to the south. This area depends on rainfall as the only water resource for agriculture activities, rain-fed and wadi agriculture due to its 218 wadis. The third entity is the Siwa oasis located southwest of NWCZ about 300 kilometers from the Mediterranean coast. The Siwa oasis benefits from water from the deep aquifer of the same name on which it is located.



Figure 1: Location of the Northwestern coast zone of Egypt in the Mediterranean and its main urban centers

NWCZ is mainly settled by Bedouins, especially in rural area. According to Daoud (2015), the five main tribes are: Awlad Ali Abiad, Awlad Ali Ahmar, Qutaan, Gomiaat, and Skena. Due to the harsh conditions, Daoud (2015) considered that Bedouin breeders have developed complex pastoral livestock farming systems based on animal husbandry, including sheep, goats and camels, taking into consideration seasonal migrations, some barley fields and a few wadis crops according to their water management. Moreover, the development of sea tourism along the Mediterranean coast over the last decade has strongly impacted NWCZ from a demographic point of view with the seasonal arrival of large contingents of holidaymakers, especially

during the summer and religious days, and from an economic point of view in connection with the supplies needed by holidaymakers.

A LONG TIME AGO UNTIL THE ROMAN PERIOD

According to Daoud (2015), two or three millennia ago, and even earlier, NWCZ was a food-providing area for the entire Mediterranean Basin, both in Roman times and under Greek and Egyptian periods; ancient literature spoke of NWCZ under the names of Mareotis, Mariout, or Marmarica. However, looking at the current landscape, the author wonders how difficult it is to imagine the zone as an important food basket for these antique civilizations. Indeed, it is almost a desert of stones and sand, except for the narrow and arid strip of land located along the coast where the Bedouins benefit from the sea air humidity and short wadis to crop barley, figs and olives. Maybe the climate was different at that time and/or agricultural practices were not sustainable?

Based on a review of the literature, Kassas, cited by Bruins et al. (1986), explains water management in NWCZ. It is a function of the land topography, especially on the coast with its succession of small limestone hills parallel to the coast (Ball, 1952; Said, 1962). The cultivated land lay at the foot of the chains of small hills where rainwater accumulated. According to Daoud (2015), Kassas, cited by Bruins et al. (1986), mentioned that in addition to the advantage offered by this geological opportunity, several types of infrastructures have been built. Among these, the *karm*, inspired by the principle of hillside reservoir, is the most notable. Hume and Hughes (1921), and Cosson (1935) describe the *karm* as a mound a few meters high and a few dozen meters at its base that has a geological or human origin, for example an old building in ruins covered with sand brought by the wind over time. Due to its surface permeability, rainwater penetrates to its base and accumulates, thus constituting a microcollinear reservoir. This ingenious rainwater harvesting system made it possible to grow crops close to houses, complementing the crops in the fields located in the shallows and wadis at the bottom of the hill chains. Another type of infrastructure associated or not with *karms* were the Roman cisterns, some of which are still in use. The small round cisterns were generally located near the *karms* in the ancient villages. They were filled with water collected by the *karms*. Their main purpose was to supply water to the villagers. The large rectangular cisterns dug under large flat stones were close to the fields and were most used during the dry season when the small cisterns had been emptied, especially for watering the herds. They are described by Shata (1953) and El-Miniawy et al. (1990).

The principle of the Roman cistern is a cavity dug into a limestone ridge with a vault that is both rigid and permeable, because made of limestone, it structures the cavity while allowing infiltration water to pass through and fill it. The cavity is lined with clay to prevent loss. Roman cisterns have a capacity of a few hundred cubic meters. The location of one or more tanks is not chosen at random. It corresponds to an area

located downstream of a watershed, with a layer of limestone, or at least limestone slabs that will provide the vault of the cistern. Consequently, the surface area of the watershed determines the capacity and number of cisterns. On the ground of the watershed, small canals can be built to bring runoff water into the cistern through an opening at the top of the cistern. More than 3000 Roman cisterns are said to have been built in NWCZ between Alexandria in the east and Salloum in the west (Shata, 1953) for a total capacity of about two million cubic meters of good quality water (Daoud, 2015). The same author considers that many of these Roman cisterns were still in use at the beginning of the 20th century as an efficient means of collecting and stocking rainwater for humans and animals.

Alongside *karms* and cisterns for domestic water use, including watering herds, Walpole (1932), then Kassas, cited by Bruins et al. (1986), described another original system discovered in 1931 near the present-day town of Marsa Matruh, now the capital of the province. According to these authors cited by Daoud (2015), it is an underground aqueduct, corresponding to the main canal, equipped with a network of galleries perpendicular to the main canal for the collection of infiltration and runoff water. It was used to collect and transport water from one site to another nearly one kilometer away. The dimensions of the canal averaged 2.1 meters depth and 1.1 meter width. It was equipped with 25 access hatches, presumably for maintenance. Its location is no coincidence either. It was built in a limestone ridge bordered by dunes on the seaside and by the rocky plateau on the desert side. The plateau is notched by the canyons of the wadis, which brought water to the aqueduct system.

For Daoud (2015), these different and complementary infrastructures, and certainly many others used still today can explain the importance of NWCZ as a food basket of the antique Roman and Greek empires and before that antic Egypt. Weedon, cited by Bruins et al. (1986), reports that the first record of the decline of Mareotis dates back to AD 950. By the 10th century, the area gradually degraded. The vineyards were replaced by desert. Only a tiny town existed west of Alexandria by AD 1400. Five centuries later, the district was described as covered with ruins of towns and villages, and the cisterns, dating mostly to Greek and Roman times. These brief reminders about the water harvesting techniques in the Roman and Greek period, more than two thousand years ago, show the strong adaptation of NWCZ society to drought conditions.

NOMADS AND THE PASTORAL BEDOUIN SYSTEM - 2ND MILLENNIUM

Regarding the Mareotis decline, Cosson (1935) added that wind, rain, and sand completed the destruction, leaving only the foundations of countless buildings to tell the tale of this once-prosperous land. Some researchers consider this decline could be attributed to climate changing toward dryer conditions (Daoud, 2015). This author cited Cosson (1935) referring to authors justifying the Ostrich extension in the Libyan Desert by a drier climate. Another school (Daoud, 2015) argued that the current

climate in Alexandria and NWCZ was probably not adequate to the intellectual activity in sciences and art during the Roman and Greek period. However, other arguments showed a relative stability of the climate over the past two or three millennia, especially based on the conservation of the materials used for infrastructures (Weedon; cited by Bruins et al., 1986).

Cossom (1935) suggests a plausible hypothesis of the decline of Mariotis. Thus the numerous conflicts linked to the advance of the Fatimid tribes into the area from the west, particularly at the end of the 10th century, may have led the rural population to flee the fighting and migrate to Alexandria where it remained. The abandoned land and agricultural infrastructure gradually deteriorated. During the 11th century, the Mariotis period came to its end with the invasion of Bedouin tribes who settled throughout the region and imposed their pastoral and nomadic way of life for which agriculture and therefore infrastructure maintenance was not a priority. According to Daoud (2015), this would be the most plausible explanation, especially because in the following centuries many other conflict-related migrations took place in NWCZ and neighboring Libyan region.

According to Daoud (2015) based on several authors, community rangeland management at tribe level and the possibility for any breeder family to move in search of the best rangeland to feed camels, sheep and goats formed the basis of the Bedouin pastoral system. Apart from the need to have pasture all year round to feed their herds, the other constraint of the nomadic pastoral system was the watering of people and animals, especially during the long dry season. Due to this constraint, the Roman cisterns and some other watering infrastructures were strategic, even water resources and supply were common in the Bedouin society. Therefore, according to Daoud (2015) the lack of boundaries between tribes imposed by the nomad and pastoral life was possible as long as common pastures and watering resources were sufficient. Due to the weak availability of these resources, the demographic growing Bedouin society progressively adopted boundaries between the tribes. Thus, while continuing to live in tents, which are easier to move than houses, families generally moved around on their tribes' lands, both in the area close to the coast and around Siwa oasis, especially during the dry season, and on those located in the hinterland, where they migrated when the rains arrived, allowing the grass to grow again.

Daoud (2015) describes the nomadic and pastoral Bedouin system using the example of the Ait Sebak family settled in 1840 in the south of Naghamish wadi near the city of Marsa Matruh, which migrated near Siwa oasis during the summer and fall. The Sebak family had been living in tents when the Egyptian government, in partnership with the World Food Program (1970), started to settle the Bedouin society by building houses. The last tent in Sebak family's area disappeared in 1989. In 1920, land tenure started to appear in the Bedouin area. It is called Al Houz. The Sebak family got land tenure on their land after a hard effort with their neighbors from the other tribes. In the south, the rangeland is still common land because it is rocky and

no oil has been found there. Formalizing the allocation of pasture land – that customary law had allocated to them – to Bedouins can be seen as the first public live-stock policy of modern times at NWCZ scale.

FROM THE 1920S TO THE 1960S

Daoud (2015) considers that the official land law did not meet the demand of the Bedouin society, whose customary law was sufficient, especially to resolve local land conflicts. According to this author, the interest came mainly from the national governance, in both Egypt and Libya, which was occupied by Italy at the time. Therefore, better control of the frequent pastoral movements between Egypt and Libya progressively appeared as a priority objective for the Egyptian government.

With the official land law, the land was common only at the level of the tribe. Consequently, no tribe herd could graze anywhere without permission from the land-attributed tribe. This can be considered as the first land constraint to the nomad Bedouin system, because they claimed: “we were depending completely on the rangeland; we were searching pasture anywhere that we can find it; and for that reason we were nomads, moving from place to another, searching pasture; and for that reason the land was common land for a long time.”

According to Daoud (2015), based on the talks of the current Omda (leader) of the Gnashat tribe, his grandfather, also Omda of the same tribe, rented in 1925 the northern area of Naghamish wadi from the King of Egypt (Khdiwy Abas). The rent was fixed to the quarter of the wadi production, which should be given or paid to the Egyptian kingdom. Based on the Omda's talks, the Naghamish wadi grew fig trees, barley and wheat, and bred pigeons. Because of an internal tribe conflict in 1972 involving the Konishat tribe and its neighbors, the land was divided between Konishat, Mawalek, and Gbihat tribes.

Daoud (2015) sums up the stakeholders' talks regarding grazing: “The best grazing period during the good years was three or four months from the end of December to March, and sometimes the beginning of April.” For the remaining months, there were two choices: to migrate to the desert in the south, especially to Siwa oasis, or to move to Behira Governorate in the east to enable their herds to pasture irrigated fields after harvesting. An important change in the Bedouin migration system occurred during World War II. At the beginning of the war, NWCZ was considered as a possible future battleground because of the Egyptian-Libyan border, attached to British and Italian-German powers, respectively. Therefore, the British Army decided to transfer all the Bedouin tribes to Behira Governorate in order to control and protect them. In consequence, during some years, the movement of the flocks was strongly perturbed. After the 1945 armistice, the Bedouin herds went to pasture in NWCZ. A specific public policy cleaned the Roman cisterns to facilitate the living conditions of the Bedouin breeders coming back to their lands.

The management of sheep and goat flocks and camel herds was the main activity of Bedouin breeders. There were several hundred and up to a thousand head in sheep flocks. According to Daoud (2015) these sizes might have referred to the extended family, including the flocks of different households. Some Bedouin families progressively started to plant barley at this time, some of them before World War II, and the majority after the war. One consequence has been the onset of mechanization and tractors at the end of this period. However, the flocks did not graze in the cultivated fields. Barley grains were only used for making flour and bread. The lambing and kidding occurred only once a year. Except in spring, when the pastures are good in terms of feeding, the sheep and goat flocks were not in a good condition.

However, animal diseases were not serious, even with the migrations, which favored contacts between the herds. At the same time, migrations helped to control parasitism caused, on one hand, by the lesser stock rate on a same pasture and, on the other hand, the sun destructive effect on parasite larvae. Thus, many Bedouins consider that the use of concentrates as feed resources in the 1980s favored the expansion of parasitism, especially pulmonary and digestive, and other sheep and goat diseases.

Regarding the 1950s and the first years of the revolution, it was reported to Daoud (2015) that “specific Egyptian policies aiming to attract the Bedouin families and to enhance the settlement in the Egyptian land” had been launched. This author also cited the example, “Bedouins travelling in NWCZ between Marsa Matruh and Alexandria did not need to have their national IDs any more, NWCZ having been totally integrated as a regular part of the national territory.” The author adds that the years after the war were the period of some significant changes in NWCZ in terms of livestock policy and provides some examples.

In 1947, started in Fuka area a research and development project focused on groundwater use to produce alfalfa, locally named *kataf*. Only one year later, in Al Dakhla oasis, Bedouins of the Al Shtor tribe planted fig trees. Moreover, in 1952, the king of Libya, Idriss, decided to build dykes in the Naghamish wadi. The construction started several years later but these initiatives show the interest of the national governance of two nations for the settlement of Bedouin breeders through the development of livestock-cropping systems using irrigation. After the revolution, several other policies were applied in NWCZ, especially related to the new extension services in rural area implemented by President Nasser’s government.

In addition, Marsa Matruh considerably grew during this period. According to Daoud (2015), “strategic place during the 2nd World War and, still a major location for the Libyan leaders, the regional capital of NWCZ has progressively become the place where were debated the regional policies, the agreements between the Egyptian government and the Western Bedouin society, and also arrangements with Libyan leaders, considering the same origin of the tribes in the two countries.”

FROM THE 1960S TO THE 1990S

According to Daoud (2015), this period started in a complex situation for Egypt. With the end of the monarchy in 1952, the young Republic of Egypt, led by the army, faced the British-French coalition in 1956 to control Suez Canal. At the same time, Israel's army occupied the Egyptian Sinai, another strategic Bedouin area located in the east. The main objective for the Egyptian government regarding NWCZ was to secure the Western border with Libya to avoid another potential conflict in the West and retain the natural resources of the subsoil, especially oil and gas. Therefore, the settlement of NWCZ Bedouin tribes and good relation with Libya were an important part of the strategy, above all the Bedouins had double citizenship, Egyptian and Libyan. Beside the national funds to implement its specific policy for NWCZ, the Egyptian government was supported by the Food and Agriculture Organization of the United Nations (UN FAO), then by the World Food Program (WFP). The Bedouin settlement policy then intensified mainly because of the war between the two nations from 1979 to 1989. Daoud (2015) writes: "Despite all the tensions and conflicts between Libya and Egypt, the relationship between Bedouin breeders from the two sides of the borders was good. Moreover, several tribes were settled in the two countries. Many leaders of Egyptian tribes recognized the Bedouin Libyan leadership, which frequent exchanges between these leaders, several in the city of Marsa Matruh."

Special efforts had already been made with regard to access and communication in NWCZ. Therefore, the railway line and the main road crossing NWCZ, from Alexandria in the east to the Libyan border in the west, were built. There were used a lot during World War II. In consequence, Daoud (2015) considers that the main investments were the maintenance of these infrastructures and building new ones, especially the secondary roads used by the Bedouin population to gain access to their communities. At the same time, new schools and public health centers were built not only in Marsa Matruh City, but also in the main small towns and villages where Bedouins had recently settled.

According to Daoud (2015), beside the public infrastructure-building program in NWCZ, since the 1980s, the Egyptian government, along with FAO and WFP support, strengthened its policy to improve local life conditions. Bedouin breeders received long-term and free-interest loans either for housing, or for breeding and crops, especially barley, figs and olives. They also received seeds, fertilizers, access to equipment such as tractors for tillage. However, the harvest was manual. Today they are harvested by machine or manually.

Beyond the adoption of cropping activities, a direct impact of the crop development has been the beginning of land division at family scale (*beat*). It primarily concerned the crop land located near and around the villages, often planted with barley and orchards. This fragmentation of the crop land at family level has strongly changed

crop land management. From this period on, each family has managed its fields located near its home. According to Daoud (2015), “Until today, the main part of the rangeland is still a common land at the tribe level and has not been yet divided between the families of the tribes.”

At the same time, other policies focused on livestock, most important Bedouin activity in terms of income. They especially promoted the building of cooperatives and associations. According to the stakeholders (Daoud, 2015), “The policies through the cooperatives’ system were centralized but the decisions were local in each village.” Via these associations and cooperatives, breeders benefited from low-cost inputs for breeding, especially drugs and later had access to animal feed, such as concentrates and more recently hay. Daoud adds that one of the key informants estimated the feeding subsidies at 40% of the production cost in the 1990s. For example, a breeder who needed around 250 Egyptian pounds (EGP) to produce a lamb received a subsidy of EGP 100. The same informant estimated the total subsidies at 750 million EGP in 1990, i.e. in today’s money around 4–8 billion EGP.

At the end of the 1980s, specific policies were launched to export sheep to the Gulf countries. Public agencies in charge of the export programs supported the breeders in terms of management, especially genetic improvement and feeding in order to enhance NWCZ livestock potential. According to Daoud (2015), it was the beginning of a strong partnership between cooperatives of breeders and public agencies, especially academic institutions, research centers and extension services.

During the same period, in particular during President Sadat’s government, tourism began developing in NWCZ, notably in the east near the Nile Delta, with four touristic sites within 25 kilometers from Alexandria, and in the city of Marsa Matruh. Daoud (2015) notes “The tourism progressively expanded in the deltas of the wadis, where it settled on the most fertile agricultural soils, planted with fig and olive trees.” Facing the demand of land for tourism construction, some breeders sold small pieces of their land to private businesses. This had not been possible during Nasser’s period, because they did not own the official title of their land. Daoud (2015) cites: “Land competition was still the great challenge in NWCZ, due to the only three types of legal landownership recognized by the Egyptian law: private ownership, cooperative ownership, state ownership.” Based on this text, the tribal or common land ownership did not exist. The rangeland, called desert land, was classified as *aradi bur*, meaning undeveloped or rain-fed lands, giving rights and ownership to the Egyptian State (*malkiya lil-dawla*). Therefore, only the Egyptian State could use these lands, lease them, even sell them. In consequence, the Egyptian government used a lot of this text to develop through irrigation the rural land near Alexandria. Only some Bedouins, who were previously settled in this area, benefited from irrigated small plots. Except for this area, in the main part of NWCZ, large pieces of land, even crop land, were attributed to the army for strategic reasons, justifiably or not.

In conclusion, for this period, specific services and policies were launched in order to facilitate the activities and living conditions of Bedouin breeders' families and tribes. However, the land continued to be the central issue of the successive military governments, notably for security and mutual enrichment of both the country and army leaders. The presence of official army land in traditional Bedouin land poses a real problem that persists today.

FROM THE 1990S UNTIL THE PRESENT

According to several stakeholders reported by Daoud (2015), two main factors changed the situation in NWCZ between 1990 and 2010. The first was the change of priority during the Mubarak government policies, compared to the 1980s, with notably the end of many direct supports and special actions focused on the Bedouin society. The second was the 15 years' drought from 1995, "partially compensated by the implementation of the Matruh Resources Management Project (MRMP), financed in partnership with international development agencies" (Daoud, 2015).

During these 15 years, the annual rainfall did not exceed 140 millimeters. Based on reports of diverse local Bedouin stakeholders, especially those from the Ait Sebak family, Daoud (2015) sums up the drought harshness and its impacts on the life of Bedouins breeders: "Until 1995, the rangeland was a natural vegetation cover. The size of the livestock was several hundred to some thousand head. The main job of the members of the family was sheep, goat, and camel breeding, in addition to cultivating barley in depressions. After this date the drought started in the area. The desertification and rangeland degradation also started. The rain stopped completely. The Southern dry wind attacked the rangeland. The vegetation cover had been progressively damaged, reduced year after year, until disappearing completely. Therefore, the soil became more vulnerable to erosion. This bad process continued for 15 years." The result is incredible: today there is no soil; it is just sand and bare rocks.

Two and up to five years' droughts are frequent in NWCZ. Therefore, the natural resilience of the rangeland ecosystem and the pastoral livestock systems allowed the breeders to face these droughts. They recovered the following years when weather conditions improved. With the 15-year drought, the socioecosystem has been deeply affected. All the breeders used the livestock to survive. The sales of animals, especially old males and culled females, enabled them to purchase feed for the herds. In fact, hay and concentrates purchased from markets became the basis of the feeding system during 7-8 months in the rainy years, and for a longer period in the drier years, mainly during summer and fall. In consequence, after this 15-year drought, the largest flocks counted no more than one or two hundred head. For many breeders' families, particularly those with a small herd, the only alternative had been to find another source of income. Therefore, most of the small breeders became traders, and yearned to continue their farming activities. Others migrated,

to Libya or Gulf countries to find jobs, often as shepherds, but also to urban areas as unqualified workers.

Adopting crop-livestock systems was also a strategy for many breeders, expanding their barley areas, and letting their herds graze the fields when the low rainfall did not allow any production of grains. Today, barley is grown around villages, in range-lands which are not available for grazing in winter and spring. Daoud (2015) mentioned conflicts caused by this new crop-livestock land use.

According to Daoud (2015), other breeders decided to invest their labor in wadi crops, planting fig and olive trees, barley and vegetables; “However, the available area is not sufficient to satisfy all the breeders’ demand in wadi land,” despite the huge investment of MRMP in water infrastructure in the wadis. Fortunately, several land conflicts were resolved at tribe level, “enhancing the importance of the tribe in the local dynamics.”

Furthermore, some breeders have decided to invest in intensive and not frequent livestock activities in NWCZ, e.g. indoor sheep fattening and intensive poultry production (Alary et al., 2014). But these new systems require funds for the initial investment and/or good connections, especially to be inserted in the complex market and supply chains of these productions (Daoud, 2015).

Regarding specific policies to support breeders’ families who faced the severe drought, a previously mentioned key-initiative was the Matrouh Resource Management Project. According to Daoud (2015), MRMP was an integrated development project that aimed to improve the living conditions of Bedouin communities settled in Western NWCZ, from Fuka to the Libyan border where are located most of the wadis. Because of the 15-year drought in the area, MRMP gave priority to water harvesting and water supply through specific infrastructures for human and animal watering and crop use, especially cisterns in the communities, dams and dykes in the bed of wadis. Several actions, focused on research, research development and extension, were developed by MRMP in diverse sectors, e.g. wadi and rain-fed crops, rangeland, product enhancement, education, public health. More recently, MRMP became a special program of the Desert Research Center (DRC), in partnership with international financial agencies. Through these actions, it has significantly contributed to maintain Bedouin farmers in rural areas. However, the access to wadi land has not been sufficient to cover the Bedouin’s demand.

Furthermore, during this period, tourism expansion continued in NWCZ, increasing its effects on land use and the food market. Therefore, beside these effects, they offered job opportunities to qualified youth in the services or non-qualified labor in the building sector. Moreover, they have induced a new lifestyle, particularly for the families “who decided to live in the urban area and for the kids who are growing in the urban area” (Daoud, 2015).

CONCLUDING REMARKS

This chapter presents a brief review of the major changes in NWCZ from the Antiquity until now, mainly induced by policies or development programs. This zone has known regular conflicts with successive settlements involving special policies with regard to the importance of the zone in the region, not only the land but also the soil and natural resources. During the last century, successive governments undertook to settle the local population, even nomads, in order to control better the area, as was the case of the British Army during World War II, then the Egyptian Kingdom, followed by the Egyptian Arab Republic. Other special policies linked to water supply and management were launched in order to improve life conditions and avoid conflicts with local populations. There was a strategic role of international centers and programs in order to support both the government policy and local populations. In parallel, top-down policies were based on the stakeholders' demand considering the area role and importance at national scale, especially regarding border issues.

The main policy regarding livestock has been in fact a rangeland policy until a land policy was implemented by the successive governments to secure the land and its resources facing threats from neighboring countries, particularly Libya. In other words, the life conditions of the populations in pastoral areas have not been the main factors of the policy demand, they were only an argument presented by development projects implemented by national and international centers and ordered by local governments. Fortunately, the effects of these projects have been well received by the local populations, but they could be much more efficient without any other government interest. Furthermore, the tribe is the Bedouin network acting in all layers of the society. The tribe level appears as the key point of sustainable rangeland management. Moreover, land is a major conflict issue in the Bedouin society of NWCZ due to the history of the zone, its strategic location, the weakness of natural resources, especially water, etc. Except in the New Reclaimed Lands and around the wadis, land tenure and land ownership have not been a big challenge yet, but could become one in the near future depending on the land demand, particularly in suburban areas, due to the development of tourism, etc.

At least the current sociopolitical situation, linked to the Egyptian and Libyan revolutions, is building a new context in which no clear perspective can be identified. Face to these social constraints, agronomic and technical issues appear essential to recuperate the rangeland and implement sustainable management. However, they have to be studied, and the beginning involves reviewing the literature and conducting experiments in similar ecosystems.

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Challenges facing agropastoral systems in the Arab dry region: case study of Lebanon

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INTRODUCTION

Livestock production in the Arab countries has always contributed to the livelihoods of rural communities, especially in the arid regions where the livestock converts the scarce feed into nutritionally and economically valuable products. Pastoral and agropastoral activities ensure about 60% of the income of poor Arab rural families, who partially depend on livestock to sustain their livelihoods (Hamadeh et al., 2015). The whole family is usually involved in the farm labor.

Animal breeds and species reared in the Arab countries are typically of small size and highly adapted to arid environmental conditions. They include 38 sheep breeds, indigenous Awassi being the most productive and popular, 54 goat breeds, and 38 camel breeds. Other species in the area comprise 22 cattle breeds, 9 horse breeds, and 3 buffalo breeds (AFED, 2011). Despite this wealth of animal genetic resources, the productivity of meat and milk in the Arab countries is considered low for many reasons such as the lack of significant genetic improvement programs, poor production systems, and the mismanagement of natural resources, particularly water and rangelands (AFED, 2011).

Livestock production in these countries is limited by the distribution of production systems: up to 90% of rangelands are located in arid or semiarid regions such as the semi-deserts in the Arabian Peninsula, and the semiarid steppe or *Badia* in Syria (FAO, 2012). The traditional agropastoral system relies on natural pastures and animal mobility in order to respond to changes in water and feed resources, diseases, droughts and other environmental hardships. However, this system has been facing increasing pressures in the past decades varying from land degradation and increased population to absence of rangeland management policies.

According to USDA (2013) “feed constitutes the major cost of livestock operations, especially in the Arab countries where local feed production is limited and costly. Given the scarcity of arable [lands] in most of [these] countries, there’s a challenging choice

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to be made between using the land for human food production or for animal feed. Feed production in the region is mostly rainfed with low productivity. Attempts to increase local feed production through irrigation have resulted in heavy drainage of the non-renewable water resources thus prompting the termination of such programs in countries where the water reserves have been depleted, such as in Saudi Arabia.”

The population in the Arab countries is expected to maintain a rising growth rate, becoming increasingly urban and consuming more animal products. Hence, in order to meet the growing demand on animal products, increasing livestock production will be challenging. According to the report on climate change in the Middle East published by Brown and Crawford (2009), climate models are predicting a hotter, drier and less predictable climate. These changes will have a series of consequences in the region, especially on agriculture. Elasha (2010) describes the “projected effects of global warming on the Arab countries: Temperatures could increase by 4°C in some countries with a decrease in rainfall of more than 30%, thus making the area threatened by desiccation. Naturally, this will affect the agricultural yields which are expected to decrease by 21%, with a decrease in value of as much as 40% in some Arab countries.”

Agricultural policies in the Arab region until 1997 were generally centered on self-sufficiency and characterized by a lack of coordination and integration within a unified Arab framework, leading to weak trade and poor inter-Arab agricultural investments. These arbitrary policies affected the livestock subsector which was also put under the pressure of an increasing demand for animal products linked to the rapid growth in wealth and population numbers. Consequently, Arab countries introduced policies to increase production to meet the rising demand and to alleviate the effect of sporadic drought and disease on the most vulnerable producers. These policies took into account feed and animal subsidies, pasture restoration and access to grazing lands in Syria, and improved veterinary services and financial assistance for the acquisition of modern technologies and investment in infrastructure like in Syria and Morocco (AOAD 2008). However, they failed to achieve the desired objective and led to an imbalance between resources – especially feed – and livestock populations and consequently a high dependence on government subsidies “which aggravated the vulnerability of the rural livestock farmers to poverty and food insecurity and has created an economically and socially delicate balance with constant threat of strife over water and land resources within and across countries.”

CASE STUDY OF BEKAA VALLEY

Pastoralism constitutes an important part of the Lebanese patrimonial heritage especially of the rural communities mainly by maintaining close social relations between

the different generations and sustaining the livelihoods of these populations. Small-ruminant keepers in Lebanon are shepherds living in marginal areas, where milk and meat products constitute a major source of living for them. Goat and sheep production relies on pastures, whereas cattle and pigs (found in fewer numbers) are mainly bred in farms. FAO (2015) estimates that almost 60% of livestock farmers in Lebanon depend on dairy animals as their main source of income.

The adopted farming system is the centuries' old extensive and traditional pastoral system, conducted on natural pastures by roaming flocks. Flocks are in transhumance between the highlands and the coastal zones to ensure access to feed during the different seasons of the year. According to a survey conducted by Hamadeh et al. (2007), there is a rising trend nowadays in the entire Bekaa area toward a pastoral system based on rented labor enabling the owners of small flocks to practice other activities or jobs. This is one major factor threatening the social aspect of pastoralism in Lebanon and leading to the extinction of the various forms of traditional sharing.

National herd numbers

According to official figures (MoA 2005; 2007; 2010), the Lebanese small-ruminant flock witnessed fluctuations in its numbers (Figure 1). A marked drop was noted in 2006 after the Israeli attack on Lebanon, figures increased in 2007 to significantly decrease again in 2010. Following the Syrian crisis in 2010, numbers rose once more because of the cross-border animal movements (estimated at 60%). Refugees who had fled Syria brought along large numbers of unvaccinated animals putting at risk the health of 70,000 (local) cows and around 900,000 (local) sheep and goats (FAO, 2015). Other reasons contributed to the increase in livestock population, especially the support of international development agencies, which provided vaccines, drugs, veterinary services and feed to around 900 small-scale livestock farmers (mainly in North Lebanon) thus encouraging them to buy more animals (UNDP, 2014).

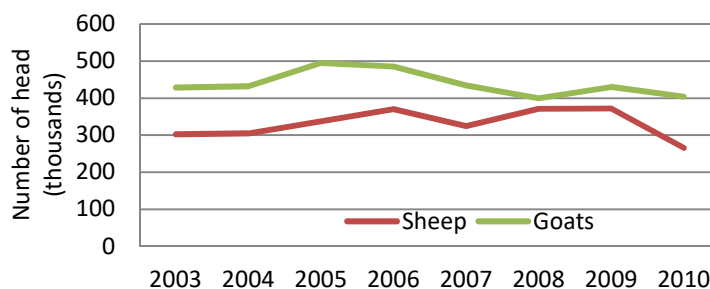


Figure 1: Evolution of small-ruminant flocks from 2003 to 2010. Source: Compiled from MoA 2005; 2007; 2010

Main pastures and distribution

Permanent pastures are almost absent in Lebanon. They only cover 16,000 hectares which is about 15% of the country's surface area. Seasonal grasslands are unevenly distributed and mainly located on the mountain tops and in Bekaa northern prairies (Gintzbürger et al., 2006). They heavily depend on precipitation, rainfall distribution and temperature. Hence, shepherds mostly rely on woodlands and forests to feed their animals, and they depend less on crop residues and feed supplement (Asmar, 2011). However, the changing weather with decreased precipitation and rising temperatures will make it harder to find grazing pastures; shepherds will tend to rely more on feed supplements and feed blocks which could jeopardize the resilience of these production systems to climate change, since feed is constantly offered to animals irrespective to the availability of pastures (Enne et al., 2004).

Rangelands cover 50% of Akkar lands and constitute the major pastures of the North. According to Srour (2006), the large flocks in North Lebanon are in seminomadic systems depending more on meat production as their main source of income, whereas the intensified small-ruminant production systems have milk production as their major source of living. In Mount Lebanon, the terraced hills are the home for small-ruminant production in this area. The borders of the Shouf Cedar Biosphere Reserve (SCBR) include two major grazing sites (Abi-Said, 2004) and the southern prolongation of Mount Lebanon and Anti-Lebanon Mountains constitutes the major pastures of South Lebanon including the Caza of Nabatieh. This part of the mountain is characterized by dry hills and still contains today mines from the Israeli occupation, which present a danger to the shepherds and their flocks (Institut de l'Élevage, 2003). Finally, the Bekaa Valley and its surrounding mountains account for 40% of the country's grazing lands of which 30% to 40% consist of common lands that ensure 20% to 30% of the animals' diet (Hamadeh, 2002).

Bekaa, center of small-ruminant production

The Bekaa Valley covers about one third of Lebanon and receives precipitations of 230 mm and 610 mm in its northern and central parts, respectively. In this area, small-ruminant systems mainly rely on pastures and rangelands during spring and summer, but also on crop residues as a source of feed (Srour, 2006). The Bekaa Valley holds the largest number of small ruminants with about 50% and 74% of the total goat and sheep national flocks, respectively (MoA/FAO, 2009). The northern part of the valley is characterized by a semiarid climate. It includes the main pastoral communities of Aarsal and Hermel who own the largest flocks. However, 65% of Aarsal shepherds are landless (Srour, 2006) and highly depend on ranges to secure more than 45% of the animal feed (Hamadeh et al., 1995). Hermel's shepherds also highly rely on transhumance and their

grazing routes reach 200–300 kilometers (Srouf, 2006). The absence of permanent pastures has led the pastoralists to feed their flocks on forest resources, especially after the agricultural reform in Syria which restricted the grazing land access from the neighboring country (Hamadeh et al., 1993).

The indigenous breeds of Awassi sheep and Baladi goats are highly adapted to semiarid environments and are recognized for their ability to withstand high ambient temperatures and tolerate water deprivation (Jaber et al., 2004). The most common systems in goat keeping are sedentary with vertical transhumance, whereas seminomadism and horizontal transhumance are usually adopted in sheep rearing. This difference is due to the capability of the goat to reach the most marginal and difficult areas that no other ruminant can value, probably making this animal easier and cheaper to rear.

Home to nearly half of the national small-ruminant flock, Bekaa is the focal point of most studies conducted in order to understand the pastoral systems in Lebanon, their types and livelihood strategies. Several research and development projects conducted by the American University of Beirut (AUB) considered Aarsal – a marginal village of 36,000 hectares on the western slopes of the Anti-Lebanon Mountains – as a case study since the Aarsali shepherds own the largest population of small ruminants (around 60,000 head of sheep and goats; Dick, 2003). The fact that this region is more prone to climate variability impacts attracted researchers and students to investigate and identify the strategies of adaptation of small-ruminant systems to climate constraints.

A farming system analysis of Aarsal (Hamadeh et al., 1999) revealed the existence of six systems. Among them two had minimal small-ruminant activities and secured their incomes either from fruit and cereal production or exclusively from off-farm activities (Table 1).

The results showed that although newly established, fruit production started to contribute considerably to the income of these communities. Facing environmental constraints and property right conflicts, herders changed their livelihood strategies and sought income diversification. Their new adopted strategies relied more on pasture grazing, reducing feed quantities and flock size, and minimizing flock movements (Dick, 2003). It was clearly shown that the farming systems in Aarsal were shifting toward a more sedentary system with rain-fed fruit production away from traditional agricultural crops such as cereals (Hamadeh et al., 1999).

A more in-depth investigation into the small-ruminant systems of the area identified four systems (Hamadeh et al., 1999): a seminomadic system moving seasonally in search of native pastures; a semisedentary system with flocks grazing on mountain pastures in spring and summer; a semisedentary system feeding on crop residues in summer; and a sedentary system relying on the common rangelands and pastures of the village. A comparative study of the Aarsali farming systems between 1997 and 2002 showed

a decrease in flock numbers and an increase in stocking rates in the pastures with a maintained sheep to goat ratio enabling the flocks to use pastures more effectively (Dick, 2003). Furthermore, in 2002, the sedentary or settled system did not exist anymore; farmers sold their entire flocks and shifted to other activities in order to sustain their livelihoods.

Table 1: Aarsal farming systems

	System activities	Main activities contributing to income
1	Fruit and cereal production with minimal small-ruminant activities	Off-farm activities supplemented with fruit production
2	Small-scale cereal and fruit production with minimal small-ruminant activities	Off-farm activities exclusively (90%)
3	Medium-scale cereals and fruits	Fruit production
4	Cereals, fruits and medium-sized flocks	Animal production (80%) supplemented with off-farm activities and cereals
5	Large flocks and small crop production	Animal production (90%)
6	Fruit production on a large scale	Fruit production

Source: Hamadeh et al., 1999

Similar herd management strategies have been recently observed in West Bekaa (Chedid et al., 2018). Facing climate variability (mainly decreased precipitation) and an unsettled political situation, shepherds decreased their flock numbers and limited their mobility to rented pastures around their villages (winter spent in the mountain forests and summer on crop residues in the plain). However, to cope with the limited pasture productivity and maintain stable milk production, they supplemented their animals with more feed.

Deficiencies and challenges of pastoral systems

The different challenges facing pastoralism that were observed in the Bekaa case studies can be representative of the situation at national level. They are summarized hereafter.

Lack of policies and laws related to pastoralism and land tenure

Land tenure and the form of ownership significantly affect the opportunities to exploit natural resources and to decide where and how to expand the land (Zurayk et al., 2001; Enne et al., 2004). This is the reason why farmers, who have access to only marginal

lands, or who temporarily or illegally use the land, practice activities irrespective of land degradation risks (Zurayk et al., 2001).

In Lebanon, national policies on land use and land tenure relevant to pasture management and preservation are either very old (outdated) or do not exist. As most of the shepherds do not own land, they acquire leases and use public and/or private forest areas and rangelands, and crop residues to feed their animals (Hosri and Nehme, 2006; Asmar, 2011). This, added to feed supplement expenses, represents a major limitation to the profitability and hence the sustainability of these systems (Hamadeh et al., 2001).

The main problems of land ownership in Lebanon are related to land tenure insecurity especially for poor people and farmers, unclear overlapping land rights caused by legal ambiguity or practices, land encroachment, illegal settlers, who cannot be stopped by farmers in the absence of legal protection, and finally the absence of land surveys either by municipalities or local authorities (Hamadeh et al., 2005). These reasons as well as the lack of regulations have weakened the traditional institutions and the system of communal range management in maintaining common lands.

Urbanization and rural migration

The increasing population combined with a decrease in land and resources is a major challenge that pastoralism faces worldwide. Pastoral systems are mainly affected by the growing demography because of the lack of techniques to increase sustainably pasture productivity (Nori et al., 2008). The increased population, especially at the expense of pastures, obstructs the flexibility of animal movements, leading to the concentration of animal stocks on the same lands, and consequently causing overuse of these lands. The imbalance in animal distribution in Lebanon has led to overgrazing and deterioration of pastures in areas with high animal density, to increased biomass production in areas without flocks, and subsequently to increased risks and occurrences of fires.

The rural population in Lebanon declined from 58.5% of the total population in 1960 (Abi Samra, 2010) to 26.3% in 1980, and to 12.9% in 2010, and it is expected to drop to 8.8% in 2050 (UN, 2011). This decrease is most probably linked to the lack of diversification in rural economies, and inadequate infrastructures and social services in marginal areas.

Crop encroachment

The conversion of marginal lands to crops is preventing their use as rangelands. The investments in the marginal lands, e.g. planting rain-fed fruit trees, do not take into account the long-term effect of these activities such as soil erosion, which will decrease the quality and quantity of pastures and eventually lead to animal loss and a reduction

in pastoralists' incomes (Hamadeh, 2002). This is the case of Aarsal, which used to be a traditional agropastoral area, where the plantation of 1.5 million of cherry and apricot trees resulted in the fragmentation of the land and hence the loss of rangelands (Chahine, 1995). Flocks were forced to seek new pastures, sometimes to graze in newly established orchards, which resulted in conflicts between shepherds and orchard growers, and ended in a sharp drop in the number of small ruminants – from 90,000 to 60,000 (Zurayk et al., 2001).

Deforestation and overgrazing

Pastoralism is a balanced use of the dry lands enabling a productive livelihood in the roughest areas of the world (Nassef et al., 2009). Despite their environmental contribution, pastoralists have always been accused of being harmful to the environment: accusation of overgrazing and desertification, and more recently of methane emissions and even low feed conversion rates (FAO, 2001). Rangelands in Lebanon, which constitute graze lands for agropastoral ruminant production, are being overgrazed, and if unsustainable grazing persists, these lands will lose their biodiversity (MoE, 2009). The Lebanese ecosystems have frequently been subject to deforestation caused by fire, grazing and quarrying. Overgrazing threatens the regeneration of indigenous tree species such as juniper and inhibits the restoration of biodiversity (MOE/UNDP, 2011). In the past, grazing in Lebanon used to be controlled by traditional grazing laws and rights taking into consideration the carrying capacity of the lands estimated at one head of sheep and goat per hectare on good rangelands and down to 0.2 head/ha on marginal lands. According to studies, the stocking capacity is exceeding 20%–30% on Mount Lebanon and Anti-Lebanon slopes; in Northern Bekaa, a carrying capacity of 10 head/ha was documented, i.e. about seven times more the acceptable stocking rate (Hamadeh, 2002). This may be due to a pressure increase on the land, caused by the decline in pasture areas and the impoverishment of the rangelands. Concurrently, El-Awar et al. (2007) report a decline in biomass production in the grazing systems of the semiarid regions in Lebanon when stocking rates increase from 0 to 4 sheep/ha. They also conclude that a resting period is mandatory in order to sustain the production of the pasture while limiting nutrient loss.

Hima in Arabic means 'protected area' and it is a traditional way to protect natural resources and manage them in a sustainable way. In order to protect the Lebanese forests, the Ministry of Environment designated many sites as national *Hima* and imposed laws banning grazing and other activities within a 500-meter radius. A successful story on controlling grazing in a natural reserve is the case of the establishment of Shouf Cedar Biosphere Reserve (SCBR), which limited grazing to a buffer zone that was created around the reserve and set rules regarding grazing times and stocking rates thus allowing vegetation replenishment and biodiversity preservation (Abi-Said, 2004).

Lack of technical skills and data for range management

One main reason which prevents the pastoral system from improving is that herders have no access to updated knowledge and technical expertise. They also lack access to veterinary services and credit facilities which could help improve their production (Asmar, 2011). Despite the establishment of a rangeland management unit in the Ministry of Agriculture, the extension service related to rangeland management and pastoralism seems to be inefficient or missing (Hamadeh, 2002). National data on the status of pastures, and their actual and potential carrying capacities and use do not exist; appropriate rangeland management strategies and mapping, as well as environmental data are also unavailable (MoE and UNDP, 2011; Hamadeh, 2002; Hosri and Nehme, 2006). Moreover, there is no serious interest to date in studying rangelands in order to develop sustainable management policies. Studying grazing systems should take into account i) the dynamics of rangeland problems at local and national levels, ii) the main factors behind the sustainability of traditional pastoral systems in Lebanon, iii) the role of the various stakeholders in the subsector, iv) the indigenous knowledge of pastoralism, and v) the encouragement and enhancement of the coordination between public and private institutions in projects related to rangeland and pastoralism (Hamadeh, 2002).

Climate variability

Evidence shows that pastoralism can perform well under the prevailing context of climate variability in the presence of adequate policies, investments and support (Nassef et al., 2009). The weather forecast for the Middle East announces changes in the distribution, quantity and frequency of precipitations that will affect grazing periods and pasture quality, replacing species composition by woody and less palatable plants (MoE and UNDP, 2011). The role of small ruminants as a tool in fire prevention and management needs to be highlighted, especially with increasing forest fire incidents in Lebanon, during the past years. As precipitation declines, finding pasture land for livestock becomes harder. However, since climatic change will make it harder to grow cereals on marginal lands in arid regions, only pastoralists will be able to take over these areas as it seems to be the case in some countries of the Maghreb and Mashreq (Nori et al., 2008). To date, no studies have yet revealed any effect of climate variability on Lebanon's rangeland (MoE and UNDP, 2011). Recent literature on the subject is still based on speculations and predictions.

Recommendations

Pastoralism is a lifestyle of subsistence embedded in an ecosystem in which the social, economic and political organization is complex. Policy makers are usually unaware of the constraints that pastoral communities face in order to sustain their livelihoods.

Hence these groups are marginalized and not often involved in decision making regarding the development of efficient governmental programs for rangelands management.

To be successful, community-based rangeland management should, on one hand, assist rural communes in better managing their lands, pastures, animals and other resources. On the other hand, it should promote cross-communities resource sharing and involve the communities in decision making through participatory approaches. Sustainable pasture management contributes to the preservation of the ecosystem and could be carried out by supporting indigenous knowledge and reviving old traditions. However, this cannot succeed without adequate policies and a national strategy or action plan.

Technical solutions

Reduce pressure on pastures

Controlling the flock size is a common practice in pastoral communities in order to adapt to emerging constraints or changes. Shepherds reduce the number of their animals when natural resources become scarce. However, enforcing limits on the flock size according to the pasture carrying capacity, complemented with capacity building on flock management and flock health are prerequisite to achieving a rational stocking rate and help reduce pressure on pastures, while increasing flock productivity and allowing grass regrowth.

Improve degraded pastures by reseeding with native legumes and grass

Reseeding grasslands with wild and native legume varieties was found to be an efficient way to 'rehabilitate' pastures as long as it is complemented with a regulated grazing program (rotational grazing and respected carrying capacity). Sown forage decreases feed supplementation and helps increase the carrying capacity of the pasture as the quantity and quality of feed increase. In this context, native legumes should be collected, their seeds multiplied and used to regenerate degraded rangelands (Hamadeh, 2002). Moreover, intercropping legumes with fruit trees is a source of feed to animals, especially in the dry months of the year (Darwish and Faour, 2008), and it plays an important role in nitrogen fixation in the soil and water preservation. However, it is necessary to secure the production for these legumes, probably through government regulation (Hamadeh, 2002).

Plant fodder shrubs

Shrubs species that are resistant to drought, adapted to the local soil type and rich in biomass can be planted in order to compensate the deficit in pastures. These could include spineless species of cactus (*Opuntia ficus-indica*) that were introduced in Tunisia and Egypt, and species of saltbush (*Atriplex nummularia* and *Atriplex halimus*) adapted

to marginal lands (Hamadeh, 2002). The only constraint would be flock management in rehabilitated ranges and ensuring adequate nurseries and multiplication techniques (Nefzaoui et al., 2012).

Establish pastoralists' cooperatives

One way for pastoral communities to ensure that they are heard is to organize themselves into cooperatives. The establishment of a shepherd cooperative in Aarsal is a fine example: shepherds joined forces in order to improve small-ruminant production in their region by facilitating technology and knowledge transfer between them, and providing market access. The cooperative, with the financial support of the German International Development Cooperation Agency (GTZ) helped the herders rehabilitate a pilot range in order to showcase how range preservation and rehabilitation can help control desertification (Hamadeh et al., 2005).

Policy level

Land tenure is one of the main reasons leading to the breakdown of the traditional agropastoral system in Lebanon. Water right and access to water also play a crucial role in fragmenting this system, especially in the absence of regulations that control water distribution and use, and when the lands that are grazed by the flocks are far from water sources. Nevertheless, local communities (shepherds and land owners), local authorities and non-governmental organizations should be involved in decision making regarding rangeland management, and regulations should be complemented by capacity building for flock keepers and resource management, animal health, etc. (Hamadeh, 2002; Srour, 2006).

The National Action Plan to Control Desertification (MoA/NAP, 2003) laid the basic outlines for a national action program. It aimed to promote sustainable management of grazing and rangelands and for empowerment of the subsector such as establishing a comprehensive legislative and policy framework, developing a national rangeland strategy, supporting the development of a proper land tenure system, building the capacity of livestock holders on relevant subjects and through pilot models, and supporting the systems through research and studies. However, none of this has been implemented to date.

The reform of the grazing subsector should start with an assessment of rangelands at national level followed by a national strategy for the conservation and management of the pastures with the help of all stakeholders, e.g. responsible representatives of pastoral communities, rural land institutions, policy makers (Hamadeh et al., 2005). The extension service of the Ministry of Agriculture should be strengthened and the capacity of shepherds would thus be built with training and follow-up. As also mentioned in

the National Action Plan, showcase plots on pasture rehabilitation should complement technical training. Land legislation and policies relevant to rangeland management should be revised to specify clearly the responsibilities over its protection and grazing capacities and programming.

CONCLUSION

Meeting the demand of the constantly growing Arab population is a challenge for the Arab livestock subsector. Unfavorable policies and a harsh environment put high pressure on the prevalent nomadic and seminomadic livestock systems leading to low animal productivity and rangeland degradation in the absence of support services and infrastructure. However, pastoralism remains a sustainable form of livestock production capable of filling a large part of the demand in spite of the scarce natural resources and climate variability. Proper public policies and supporting services are needed to maintain these production systems and preserve the livelihood of a vast majority of rural Arab communities.

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Livestock and animal sectors in Brittany

A look at three-quarters of a century of change

Jean Lossouarn¹

INTRODUCTION

Brittany, the western peninsula of continental France, became the first French breeding area at the end of the 20th century, and one of the first in the European Union (EU). According to the French Regional Office of Food, Agriculture and Forestry (DRAAF 2013; 2017a; 2017b), with 5.6% of the French utilized agricultural area (UAA), it was, in 2015, first for dairy products (22% of national deliveries), third for beef cattle (11%), first for veal calves (22%), first for slaughtered tonnages (21% of cattle and 37% of calves), first for pig production (56% of national volumes), first for broilers (about one third of the national production, in rapid evolution, see below), first for eggs (40% of eggs for consumption, and 42% of eggs for hatching), and produced 38% of compound feed for livestock. But this was not always the case, far from it. It is therefore interesting to analyze the conditions and modalities of this spectacular development to approach the limits and counterparties, to try to draw lessons that may be worthwhile in other contexts.

GLANCES ON THE BRETON CONTEXT, ITS ORIGINALITY

At the end of World War II, after four years of German occupation, in France, Brittany was a poorly industrialized region, mainly agricultural and maritime. Primary school geography textbooks presented it as "a poor and backward region".

A linguistic boundary distinguishes Lower Brittany, the Western part where the Breton language (Celtic) is still very dominant, from Upper Brittany, the Eastern part where the Gallo (a Roman dialect) and more and more French are spoken.

The relief is peneplains and hills. The basins of Rennes, Loudéac, Carhaix, on one hand, the coastal plains, on the other hand, have silty soils with good agricultural potential. The hills form two chains oriented east-west, Black Mountains and Monts d'Arrée, which peaks at 384 meters. Their geological base is granitic or shale, and the corresponding shallow and initially acidic soils have much less potential. It is usual to oppose

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the Argoat of inland Brittany, historically very poor, and the Armor or coastal area significantly richer. The climate is mild and humid. The average annual rainfall is between 800 and 1200 millimeters, heavier and steady in the west with about 200 days of rain in Brest.

At the end of World War II, the rural population is dense, large families are common with six to eight children. The agrarian structures are very small: the farms are family owned or rented. Their almost exclusive vocation is subsistence agriculture and/or small market production. The main annual expense, in an economy, which is still slightly monetarized, is the rent of the land (farm rent). Except in coastal areas where the tendency to grow vegetables is well marked, locally long-standing, it is 'the golden belt', the crop livestock systems largely predominate (Canévet, 1992; Le Tallec, 2006): cereals to feed the family (wheat, rye, buckwheat) and animals (oats for horses), vegetables for humans and/or animals (potatoes, beets, rutabagas, turnips...), forage crops (purple clover). Natural grasslands are rare: mainly meadows in valley bottoms, often very humid and not accessible to carts. On the other hand, especially inland, the heaths still constitute a vast biome dominated by gorse, broom, heather, ferns... Agriculture also values them: gorse for the horses, grazing for the cattle, litter for all the animals. On the small cultivated areas, land use is intensive, with a general practice of stolen crops; "Almost three quarters of the stolen crops in France are found in Brittany" (Dumont, 1956).

CHANGES

At the end of World War II starts a set of processes that gradually lead to a profound mutation of crops and livestock, more broadly of society, in Brittany. The war, the foreign occupation, the resistance and the liberation were a trauma and a major political, ideological and cultural shock. The roots of a deep questioning took place on this land. Gradually, younger generations no longer accepted poverty as an assigned destiny. Moreover, a set of factors contributes to accelerate society evolution, in particular:

- The progress of education. School has been free of charge, secular, and mandatory since 1881. Illiteracy has considerably declined, in a spectacular way in Lower Brittany, where intense competition opposes the public school and the religious institutions. French language is now known to all younger generations, removing a major obstacle to out-of-region emigration.

- The new political and cultural balances. The weight of the Catholic religion, which for centuries has marked the whole functioning of society particularly in rural areas, is strongly contested by new political forces. A lively competition results in a double series of consequences, for what concerns us here. On one hand, a profound renewal of certain forms of life of the church is observed, long before Vatican II proclaims 'The

Aggiornamento', one is thinking in particular of the life of the Christian Agricultural Youth (*Jeunesse agricole chrétienne*), which plays a major role in the modernization of French agriculture (Canévet, 1992; Fort, 2001; Cornette, 2015). On the other hand, agricultural cooperatives emerge, vying with those ideologically close to the church. A spirit of competition is established, providing decades of source of emulation and creativity. Thus, for example, the Union of Cooperatives (UNICOPA) has competed with the Cooperative of Landerneau. It became COOPAGRI then TRISKALIA. This development of a dual network of cooperatives does not stifle the presence of private operators, some displaying remarkable dynamism. New organizations also play a major role in changing attitudes and technical progress in agriculture: agricultural syndicates, agricultural technical study centers (CETA), which experiment with groups of farms in new techniques, while chambers of agriculture are developing their extension and advisory activities. Canévet (1992) refers to this aspect as the "modernist social bloc of the 1960s". At the beginning of the 1960s agricultural high schools were created; they have been training new generations of farmers and breeders. The spectacular improvement in transport infrastructures links Brittany better and better to the entire French and soon European economy. All farms are finally served by motor roads which facilitate the access to production factors: equipment, fertilizers, animal feeds, and marketing. Soils, mainly acidic, highly benefit from sea limestone amendments: maerl (lithothamnion debris) and trez (sand shellfish), as slag dephosphorization, fertilizer, which besides phosphoric acid (P_2O_5) also bring 40% of calcium oxide.

- The general movement of society, of course. Migrant Bretons, particularly to Paris area, regularly return to their native land (paid holidays date back to 1936), bringing new values, giving new views. The electrification of the countryside ends in the 1960s, bringing broadcasting and soon television, opening the era of mass media and information access, and also facilitating labor and productivity in agriculture, for example mechanical milking.

- The political level. It is worth pointing out the Breton originality represented by the Committee of Study and Linking Bretons Interests (CELIB), which for two decades brought together the elected and political leaders of the different political parties, with the notorious exception of the communists. We owe it the building of the free highway in the 1970s and 1980s.

NEW FRAMEWORK AND ECONOMIC CONTEXT OF AGRICULTURE

At the end of the war, a national objective is to feed the population who has suffered serious deprivation. Proactive national policies aim at rapidly increasing production: aids to mechanization, extension incentives, market organization (FORMA: Agricultural Market Organization and Regulation Fund) and intervention companies, interest rate

subsidies, etc. The agricultural orientation laws of 1960 and 1962 confirm this policy of accelerated modernization and transformation of agriculture, with a view to setting up the European Common Agricultural Market. Simultaneously, the country reconstruction and its rapid industrial development (1st French Plan for the economic development) require workers, 'aspiring' young generations of rural origin, with a double consequence that will have a major impact in Brittany: reduction of the rural population and concomitant increase in the surface area of the farms.

The introduction of the European Economic Community (EEC) between the six signatory countries of the Treaty of Rome in 1957 led to the European Common Agricultural Market in the early 1960s. The initial common agricultural policy (CAP) has a central objective of food self-sufficiency, transposing in this new framework the demand previously mentioned for France. For this, it has a set of tools:

- Objective prices with support mechanisms (intervention capacities on the markets of the European Agricultural Guidance and Guarantee Fund [EAGGF]), within the framework of common market organizations (CMOS) for major types of production (e.g. cereals, milk, beef, pig meat).
- Border protection, with a common customs tariff and a variable sampling mechanism, bringing imported products to internal price levels.
- A mechanism of export refunds, which brings the prices of European products, as a general rule higher, to the level of world prices.

In two decades, this set of policies structurally enables EEC – in the meantime enlarged and having become the European Union (EU) by the Maastricht Treaty of 1992 – to export agricultural commodities within the global market.

RADICAL CHANGES IN CROP AND LIVESTOCK PRODUCTION

In this political, economic and cultural context, the Breton agriculture has experienced a very rapid and spectacular mutation. The results are as follows:

- Expansion of farms correlated with their reduction in number; 200,000 farms with an average 10 hectares of utilized agricultural area in 1950, 118,500 with 15.5 ha in 1980, 82,600 with 22.5 ha in 1990 (Canévet, 1992). The general census of 2010 reports that Brittany hosts 26,000 farms, with an average utilized agricultural area of 60 hectares (DRAAF, 2017b).
- Strong extension of the cultivated land by the clearing of a large part of the rangeland.
- Rapid mechanization and motorization of farms in the 1950s and 1960s.

- Huge intensification of production, enabled by a set of factors, i.e. the ratio of land to work that remains low, the rapid improvement of the fertility of many soils by calcium amendments and chemical fertilizers, a favorable context for the development of soil-less rearing – notably poultry – by making work available in small farms.

- A concomitant movement of farm specialization. The historically dominant system of crop and livestock integration has given way to specialized systems, mainly vegetables in coastal areas, and livestock breeding inland with the rapid expansion of cultivated grass, followed by maize for silage.

However, changes do not only apply to farms. It is essential to consider also what is happening upline and downline. Upline, a powerful animal feed industry emerges, with private or cooperative actors. The growth concerns initially the poultry industry, and is followed by other animal species, i.e. swine, dairy cows, calves and beef cattle. Artificial insemination is concurrently developed by the cooperatives. Downline, the rapid expansion of the milk collection infrastructure since the 1950s allows the creation of a powerful industry in a region, which has no cheese tradition and where butter is made at the farm for family consumption, its small surplus sold to traders, and skim milk used for family consumption and to feed the animals, mainly swine. In the swine and beef sectors, producer groups are set up in the 1960s, removing a marketing monopoly from private traders, whereas in poultry farming an integrated organization is introduced.

QUICK GLANCE BY VALUE CHAIN

A value chain approach is the best way to understand the context dynamics, especially using two value chain concepts, complementary and very operational, of the sectors (Lossouarn, 2003):

- The value chain of a product, or group of products, is a collection of material flows which involve economic agents performing complementary and interdependent functions in order to contribute to the product which responds to a demand.

- The value chain of a product or group of products consists of a set of technical operations carried out by technical agents who implement strategies.

The animal sector, including production and products, is in an economic and social context. Consequently, its organization is changing according to the dynamics in the two contexts. Especially scientific and technical innovations (e.g. genetics, feeding, processing) impact the diverse animal subsectors. The deep changes in society (e.g. urbanization, living standards and human needs) also have significant effects on the animal sector and subsectors, as well as the major changes in marketing and consumption (e.g. supermarkets, catering out of home, internet).

In the dairy subsector, the productivity gains are impressive. The farms grow and specialize, and in less than two decades they have replaced the mixed local breeds (Breton Black Pie, Armorican, Froment du Leon) by more productive breeds: Norman and soon mostly Frisian Holstein, whose potential is fully valued with the use of new forages. Simultaneously, there have been significant improvements in the training of breeders and the development of technical support. The growth of the industrial dairy subsector followed, powerfully driven by a sharp rise in quantity and diversity of the consumed products. The result is a huge development of cheese production without protected designation of origin, for example 'Emmental Breton'.

The EU applied milk quotas from 1984 to 2015. This original European policy states that each producer has a "right to produce", but any overrun is sanctioned in order to avoid weakening the entire European dairy system. In 1983, Brittany had 1,342,000 dairy cows in 66,000 farms. In 2014, there were 751,000 dairy cows in 12,000 farms. The annual milk yield per cow rose from 4100 to 7200 liters in the same periods (DRAAF, 2015a).

In Brittany calves used to stay with cows up to the age of five to six weeks, when they were sold for the specific French veal market. There was also a well-established tradition of producing fat young bulls, especially of the Armorican breed, slaughtered by the age of two years and at 500-kilogram live weight. This model changed drastically. Linked to the strong development of the dairy industry and based on the demand from the French gastronomy for veal, an original production chain was set up. Young veal calves are nowadays produced in specialized farms, which were a few dozens initially, then up to several hundreds. They operate in homogeneous batches: animals of the same age, of the same breed, consuming the same compound feed (based on no-fat milk powder and vegetable fat). It is a soilless production. The three-week calves enter simultaneously in the unit. They stay around six months, and they are slaughtered at the same time. These units depend on an integration framework based on contacts between breeders and the agribusiness firm which buys and brings the three-week calves to the workshop, provides the feed, controls the production, pick-ups and slaughters the animals at the end of the period, and eventually markets the meat. It is a lucrative additional job for many farmers.

Renewing with the local tradition, the production of young bulls has grown considerably, the marketing being carried out in a very large majority of cases by cooperatives, thus escaping traditional trading. Cooperatives constitute the units of young males for fattening, and provide technical support. Dairy males were very predominant before the dairy quotas (1984). These rapidly induce the contraction of the dairy herd as previously mentioned, thus reducing the number of calves. The situation has encouraged producers to supply also beef-breed calves, essentially just after weaning at around eight months old, from the central regions of France. At the same time, due to milk production stagnation, beef specialized farms (Charolais and Limousine) have also appeared in

Brittany; the Brittany beef herd comprised around 130,000 cows in 2014 (DRAAF, 2015b). Trading practices are also renewed: the first French market using electronic auction opens at Guerlesquin in 1972.

A network of modern slaughterhouses, the most important and efficient in France, has been established to promote this beef production. In 2014, 60% of their wholesale cattle supply came from other French regions (DRAAF, 2015b).

Pig production also radically changed by the 1960s. It used to be complementary to dairy production, by valuing skimmed milk in dietary rations entirely produced on the farm. Specialized farms emerged. Some produced and fattened young pigs, others specialized in farrowing or fattening. The size of these farms steadily increased. They are organized in cooperatives, specialized in pig production or not, and they benefit from the remarkable dynamism brought about by the French restructuring of the 1970s. Thus, the capacity of pig farms has progressively increased, while the number of farms has decreased. In 2015, there were approximately 3000 specialized pig farms, with a dominant farrowing to fattening activity, and on average 200 sows. The geographical concentration is spectacular, especially in the east of the Côtes-d'Armor department around Lamballe town, and in the north of the Finistère department. The cooperatives manage the genetic aspects and market fattened pigs. The animal feed industry provides the bulk of the feed, although some farms have kept feed production on the farm, with the purchase of all or part of the raw materials, especially the proteins, mostly soybeans. The Breton Pork Market, created in 1972, has become the reference market throughout France and sets the price every Monday and Thursday. Transactions are made through electronic auctions, from a catalog, without the presence of animals. A cooperative of producers of the Lamballe region (COOPERL) is the most complete example of this structuring of the Breton pork industry: First French group, it is present across the value chain with its own tools, such as feed factories, breeding schemes, producers' groups and marketing, slaughterhouses, and is able to cover all necessary services and benefits.

In poultry production, specialized farms for eggs or broilers were set up in the 1950s, initially with a few hundred birds, using existing buildings and the abundant labor in family farms. The two major products, eggs and broilers, were soon after integrated in a structure with all the production factors such as feed factories, hatcheries, farms, producer groups, packing centers, specific slaughterhouses, workshops for elaborated products, companies specializing in building poultry structures, supply of equipment. The place of the egg chain in France was mentioned above. DRAAF (2013) reports a productivity of almost 298 eggs per hen per year.

Benefitting from the European policy mainly with regard to export refunds, two local companies, DOUX based in Chateaulin, and Tilly (then Tilly-SABCO) in Guerlesquin, established themselves in the Middle East market, particularly in Saudi Arabia, where

they provide frozen chickens. These two companies are helped by a powerful regional cluster specializing in the export of broilers, with farms producing batches of several tens of thousands of broilers in an integrated system: the farmer provides buildings and labor, the industry brings the day-old chicks, the compound feed, the technical support, and manages slaughtering and marketing. In 1998 the Breton poultry industry reached 900,000 tons (mainly broilers and turkeys), of which 572,000 were exported, 244,000 to the EU, and 328,000 to other countries.

LIMITS OF THE BRETON SYSTEMS: NEW ISSUES AND CHALLENGES

The general movement of strong intensification in Brittany has gradually produced severe environmental impacts, similar to those faced earlier by European countries after scaling up, especially the Netherlands (Coléou, 1992). Nuisances are mainly odors from the application of pig or poultry manure, damages related to the high level of nitrate in ground waters and consequently the proliferation of green algae on the Brittany coast. This is an emblematic environmental impact with a strong negative effect for local, national and European potential tourists. The analysis showed that, at the turn of the millennium, the raw materials for animal feed imported into the region (cereals from other French regions and soybean from America), mobilized a cropping surface comparable to that of Brittany (Montel, 2001). The balance between the economic growth of the livestock subsector and its environmental impacts gradually became a local development issue (Bonaudo et al., 2009).

Specific policies have been launched to face the environmental problems. The EU Nitrates Directive in 1991 fixed the maximum discharge at 170 kilograms of nitrogen per hectare allowed for spreading. The areas using higher discharges (initially 104 out of the 171 Brittany counties) must adopt drastic measures aiming to: i) stop increasing animal density and in many cases reduce it, and ii) constrain farmers and companies to invest significantly in order to reduce their environmental impacts (e.g. farm upgrading and adaptation, animal waste storage and treatment, very restrictive regulations on manure application). New valuations are explored, such as manure biodigesters. Although not the only one, this has been a major reason for the capping of Breton pork production: a maximum of 26 million pigs slaughtered in 2000 has not been reached since that year; the level for the last years is around 24 million, for a little less than two million tons.

The farming systems of Brittany, like those of France and the EU in general, face the change of societal perspective (Lossouarn, 2011). Health security crises that affected them (e.g. bovine spongiform encephalopathy, avian flu, adulterated milk powders) have been drivers of change. They have paved the way for specialized associations, including some very activist and polemical, as the L214 association (the number of an article in

the French Rural Code). This non-governmental organization especially disseminates videos on social networks showing suffering animals, which have been shot in intensive farms, hatcheries and slaughterhouses where the NGO has broken into. These videos have shocked urban populations already aware by diverse scandals linked to animal production. Furthermore, the distance between urban populations and the animal production units has been strongly growing over the past decades because of diverse factors such as i) the agricultural population has become a small minority in the society, ii) production units must avoid any contact with human population for sanitary reasons, iii) death has become almost invisible in society, whether that of humans in specialized homes for the elderly, or of animals in slaughterhouses, although animal slaughter is a precondition for meat products. Moreover, the urban lifestyle has built an idyllic image of rural animals, usually distanced from real farming. Consequently the intensive system, very dominant in Brittany, is nowadays the most targeted one. In fact, without it, the public cannot access all the factors which explain its very significant and essential contribution to human food and also its limits.

The international context has changed. The EU has expanded to include a set of Central and Eastern European countries with remarkable agricultural potential, and much lower wage costs than those of Western Europe, notably France. The creation of the World Trade Organization in 1994 changed the rules of international trade, condemning European export refunds and variable import levies (Tregaro and Lossouarn, 2002). The Breton poultry companies that had secured an enviable position on the broiler market in the Middle East paid dearly for their procrastination to forecast the day after. The initiative of DOUX group to implant in Brazil, via FRANGOSUL, was faced with the new context of being nearer to feed production, especially soybeans, and low-cost labor, and far from environmental constraints. This did not happen because of other organizational and governance factors specific to Brazil. Losses have been higher than gains. Early 2018, DOUX was sold to a consortium including the French leader in poultry (LDC), TERRENA Cooperative, and the Saudi AL MUNAJEM, a historical DOUX client. TILLY-SABCO, also shut down early 2018. In 2015, Brittany poultry production fell to 540,000 tons, of which 350,000 were broilers, less than the level reached in the 1990s (DRAAF 2016).

Over half a century, the Brittany development based on the strong intensification of animal production was concomitant to the growing food demand of an urban lifestyle based on basic and safe products, as for example the Breton Emmental cheese in France, and the frozen broilers for the Middle East. Nowadays consumption standards are upgraded, especially in the developed world, and this process has started in emerging countries. This trend is inducing an in-depth change in the demand for animal products.

Meat consumption in France and Europe might progressively and slowly decrease, but simultaneously the projections of demographic growth and food consumption in the South and East Mediterranean countries (important markets for France and Europe),

as in other parts of the developing world, clearly indicate that the need for meat products will increase.

According to the concept of ecological intensification (Griffon, 2013), the challenge of animal production systems, and more generally for agriculture is feeding the world (it is far from being won!), reducing their impacts on global warming, integrating the protection of biodiversity, adopting diverse types of robots, agreeing to new lifestyles including the New Technologies of Information and Communication (NTIC), social networks, etc. In this overall vision, Brittany is facing specific new problems.

Firstly, the intergenerational and traditional parent-child transfer of the farm has become more complex in many farms due to high-level investments in land, buildings, equipment, herds, etc. It is especially true for pig and poultry farms. It has begun and it is increasing for dairy farms. In the absence of a historical or cultural reference, new forms of farming must be defined in terms of land ownership, individual and collective investments, work and capacity building, etc., all of which in a sustainable local development way. Secondly, the previously mentioned case of DOUX Company, which has been bought by a local consortium with a global reach, and the recent implantation of SYNUTRA Chinese group in Carhaix town in the dairy sector, in partnership with the French group SODIAAL, are feeding the debate on the local/regional decision-making power.

CONCLUDING REMARKS

This brief overview of the past half-century, in which Brittany has become a very large animal production region, gives some elements of a general scope. The Brittany example suggests that economic development is possible with a coordinated set of adequate and adapted policies. It also highlights the strong integration of agriculture development in complex and changing contexts, especially the urban lifestyle demand, the national and international food supply market, climate change, the globalization of other sectors such as the industry, tourism, culture, etc. Public policies, in their diverse aspects (e.g. economic, social, educational, environmental) are therefore essential. For example, the case of Brittany shows the positive effect of local production protection, in the face of imports, at the beginning of the process for its economic development.

However, as this policy making is carried out at international level, especially regarding trade and environmental issues, it raises new questions. A large part of animal production is in soilless farming systems. Nevertheless, feeding is always provided by farmland, water, solar energy, and manure applications contribute to production. In Brittany, the soil for feeding and the soil for discharge can be very distant. Thus, the local and regional coherence of farming systems have to lead the objectives and strategy of production

and decision-making to avoid social, economic and environmental disasters. In addition to geographical distances, the transfers of food and industrial commodities (e.g. energy, minerals, etc.) question the advantage of economic liberalism, of the free market and worldwide competition in terms of sustainable development. Maybe it will be better to develop at local scale using more local products.

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Livestock policy in Norway

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INTRODUCTION

The term *husdyrpolitikk* for livestock policy has not been frequently used by policy makers in Norway. For a long period, the terms *foranstaltninger til husdyravlens fremme*, used to promote livestock breeding, also included livestock policy (Landbruksdirektøren, 1914). However, to our knowledge, this term has not referred to budgetary purposes since 1925. This was not reflective of any policy change at that time, and livestock has been and still is important in Norwegian agriculture and agricultural policy, both directly and indirectly.

About one million hectares of agricultural land is under cultivation in Norway, that is only a little more than 3% of the total land area. Two-thirds of the agricultural land has been used for grassland in 2015, either to harvest the grass for winter feed or as pasture. About one-third has been used for cereals, mainly barley, wheat, and oats, or for potatoes and vegetables (Statistics Norway, 2016). A considerable share of the harvested grain has been mixed with animal feeds, and close to 90% of the agricultural area has been dedicated to feed production (Rognstad et al., 2016). In addition, large forest and mountain areas have been browsed or grazed in the summer by sheep and cattle. About 70% of agricultural incomes has originated from livestock farming (Rognstad et al., 2016). The country also has reindeer herding, especially in its northern parts, and as much as 40% of the land area might be available for reindeer herding (Landbruksdirektoratet, 2015).

In general, Norway has been self-sufficient in most animal products, but has imported relatively large quantities of grains and other raw materials for production of animal feed, as well as grains, sugar, and many kinds of fruits and vegetables for human consumption. There has been some export of agricultural products, such as cheese and fur pelts. Except for fur pelts, most of the agricultural export is classified as subsidized export under the World Trade Organization (WTO) agricultural agreement, and restricted.

The agricultural policy is formulated by the Norwegian parliament and the central government, whereas counties and municipalities implement the policy. The strategic objectives of agricultural and food policies are food security and safety, agriculture throughout the country, creation of more added value, and sustainable agriculture. The main policy tools supporting agriculture include import tariffs, budgetary

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payments and domestic market regulations. The agricultural support policy is a substantial part of Norway's regional and rural policies (OECD, 2017). Several budgetary payments are regionally differentiated as part of the national policy and the differentiation is decided at national level.

The aim of this chapter is to describe and analyze the parts of the Norwegian agricultural policy that most relate to livestock. In general, there has always been a livestock policy in the country, and livestock has been a criterion to allocate subsidies. Since the 1970s, aquaculture has become a major industry. Including fresh water farms, it is separate from the rest of agriculture and is under the authority of the Ministry of Trade, Industry and Fisheries. However, some of the legislation, in particular food safety and veterinary regulations, applies to the agriculture, fish farming included. In this chapter, the focus is on agriculture exclusive of aquaculture.

BEFORE WORLD WAR I

One of the first examples of livestock policy dates from 1788 when the Danish-Norwegian king introduced an act on infectious horse diseases. The importance of horses for military purposes was the main justification for the legislation (Kvåle, 2000). Since the first decades of the 19th century, Norway has developed free trade for most products. A similar trend occurred in many other European countries and, around 1870, free trade in agricultural products had developed almost all across Europe. Norwegian cereal production, similar to that of many other European countries, was not very competitive compared to imported cereals. Consequently, starting around in 1875, Norwegian farmers reduced cereal production to focus on livestock, mainly dairy (Gjerdåker, 2004). The increased demand for animal products as the urban population expanded reinforced the changes.

What can be described as a genuine Norwegian livestock policy began in the 1850s when the government introduced several measures to support and stimulate agriculture through improved education, extension and research. The government instructed agronomists and veterinarians to coordinate these efforts and provide advice to farmers. It also supported efforts to improve the quality of livestock by import and selection of breeding animals of high genetic merit. Moreover, it helped the establishment of breeding farms (*stamhjorder*) for horses and cattle, and later for sheep.

The aim was, at least for the cattle farms, to show what could be achieved by selecting and rearing animals, and by rational feeding and care. The breeding farms also had to provide other farms with breeding animals of higher quality. Some of them did not last long. Others, at least some for sheep, developed into experimental stations. The government also bought stallions and bulls for breeding purposes. Livestock exhibitions and prizes for outstanding animals and excellence in animal husbandry were introduced around 1860 to improve animal husbandry. The government also financed or set up pedigree books. One way to improve feeding was to

produce more and better feed. Another way was to have fewer animals per farm, and sufficient and balanced feed for each animal in order to increase yields (Gjerdåker, 2004).

Milk recording societies started in 1898 as private initiatives. From 1901 on, they obtained financial support from the government (Landbruksdirektøren, 1914). In the late 19th century, the prevailing opinion was that cattle breeds that had been in a region for a long time were better adapted to the local conditions than breeds from other regions. About 30 cattle breeds were identified in the early 20th century, and breeding associations for each breed were established (Gjelstad, 1993). Most of these associations later merged, and in the late 1950s only seven remained. During the 1960s, the dual-purpose Norwegian Red cattle breed became dominant. Its development was based on both Norwegian and imported breeds.

Because of the import of British sheep breeds, e.g. Blackface and Cheviot, and cross-breeding in the second part of the 19th century, the original Norwegian sheep breed, the Spelsau, almost disappeared in the early 20th century. In order to preserve the Norwegian breed, two breeding stations were set up in 1912. Breeding animals from the stations contributed to the spread of the old breed and of cross-breeds such as the Dala, which was based on the old breed (Gjelstad, 1993). Norwegian farmers also imported as many as 10,000–25,000 pigs annually in the 1880s (Gjelstad, 1993). The smaller of the two national swine breeds disappeared and the larger one was crossbred with imported breeds forming the currently dominant Norwegian Landrace breed.

In 1894, Norway implemented its first act on animal diseases and efficient policy instruments against animal diseases (Kvåle, 2000). The act targeted both virulent and non-virulent infectious diseases. It was important to prevent the introduction of new diseases and to eradicate diseases that were present in livestock. The act laid the legal basis to ban export and import of animals. The legal basis was later used to prohibit import and export of animals for other reasons than the control of animal diseases, for instance before and during World War I (WWI) and WWII (Kvåle, 2000). The act also authorized measures to protect human health and ensure food safety by introducing systems for meat and milk hygienic control. The Veterinary Directorate and the Norwegian Veterinary Institute were established in the 1890s.

The Ministry of Agriculture was established in 1900. A main task during the first years was to strengthen agricultural education and research, whereas the focus was later on legislation and control systems concerning agricultural products and inputs (Gjønnes, 2000). One goal was to protect agricultural products against other products, for instance butter vs. margarine, and livestock meat vs. whale meat (Sørheim, 2000). Education of veterinarians had been discussed on and off since Denmark's independence in 1814, but only in 1935 a permanent solution was implemented with the creation of the Norwegian School of Veterinary Sciences (Borgedal, 1967).

INCREASED AMBITIONS DURING AND AFTER WORLD WAR I

Although Norway was neutral during WWI, food from abroad became less available and more expensive. A main goal for the agricultural policy was to secure enough food for the population. Domestic production was stimulated, both crop and animal production. After the war imported food became less expensive and Norwegian products had to face again the competition. Farmers' organizations promoted increased import tariffs, and these tariffs were a main part of the agricultural policy until about 1930 (Lidtveit, 1979).

Around 1930 it became obvious that import tariffs alone could not solve the agricultural problems, and several other measures were introduced to deal with overproduction and declining prices. Marketing farm products became a major issue. Agricultural marketing cooperatives, established since the middle of the 19th century, got a legal basis for regulating markets. The costs of the regulations were financed by levies on all marketed products. A marketing board (*Omsetningsrådet*) was set up and it decided on the use of marketing funds. For milk, regional price pooling was introduced in 1930. During WWII, this developed into a system of national price pooling. The intention was to obtain the same milk price for farmers regardless of where the milk was produced and what it was used for (Norby and Aresvik, 1951), to reduce competition between farmers. The parliament also introduced a legislation that forbade import of agricultural products, but the government granted import licenses whenever it deemed it necessary. This system of quantitative import restrictions lasted until the WTO agreement was implemented in 1995 and made only import tariffs legal.

FROM WORLD WAR II TO PRESENT

During WWII and the following years, food availability was scarce. A main concern was to secure the food supply for a growing population. After the war, the agricultural policy gradually became more ambitious, as did policies in other sectors, and Norway went into an era of a mixed market economy. The government and the two farmers' unions have been holding annual negotiations on prices and other support measures since the late 1940s. Income parity between farmers and other groups became a key issue in the agricultural policy, especially from 1976 to 1992. Agriculture in all parts of the country and regional income parity have also been important goals. Regionally differentiated price support for milk and meat is one of the measures used to reach this goal. The present differentiation for milk is illustrated in figure 1. One-third of total deliveries were in zone D. Zones F to J in Northern Norway totaled less than 9% of the deliveries (Prop. 120 S; 2018-2019). The average producer price for milk, excluding subsidies, was 5.71 Norwegian kroner (NOK) per liter in 2018 (Budsjettnemnda for jordbruket, 2019). There are fewer and larger zones for regionally differentiated price support for meat than for milk.

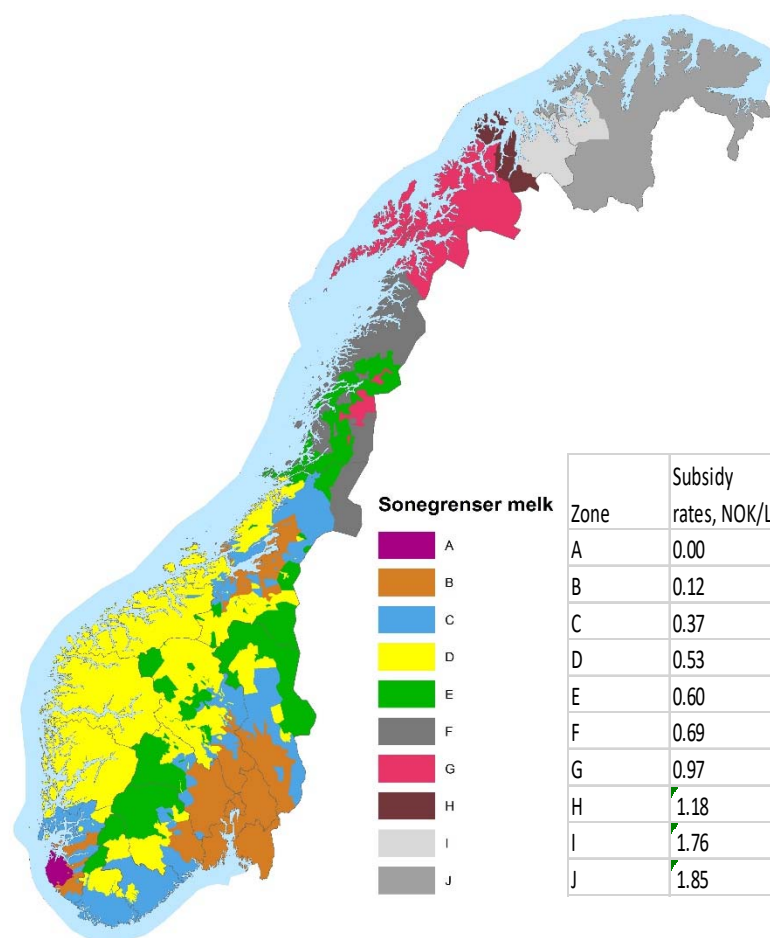


Figure 1: Zone-differentiated price support for milk (sonagrener melk) and milk rates from July 1, 2018 to June 30, 2019; average in 2018-2019: 1 NOK = 0.1030 €. Sources: for the rates: Prop. 120 S (2018-2019); for the exchange rate: DNB (2020); © Map: Norwegian Agricultural Authority

There has also been a subsidy that aimed at leveling traveling costs for veterinarians regardless of the farm location. In recent years, the income parity goal has received less attention than environmental issues and budget considerations.

Food production increased relatively fast after the war, and around 1950 there were temporary or permanent surpluses of some animal products. At the same time Norway imported relatively large quantities of grains for food and feed. By keeping cereal prices high compared with milk prices, and a regionally differentiated price support for milk, the government and the farmers' unions stimulated grain production in areas suited for that, and stimulated milk and roughage production in areas best suited for grassland. This regional specialization was carried out, but it has been argued that it would have happened anyway, partly because of the technological changes at that time (Vatn, 1989).

Until the late 1940s, almost all farm holdings had livestock, especially cattle. Since then, farms have specialized and the majority of grain-producing farms currently

have no livestock, whereas many cattle, sheep and goat farms only have grasslands. This specialization had effects on transportation of feedstuff and agricultural products. It also had effects on the amount of manure relative to farmland. It had long been recognized that agriculture pollutes both water and air, and at least from the 1970s onward the government introduced measures to curb pollution. The first years these efforts concentrated on nutrient run-offs from manure storage and grass silos. Since 1989, the law required that all livestock farms have a minimum area per livestock unit to distribute the manure. The amount of phosphorous in the manure is the basis for the size of the required area. This regulation might have influenced the current balance between agricultural land and the number of animals on a farm. In order to obtain full production support, farmers are also required to have a fertilization plan. A few Norwegian farmers had invested in tractors before WWII, but the main shift from horse draft to tractors started in the 1950s. The shift contributed to increase food production as areas used for horse feed became available for other productions. Around 1980, the military use of horses was terminated. A change in horse use had immense effects on horse breeding. Instead of large and strong draft horses, horses became better suited for leisure and sport activities. Policies changed accordingly as the government gradually withdrew its involvement and transferred most of the responsibility for horse breeding to the private sector.

Recently, greenhouse gas (GHG) emissions from agriculture and especially methane from cattle, sheep and other ruminants have become a policy issue. It is estimated that GHG emissions from Norwegian agriculture declined by 5.4% from 1990 to 2016 (Statistics Norway, 2017). Lately, it has been discussed to put a carbon tax (or lower subsidies) on production or consumption of beef in order to reduce GHG emissions. Concerns on the effects of meat consumption, especially red meat, on human health contribute to the arguments for such a tax change. So far, no measure to reduce either production or consumption of beef and mutton has been introduced. However, there seems to be a growing consensus among the public that agriculture has to be included in a policy to curb GHG emissions.

The demand for domestic milk and dairy products has been quite stable for the last 20 years in spite of the increased population. Export of dairy products has been reduced as a result of the WTO agreement, and milk production decreased in the 1990s. Import of dairy products has increased as a result of the European Economic Area (EEA) agreement with the European Union in 1994. Since about 2000, the produced quantity of milk has been almost constant although the milk yield per cow has increased, and thus the number of dairy cows has decreased. Several measures have been introduced to increase beef production from suckler cows, but the production of beef still declined from 1999 to 2015. Demand has increased proportionally to the population growth. Norway has become a net importer of beef. Production and demand for pork and in particular chicken have increased, whereas the production of mutton has been fairly stable. The relative development of produced quantities of some livestock products are illustrated in figure 2. Poultry is not included since its growth rate has been much higher than those of the other products.

If the quantity of poultry meat in 1959 is set at 100, the index for 2015 would be 3151, i.e. an average annual growth rate of 6.5%. The rapid growth in production and demand for poultry and pork has occurred despite the fact these productions have received a lesser policy priority than cattle and sheep.

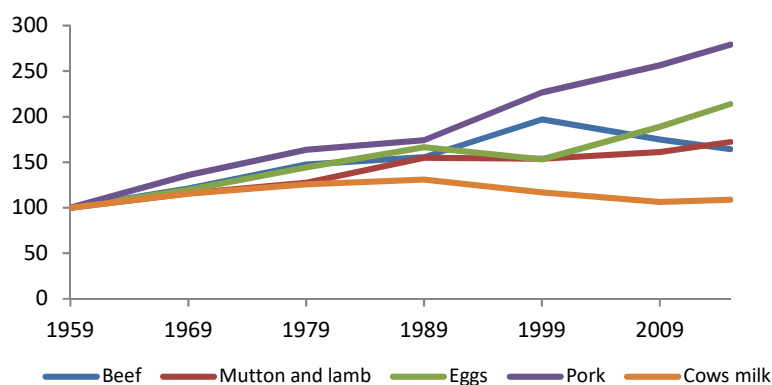


Figure 2: Produced quantities of major livestock products; relative development 1959-2015

Although large areas of forests and mountains are still used as summer pasture by sheep and cattle, the feed uptake by grazing animals has declined (Asheim and Hegrenes, 2006), contributing to forests encroaching on marginal agricultural lands and a changing rural landscape. Grazing is regarded as important to maintain landscape values, and subsidies for grazing animals are important parts of the agricultural policy. At present, the government spends about 780 million NOK annually on subsidies for grazing animals, i.e. about 9% of the direct subsidies. If measures to curb methane emission from ruminants are introduced, the number of grazing animals might be reduced. There might be a conflict in the offing between reducing GHG emissions and preserving landscape values.

Through the EEA Agreement, the EU's food safety legislation – which covers health hazards, food labeling, animal health and welfare, fish, feed, and seeds – has been implemented in Norway. The legislation has great significance for trade in food and makes it possible for Norwegian food, particularly fish, to be exported to the EU without further control measures on the part of the EU (Ministry of Foreign Affairs, 2015). Food can also be imported from the EU to Norway without further control measures.

A first Norwegian act on animal protection was passed in 1935. Since then, the legislation has changed several times. In 2009, the parliament passed the 'Animal welfare act' (Act-2009-06-19-97). In some cases, Norwegian requirements are stricter than the minimum set by the EU, for instance regarding castration of piglets. Higher standards in some cases are due to concern for animal welfare, but they are also implemented in the marketing of Norwegian animal products.

The food legislation and organization of food safety institutions have changed, partly as a response to the implementation of EU legislation in Norwegian law. Several food acts were merged into one in 2004 (Act-2003-12-19-124), and several institutions also merged (Mattilsynet, i.e. the Norwegian Food Safety Authority). The Norwegian Food Safety Authority is responsible for safe food and drinking water and works within the fields of human, plant, animal health, as well as environmentally friendly production, ethically acceptable farming and welfare of animals including fish.

Although this institution considers that the animal welfare is mostly good, it has also expressed concerns. Losses of sheep on natural forests and mountain pastures are the main animal welfare problem (Mattilsynet, 2016). Losses to predators (bear, wolf, lynx, fox and golden eagle) are part of it. Farmers are financially compensated for losses to predators, except the red fox, but there are obvious conflicts between the welfare of farm animals and the obligation to protect endangered species. Recent assessments (Ross et al., 2016) indicate that up to roughly half the losses is supposedly caused by protected predators. In reindeer husbandry, inadequate feed accessibility in winter is an important reason for losses in addition to predators (Mattilsynet, 2016). Overgrazing by reindeer has been regarded as a major problem, and there has been a policy goal to reduce the number of animals. According to a review by the Office of the Auditor General, the policy has not been very successful (Riksrevisjonen, 2012). However, there are also voices calling overgrazing a myth (Benjaminsen et al., 2016).

In the second half of the 1980s, the government stimulated fur farming as part of a rural development program (St.prp. nr. 1, 1985-86). During the latest years, there has been a heated discussion about banning fur farming or introducing stricter regulations. In 2016, the government in a white paper to the parliament concluded that fur farming should not be banned but proposed stricter regulations (Meld. St. 8, 2016-17). A majority in the parliament supported this. However, when the government was reorganized in January 2018, the three political parties present in the government agreed to ban fur farming by 2025; it was acted by the parliament in 2019 (Act-2019-06-21-63).

Headage payments for farm animals, like several other support schemes, have been differentiated so that small farms receive higher support per animal than larger farms. This differentiation has been gradually reduced in recent years. A system with milk quotas per dairy farm was implemented in 1983. The system has become more flexible over time, milk quotas are now marketable, the regional bindings less strictly practiced. In pig and poultry farming, there are restrictions on how many animals a producer can have without having a concession from the government. The aim of this legislation is to spread production on many herds and to prevent what is regarded as industrial production. The concession limits have been increased from time to time since the introduction of the act in 1974. At present, a large part of the pig and poultry production is close to concession limits.

Although artificial insemination has been subsidized since the 1970s (Lidtveit, 1979), it has also been a policy goal to preserve genetic resources and old breeds. The Norwegian Genetic Resource Center was established in 2006 in order to coordinate resources and competence in dealing with genetic resources for food and agriculture (Sæter et al., 2013). There is a special support for cattle breeds defined as worthy of preservation, but the number of animals of such breeds is still rather limited (Steine, 2013). At present, there is also a subsidy to national breeding organizations. The aim of the latter is manifold, for instance to contribute to genetic improvement and populations of healthy animals adapted to the Norwegian environment, to secure genetic variation in the populations, and to include functional traits in the breeding goals (Prop. 133 S, 2015-2016). This is in many ways similar to the goal of the policy to advance animal production started in the 1850s.

Norway has been almost free of infectious animal diseases such as rabies, foot and mouth and virulent footrot, and measures are undertaken when such diseases are detected. A 2008–2014 program to eradicate virulent footrot in sheep is a recent example (Asheim et al., 2017). Other examples are the bovine virus diarrhea control and eradication strategy for 1993–2003 (Valle et al., 2005) and caprine arthritis encephalitis, caseous lymphadenitis and paratuberculosis (Johne's disease) in goats (Nagel-Alne et al., 2015). Norway has a program to eradicate methicillin-resistant *Staphylococcus aureus* from pig farms. Such programs are usually carried out in cooperation between public authorities and the industry. Farmers that have to slaughter their animals as part of an eradication program are compensated for financial losses. The use of antibiotics has been very low in fish farming during the last 20 years, and the government and farming industry try to reduce the use of antibiotics in agriculture in general. Phasing out the use of narasin in chicken feed is a recent measure to improve safety of Norwegian food.

In March 2016, the chronic wasting disease (CWD) was diagnosed in a wild reindeer in Southern Norway. This was the first documented case of CWD in Europe. The authorities decided to stamp out the entire reindeer population of about 2000 animals in the infected area, as a means to prevent spread of the disease to other reindeer populations and other cervids. By the end of February 2018, all known reindeers in the area had been culled (Miljødirektoratet, 2018). The long-term goal is to reestablish a healthy reindeer population in the area.

CONCLUDING REMARKS

As more than 90% of the agricultural area is used for production of animal feed, livestock is important in Norwegian agriculture policy, although the term livestock policy is not frequently used. In this chapter, we have considered the livestock policy as these parts of the Norwegian agricultural policy that are most directly related to livestock and livestock production.

The main objective of the livestock policy during the late 19th century was by and large to improve productivity so as to contribute to the increased competitiveness of the country's agriculture, mainly on domestic markets, but also abroad. Increased production and lower relative food prices were also important for securing food for the poor. Combating animal diseases and improving the hygienic standard in handling of animal products could also prevent human diseases. Improved food safety was, and still is an important goal. Another goal was to protect agricultural products from competing with other products.

During the two world wars, a main goal was to secure enough food for the population. After WWII, a main objective was to become self-sufficient in products that the country had natural conditions for producing. Export has not been a goal for Norwegian agriculture, with a few exceptions, e.g. pelts from fur-bearing animals whose production will be banned in 2025. This has become even more marked after the WTO agreement was implemented in 1994, which limited subsidized export.

Income parity between farmers and other groups was a main goal in the agricultural policy, at least from WWII until the early 1990s. Since then, income support has officially been a measure to obtain other goals. The government and the farmers' unions still negotiate annually on target prices and support. However, as a result of the WTO agreement, Norway has abolished target prices on several products. The government has less control over agricultural prices than it used to have. Produced quantities, number of animals per farm, area of the various crops, and location are used as criteria for allocating farm support.

Much of the present livestock policy relates to food safety and animal welfare. Relevant EU legislation has been implemented in Norwegian law. This is more important for Norwegian fisheries and aquaculture, which are more export oriented than the rest of agriculture, which mainly focuses on domestic markets. Norway has been and still is free of several animal diseases. The country has an eradicating strategy of stamping out animals if specific diseases are detected.

Lately, there has been an increased focus on the public benefits and downsides of agriculture. On the positive side are the landscape values, and the effects of agriculture on rural activities and settlement. Livestock grazing is considered to be important to maintain landscape values. On the negative side are air and water pollution, and greenhouse-gas emission. Methane emission from ruminants has attracted a lot of attention lately. There are many ongoing works to obtain more information on actual GHG emission from agriculture, on the effects of the various measures to reduce GHG emission, and on developing effective policy measures.

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Livestock policies in Switzerland

Marion Zumbrunnen¹, Hannes Joerg¹ and Beat Reidy¹

CLIMATE AND LAND USE

Switzerland is a small mountainous country located in the center of Europe. Hills and mountains cover over 70% of its area of about 41,290 square kilometers. The landscape is characterized by the Jura Mountains in the north (up to 1700 m above sea level), the Central Plateau of plains and large lakes in the center (average elevation of 400–600 m) and the Alps (up to 4700 m) in the south. The Central Plateau makes up only about 30% of the total surface area, but more than two thirds of the population lives in this region (Figure 1).

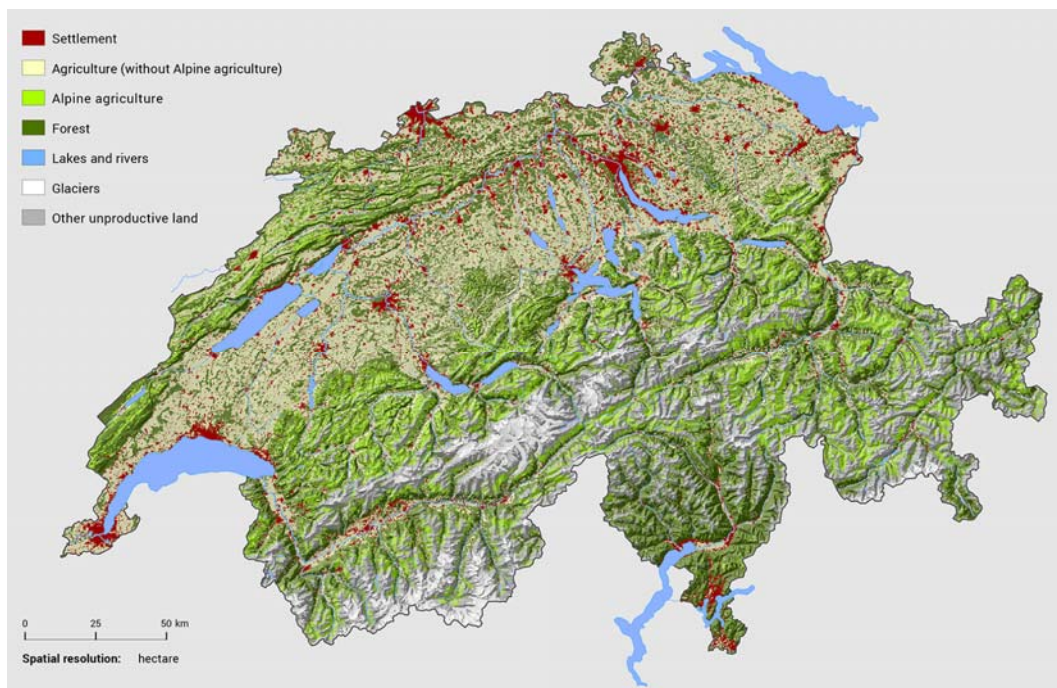


Figure 1: Land use in Switzerland. © Swiss Federal Statistical Office (FSO), Land use statistics, Geoinformation, Neuchâtel, 2017

The Central Plateau is highly populated with more than 380 inhabitants per square kilometer and contrasts with the much less populated mountainous regions. The climate is extremely variable, depending on the altitude and season, but it is generally

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considered to be temperate (average annual temperature in the plains of 8°C) and moist (average annual precipitation in the plains 1000–1500 mm) with a relatively even rainfall distribution throughout the year. Including Alpine pastures, more than one third (36%) of the total surface area is in agricultural use. Over 70% of the agricultural area (1.1 million hectares) consists of semi-natural grassland (pastures and meadows). Alpine pastures account for an additional 0.5 million hectares. Due to climatic restrictions, arable farming is limited to lower elevations, mainly in the Central Plateau, where the most fertile soils can also be found. Forage production covers a climatically much wider variety of elevations and dominates at higher altitudes (Figure 2).

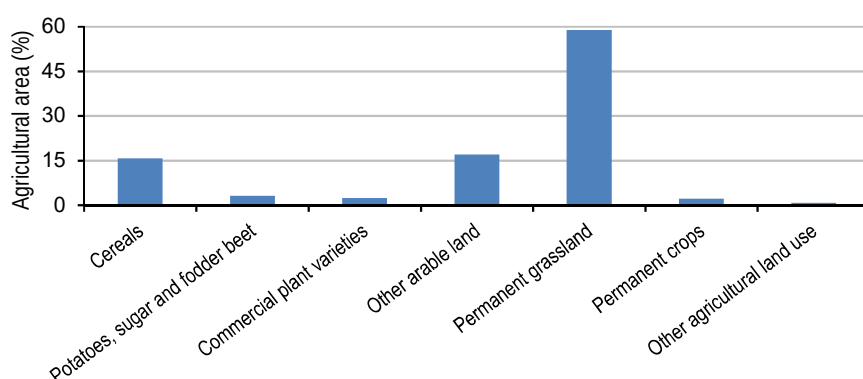


Figure 2: Agricultural land use categories in Switzerland excluding Alpine areas in 2015. Total agricultural area = 1,049,000 ha. Source: Swiss Federal Statistical Office, 2016

Intensive grassland-based dairy and cattle farming, allowing stocking rates as high as two livestock units per hectare in the most favorable areas, is of major importance. In 2013, almost 60% of farms specialized in grazing livestock (Figure 3).

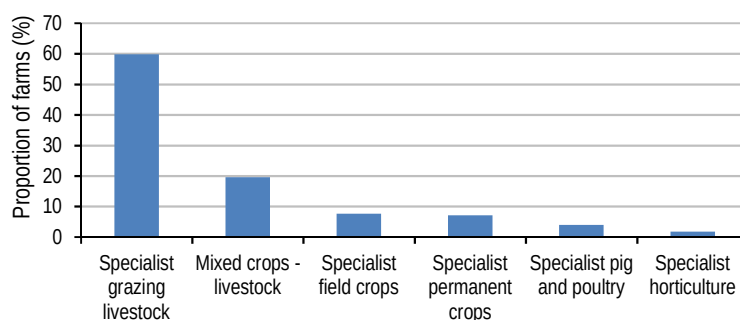


Figure 3: Farms by type of farming in 2013. Source: Swiss Federal Statistical Office, 2015

The average farm has around 20 hectares of agricultural land in use (Figure 4). However, this varies widely depending on altitude and topography, consequent labor intensity requirements and economic considerations.

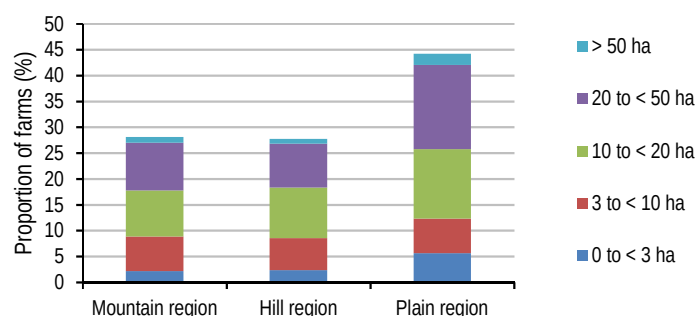


Figure 4: Farms by size category and region. Source: Swiss Federal Statistical Office, 2015

SOCIOECONOMIC STRUCTURES

Of Switzerland's 8.3 million resident population, only 4% are engaged in agriculture (Figure 5). The most prevalent farm type is the family-owned farm with the main workload carried out by family members. In the mountainous area, this leads to smaller production units. Out of the 53,000 farming units, over 80% are livestock owners. Most of them raise cattle (> 80%), with dairy production as the dominant production form (21,875 dairy producers in 2015; SMP, 2016). Other cattle farms keep suckler cows or specialize in veal or beef production. The husbandry of goats and sheep is typical for hilly and mountainous regions, but is overall of minor importance. About 6000 and 8000 farms keep goats and sheep, respectively; about two-thirds of these are in the mountainous regions. The tradition of summer grazing

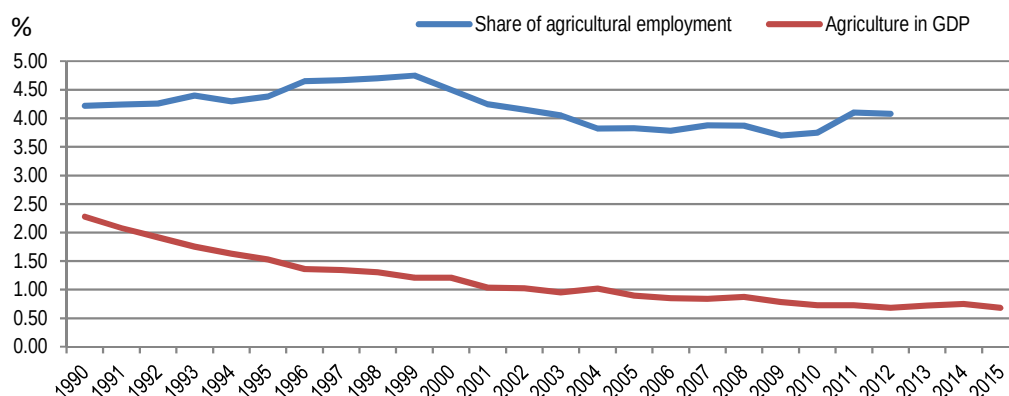


Figure 5: Share of agricultural employment in total employment and gross value added in agriculture in national GDP. Data from OECD

of ruminants in the Alps and Jura mountains is of major significance. In addition to production, it maintains the cultural landscapes and contributes to biodiversity by protecting alpine meadows from tree and shrub encroachment.

Swiss agriculture has an overall production value of 10.2 billion Swiss francs (CHF). Agriculture and the primary sector are only a minor contributor to the total income of Switzerland (Figure 5). Despite its relatively minor and declining role for the economy, agriculture is still of high public interest and strongly supported by annual subsidies of 2.9 billion CHF.

These payments constitute 22% of the total resources of the agriculture industry. The high financial support is justified by a strong and partly historic interest in maintaining food security. The level of self-sufficiency in agricultural products (gross foodstuff total) was 63% in 2014 and for animal production in total (gross foodstuff of animal origin) it was 100%, specifically 115% and 79% for dairy and meat products, respectively (Figure 6). However, due to an increase in the import of cereals and soybean meal for livestock production since the beginning of the 21st century, the net level of self-sufficiency for animal production (taking into account that part of domestic production relies on imported feedstuff) is lower and tends to decrease.

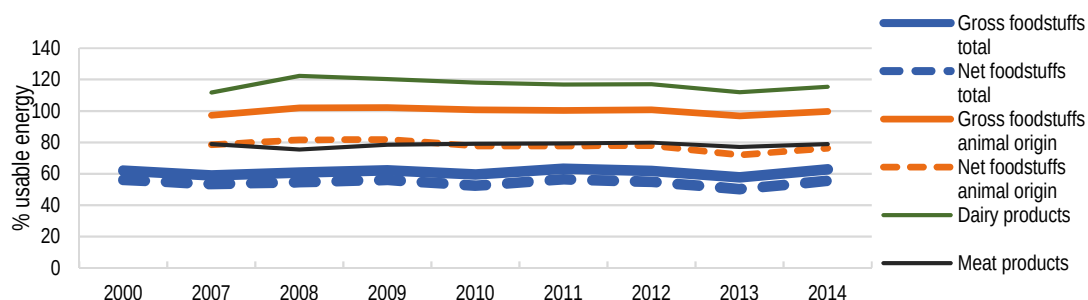


Figure 6: Self-sufficiency in foodstuffs in Switzerland; 'net' refers to animal products produced excluding imported feedstuff. Source: Swiss Federal Office for Agriculture, 2016

HISTORY OF LIVESTOCK FARMING

In the second half of the 19th century, the growing demand in Switzerland and abroad for livestock products in the form of meat, milk and dairy products led to an expansion of livestock farming (Figure 7). The cow stock rose from 500,000 in 1850 to 750,000 in 1900, whereas the number of sheep fell significantly because of cheap imports from abroad; the number of goats decreased similarly. The expansion of livestock farming was primarily the result of the changing price relations between grain and animal products. The ratio of the prices for one kilogram of milk and one kilogram of grain in 1870 was 1:3, but dropped to 1:1.2 during World War I. Another reason was the increase in cheese exports, which led to the export of more than a quarter of the Swiss milk production from 1880 onward. Switzerland also improved

its supply of fresh and processed milk to the domestic market. The doubling of pig numbers between 1850 and 1914 was due to the "hunger for meat" of the rapidly growing population. Higher slaughter weights and faster fattening in cattle and pig farming also increased meat production.

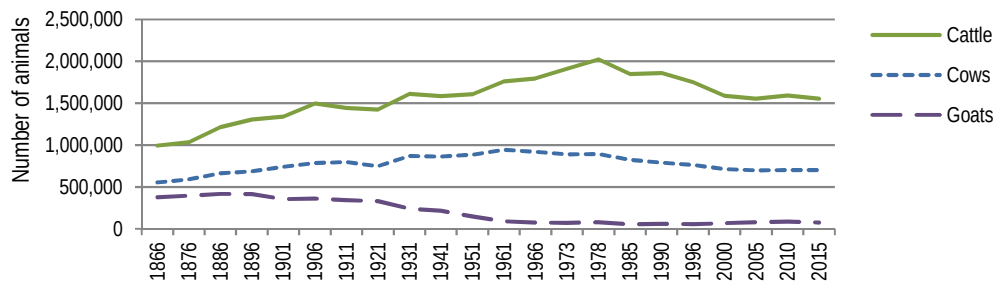


Figure 7: Livestock development in Switzerland since 1866. Sources: Hans Brugger, 1978 and 1985; Swiss Federal Statistical Office, 2016

The average milk yield of a cow increased from around 800 kilograms at the end of the 18th century to more than double that by 1850, mainly as a result of indoor feeding in summer and improved forage production. With a second doubling due to breeding progress, cows in Switzerland achieved an annual milk yield of about 3000 kilograms at around the turn of the 20th century (Figure 8). The proportion of the Simmental breed steadily increased: in 1911, 55% of the cattle population belonged to this breed, which was more suited to the demands for increased meat production than the Braunvieh. The latter also increased, but its share of the total stock decreased from 42% in 1861 to 38% in 1911. The proportion of crossbreeding declined.

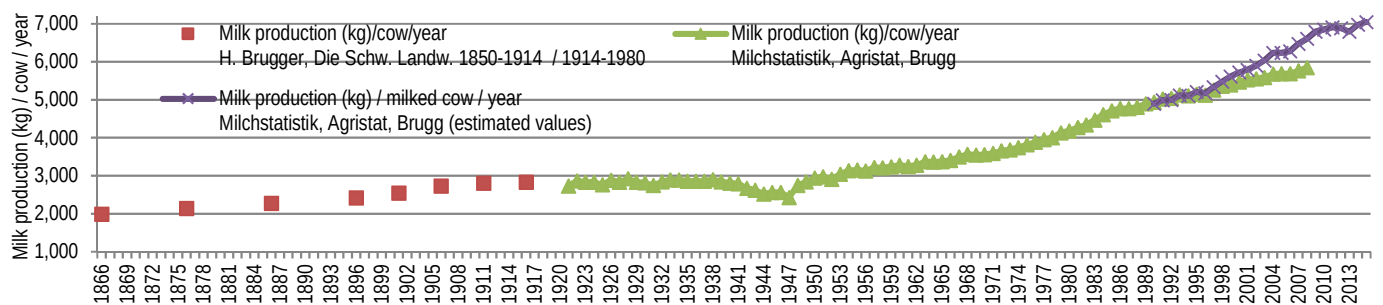


Figure 8: Milk production per cow in Switzerland since 1866. Sources: Brugger, 1978 and 1985; Agristat (Milchstatistik, pers. commun.), 2017. Milk production per cow, calculated including cows producing milk for calf fattening, also including foster and suckler cows since 2000. The graph is therefore complemented by an estimated value for milked cows only.

By the beginning of the 20th century, dairy production had become the dominant sector within Swiss agriculture. Almost all other sectors were associated with it as by-products (slaughtering cattle, pig fattening with whey) or suppliers (cattle breeding, feed grain). As early as the 1880s, the livestock sector accounted for 64% of

the gross income of the agriculture industry and had risen to 74% by 1911. The number of livestock farmers decreased in the second half of the 19th century and consequently the average number of animals per farmer rose from 4.2 livestock units to 6.2. In the 20th century, the importance of livestock farming continued to grow and its contribution to gross farm income rose to almost 78% in the 1970s. In the postwar period, small- and medium-sized farms in particular tried to safeguard their existence with the so-called 'inner increase', the expansion of animal production independent of the farm's own feed base. This resulted in a large increase in the number of animals and an enormous increase in their performance (milk production, daily weight gain, slaughter weight, fattening period). The cattle stock rose continuously to 2.2 million until 1978, the number of cows reached its peak in 1961. This inner increase of livestock was especially pronounced in the hilly regions, where crop production is limited due to climatic and topographic factors. It led to the development of intensive livestock farms with regionally very high livestock densities. Especially in Central Switzerland, the resulting nutrient surpluses were responsible for severe environmental problems (i.e. eutrophication of lakes as a result of increased phosphorus concentrations).

Due to increasing difficulties in processing (for example unsuccessful state subsidies for cheese exports) and increasing awareness of environmental problems, Switzerland tried to reverse this trend by restricting dairy and meat production in the late 1970s. This was not the first time that attempts had been made in the 20th century to use state measures to curb livestock production. Having experienced declining cheese exports and the complete loss of condensed milk production during World War I, Switzerland promoted grain production over the dairy sector for food security in the interwar period. Although grain cultivation was subsidized, and dairy and pig production was restricted, the measure was not very successful. To strengthen food security during World War II, livestock numbers were substantially reduced but strongly increased again during the postwar period to reach a maximum by the end of the 1970s.

In 1977, the Federal Council introduced the allocation of quotas for milk production, leveling the total quantity of produced milk to 3.2 million tons annually. The aim was to prevent an expansion of dairy production at the expense of crop production. By allocating quotas, the Confederation required farmers to specify how much milk they could deliver per year. If the assigned quota was exceeded, the farmer received a massively lower price for the surplus milk. Indirectly, the quota system was used to balance the milk price by preventing surpluses and livestock numbers fell to 1.7 million by 1993.

With the introduction of a new multipurpose agricultural policy in 1996 and the resulting total revision of the Agriculture Act, farmers were expected to adopt more entrepreneurial approaches and assume more responsibility for production. Under these new conditions, the restrictive handling of dairy quotas had to be relaxed and, in a first step, the possibility of trading quotas between farms was introduced. From

then on, farmers were free to handle their milk production without the intervention of the government, although the transfer of quotas from the mountain area to the Central Plateau was prohibited in principle.

Finally, in 2009 the milk quota system was abolished. Since then, there has been no state regulation of milk quantities, and regulation now lies with dairy-producer organizations. With this step, the federal government liberalized the dairy market in accordance with World Trade Organization requirements. To mitigate the effects of liberalization, the Confederation offered dairy producers the opportunity to leave the quota system as early as May 2006 as a member of a producer organization, producer and milk-processing organization or a sector organization. The milk organization (BOM) serves as a platform where all actors in the milk production chain (producers, traders and processors) can shape the future of the dairy market.

To determine the market price, BOM introduced a subdivision of the milk into three segments, A, B and C milk, based on prices in Switzerland, the European Union and the world market, respectively. Accordingly, each producer can sell a fixed quantity of A, B and C milk. However, the system has not been consistently implemented, which means that the producer now receives a mixed price from all three segments. The introduction of single-farm milk quotas, the setting of maximum livestock per holding and the prohibition of barn extensions as well as payments for the reduction of livestock led to a fall in the proportion of livestock production in terms of gross farm income to around 75% in the 1980s and 1990s.

Since the 1950s, the number of dairy farmers encouraged with subsidies not to use the milk produced for cheese making, nutrition or consumption has become more and more important. In 1988, 9% of cows were on such farms, most of them engaged in calf fattening, and since the 1970s, suckler cows have been the alternative to dairy cows. The production of fattening calves, which was increasingly shifted to commercial plants at the end of the 1960s, has been returning to farms since the 1980s, partly because of the milk quota. The expansion of beef production has paralleled the increase in silage production since 1960. The number of livestock keepers per household decreased in the postwar period from 28% in 1946 to 14.5% in 1966 and to 5% in 1988. On the other hand, annual meat consumption rose from 30 kg in 1946 to 54 kg in 1964, and to 73 kg in 1983. A trend reversal was observed in the 1990s, mainly because of the outbreak of the bovine spongiform encephalopathy disease, and controversies surrounding the production of meat in 'animal factories' since 1978. In contrast to the decline in beef and pork consumption, an increase in the consumption of poultry meat and fish has been observed.

HISTORY OF ANIMAL BREEDING

The success of dairy production in Switzerland has been closely linked to significant efforts undertaken in animal breeding supported by the government. As early as

the last quarter of the 19th century, livestock cooperatives developed local and national livestock associations, which introduced herd books or breeding registers. Until the 1950s, cattle breeding aimed at health, performance and a suitable condition: cows had to deliver both milk and beef, and also be suitable for drawing carts and logs. To attribute a weight to the three types of use, the livestock associations postulated specific ratios. In the Simmental, which was widely spread in Switzerland, a milk-meat-draft ratio of 55:25:20 was applied, and in the Braunvieh one of 60:30:10. Hence, a very versatile animal was developed: robust, resilient, fertile, long-living, efficient, adaptable and very well balanced in its body shape and color. Its strong legs and feet enabled it to search for forage even in difficult areas with sparse grass and few water sources. With the advent of tractors, the draft power of cattle became irrelevant. Breeding therefore focused on dairy and meat production (dual-purpose breeds), allowing owners to fulfil both production requirements. Afterwards, breeding specialized in either milk or beef.

Until the mid-20th century, Switzerland insisted on pure breeding. Scientists and practitioners feared that crossbreeding would lead to a split of the desired characteristics from the second generation of offspring according to the Mendelian doctrine of inheritance, thus endangering the breeding of quality desired by the Confederation. For this reason, Switzerland promoted only four breeds (Simmental, Braunvieh, Fribourg and Herens). Crossbreeding with foreign breeds was forbidden. However, in order to remedy the inheritance defects occurring in the Fribourg breed as a result of pure breeding within a relatively small population, the state allowed the mating of Fribourg cows with bulls of the Holstein-Friesian breed for the first time in the 1950s and 60s. The progress made in these daughters resulted in the Fribourg breed, which was designed for multiple uses, being replaced by the Holstein breed within 15 years. As the import of Montbéliard cattle and semen was forbidden to cattle farmers, farmers illegally imported semen from France, leading to the so-called Cow War from 1964 to 1967.

As an outcome, experimental crossbreeding in Braunvieh and Simmental cattle was legally carried out from 1967 onward. Due to their desire for higher milk performance, many Braunvieh cattle breeders used American Brown Swiss genetics in their mating programs and Simmental breeders crossed their cows with Red Holstein bulls. The breeding populations of the Swiss Original Braunvieh and Simmental breeds could be preserved by the establishment of separate breeding populations.

Artificial insemination (AI) played an important role in this specialization. In the mid-1950s, the federal authorities concluded that the spread of AI could no longer be prevented. In its 1958 regulation on cattle breeding, the Federal Council stated that the implementation of AI should be carried out by a single organization, despite the fact that a decentralized structure prevailed in most other countries and Swiss AI pioneers were already using three existing insemination centers. Within the Federal

Office for Agriculture, however, there was a conviction that the trench warfare surrounding AI could only be overcome if AI skeptics and supporters were united in a single organization.

The breakthrough for AI came in the second half of the 1960s after the storage of semen in liquid nitrogen became practical. This was consolidated by the fact that the offspring tests also aroused the interest of the breeding associations to the extent that even bull breeders were increasingly reconciled with AI. Those who had raised a bull which was successfully tested were also substantially involved in its financial success. In 1980, more than two-thirds of all cows were pregnant as a result of AI. That year, the Federal Office for Agriculture prompted the AI organization to launch a fund for research in the field of animal production. New technologies such as embryo transfer, followed by in vitro fertilization, semen sexing and genomic selection subsequently followed.

During the agricultural policy changes of the 1990s, the Swiss cantons withdrew support for AI and the Confederation prematurely abolished the ten-year monopoly it had renewed in 1991. The new AI providers neither guaranteed comprehensive coverage nor pursued state objectives and thus became serious competition for the state AI organization, which was subsequently privatized and transferred to Swiss Genetics AG. In addition to concentrating on the development of its own products, the company separated its tasks from those of breeding associations. Swiss genetics was solely responsible for market-related activities, such as contracts with breeders, the selection of bulls in Switzerland and abroad, sperm production and semen marketing. The breeding associations, on the other hand, were responsible for the formulation of breeding objectives, breed promotion, the assessment and inclusion of bulls in the herd book, and strategies for preventing genetic defects. Breed strategy issues of common interest were decided on a parity basis. The success of self-produced genetics in the form of top bulls manifested itself in its increasing share of the domestic market and genetics exports. Since the turn of the millennium, the crossing of dairy with beef cows has increased by around 40% and the use of sexing and genomically tested bulls has become increasingly popular. Genomic selection enables breeding values to be calculated with a higher degree of accuracy, especially in young animals without long-term performance control of offspring. Since breeding in Switzerland is based on offspring tested bulls, breeding success is not as fast as with genomically tested bulls and Swiss genetics will be a niche product on the world market.

State measures to promote livestock breeding have a long tradition in Switzerland and date back to the introduction of organized breeding. It used to focus exclusively on nationally recognized breeds, as set out since 1893 in the federal decree on agriculture, where subsidies for an independent animal breeding is to be maintained in Switzerland. The Confederation therefore supports the recognized breeding organizations with payments for herd bookkeeping, performance tests, breeding value estimates and projects related to the conservation of native breeds.

AGRICULTURAL REFORM TOWARD A MULTIFUNCTIONAL AGRICULTURE

With an increasing awareness of environmental problems resulting from postwar inner increase and intensification of the agricultural production, and with the growing international competition, a significant shift in Swiss agricultural policy was initiated in 1996. Beside its role in ensuring food sovereignty, the social and ecological aspects of Swiss agriculture became more and more important toward the end of the last century in justifying state financial support. Additional benefits of agriculture, such as the conservation of natural resources (i.e. maintaining biodiversity), the maintenance of cultural landscapes and the safeguarding of decentralized settlements have become of major public interest. Particularly in mountainous and other peripheral regions, agriculture plays a vital role in fostering decentralized settlements and the rural economy. To rise to these new challenges, a new constitutional mandate was introduced in 1996 defining the principles of a sustainable and multifunctional agriculture. According to the new constitutional article, in addition to providing foodstuffs to the population, Swiss agriculture had to contribute to the conservation of natural resources, and the maintenance of rural landscapes and decentralized settlement of the land. The new legalization resulted in a strong shift away from the internationally criticized market support instruments toward a production- and price-neutral direct payment system. The fading out of guaranteed prices and markets caused farmers' production-related earnings to fall substantially (Figure 9).

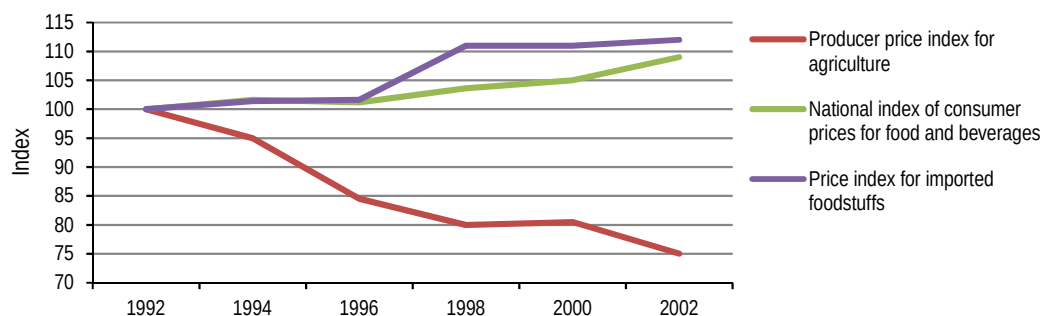


Figure 9. Producer, consumer and import price index for food products.
Source: Swiss Federal Office for Agriculture, 2004

This legislation accentuated the transition already in progress within the primary sector. Although income losses were fully compensated with direct payments, the new policy had a strong and lasting impact on farm structures and production strategies. This was especially pronounced for the dairy sector, where the number of dairy farms continued to decrease sharply (-59% dairy farms between 1990 and 2015). Interestingly, the total amount of milk produced increased due to the more

intensive and specialized production of the remaining dairy farms (bigger production units with higher milk yield per cow and more intensive feeding strategies; Figure 10).

The farmers who gave up dairy production partly moved into the production of suckler cows, where animal numbers increased from 12,000 in 1990 to more than 111,291 in 2015 (Klossner et al., 2014). Despite the significant structural changes after the introduction of the new policy, market share and food self-sufficiency could largely be maintained. The gradually tightened key elements associated with more environmentally friendly production such as farm nutrient balancing, ecological compensation areas, crop rotation, soil erosion and animal welfare measures resulted in a considerable increase in ecological performance.

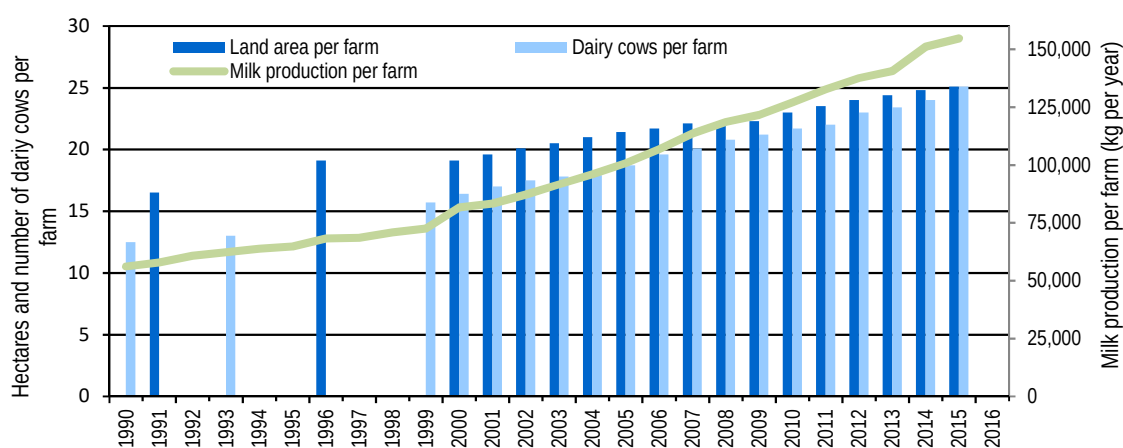


Figure 10. Development of land area, dairy cow number and milk production per farm in Switzerland since 1990. Data on per farmland area and cow number are partially missing between 1990 and 2000. Data from Swiss Milk Producers

The shift from price support to direct payments has reduced the intensity of inorganic fertilizer and pesticide use. As an example, the share of ecological compensation areas, mostly consisting of extensively managed grassland, rose from 20,000 ha in 1993 to 130,000 ha in 2013 (Swiss Federal Statistical Office, 2015), whereas the nitrogen and phosphorus surplus per hectare of agricultural area decreased from 81 kg to 59 kg and from 12 kg to 1 kg, respectively (Figure 11). The linking of direct payments to ecological performance has resulted in a large part of the farmland being used in a more sustainable way than before the introduction of the policy change.

To compensate for income losses, a substantial number of farms changed to organic production, specifically subsidized by the federal government. Between 1990 and 2015, the number of organic farms increased almost six fold. Organic agriculture is now practiced on 12% of the farms and on 13% of the agricultural area. Many

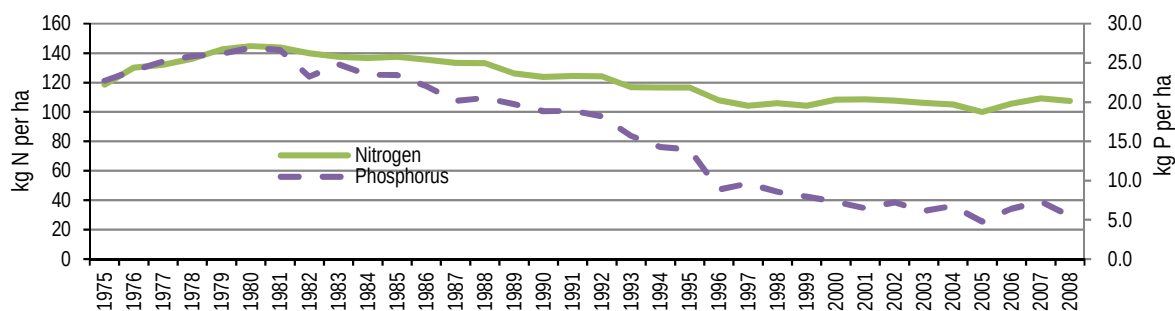


Figure 11: Nitrogen and phosphorus surplus of Swiss agriculture of the utilized agricultural area from 1975 to 2008. Source: Spiess, 2011

of these farms are in mountainous regions with livestock production for a better circulation of organic matter and nutrients. Many other farms have adapted their production to the less stringent but also environmentally friendly integrated production standards, represented on the market by the association of the Swiss integrated production farmers (IP-Suisse). By respecting specific rules related to integrated farm management and animal welfare, producers can achieve higher market prices for their goods.

OUTLOOK – MULTIFUNCTIONAL AGRICULTURE IN THE 21ST CENTURY

The new agricultural policy framework led to substantial structural changes and adjustments in the Swiss primary sector. The multifunctional agriculture policy approach has not only enabled farmers to maintain their income by receiving compensation for additional services performed and benefits rendered, but also improved their market orientation. However, the costs of this policy are high and very much depend upon the willingness of the population to support the agricultural sector with direct payments. Moreover, income from direct payments has now become a major part of a farmer's income relative to earnings from selling products. This may impede additional structural improvements and limit the further development of a competitive primary sector which provides enough high-quality food to contribute to meeting the strongly increasing demand forecast for the decades ahead.

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Livestock systems in the midst of History's upheavals in Kazakhstan

Gaukhar Konuspayeva¹ and Bernard Faye²

INTRODUCTION

The place of livestock in Kazakhstan, both historically and geographically, is central in the country's culture and economy, even if the industrial revolution during the 20th century, enabled by the political changes that occurred at the same time, have decreased its importance. With an area of 2.7 million square kilometers (9th place in the world), mainly composed of arid or semiarid regions, steppes or desert (more than 80% of the territory), Kazakhstan's location in the heart of Central Asia is the hub of the regional economy (Figure 1). However, with only 18 million inhabitants, the country is characterized by a low human density, and only crop and livestock activities can contribute to the occupation of the spaces, especially since farming remains mainly extensive.



Figure 1: Location of Kazakhstan in the heart of Central Asia

Whereas cattle farming occupies the most favorable areas, the steppe regions are dominated by horse (the Kazakh population consumes a lot of horse meat and mare

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milk) and sheep farming, and, at least in the Southern parts and in the most marginal areas (desert), by camel farming. The country is indeed marked by large, nearly empty spaces, often semiarid, which only these species adapted to such a context are able to value.

This chapter focuses on livestock farming, which has undergone a century of intense upheavals that have induced deep changes in production systems, irreversibly altering farming patterns and more generally the rural life and agricultural economy. The modernization of the rural life displayed as a primary objective by the authorities in place today cannot be envisioned without understanding the weight of the upheavals that marked the 20th century.

KAZAKHSTAN, AN AREA HISTORICALLY DEVOTED TO NOMADIC PASTORALISM?

Immense spaces

Formerly populated by nomadic riders, more than 33% of the territory consists of steppes, and 53% of deserts and semideserts (Figure 2). The central part is a sandy plateau with small hills surrounded to the north and northeast by the Sary-Arka plains, to the south by the Touran plain, to the west by the Caspian plain. In the east and southeast, several mountain chains (Altay, Djungar Alatau) alternate with depressions (lakes of Zaisan, Balkhash, valleys of Alaköl, Ili and Chu, Talas). The central part between Karaganda and Shymkent is a sandy desert (Moyoumkum). The highest point (Khan-Tengri) in the Alatau chain reaches 6995 meters (or 7010 m according to some data) above sea level.

The steppe zones therefore represent the main feed resource for the herd. These pastures are in four geographical areas with different ecological characteristics: i) a flat area, a broad strip along the territory in Northern Kazakhstan, characterized by a vegetation based on *Stipa* spp., *Festuca* spp. and wild oats (*Avena* spp.), ii) a semidesert zone, consisting of a strip crossing Central Kazakhstan, typical with its scrubs and wormwood (*Artemisia* spp.) pastures, iii) the desert extending from the south to the west, sand deserts with woody vegetation based on 'saxaul' (*Haloxylon* spp.), sometimes mixed with tamaris (*Tamarix* spp.) and wormwood (*Artemisia* spp.), and iv) Southern pastures interspersed with desert basins, which can be used all year round.

History dominated by nomadism

Historically, according to the earliest available data on the Kazakhs and living peoples in the current territory of Kazakhstan (Mesolithic and Neolithic), the entire population, organized in tribes and around a family nucleus, was nomadic. The administration was based on tribal rules. Based on nomadic lifestyle, four animal species

were traditionally bred: sheep, horse, cattle and camel. The wealth of families and tribes was expressed in the number of livestock head. The tribal social organization was under the traditional authority of the Bai based on family or clan connections. The crop-livestock association, a prerogative of the oasis culture, was scarcely present in neighboring countries (territories of the Uzbeks and Turkmen), because the territory of the Kazakhs, almost without large oasis cities such as Samarkand, Bukhara or Merv, indispensable steps along the Silk Road, offered only large spaces and more modest oases which undoubtedly have less marked the history of the region (Taraz, Samara and to a lesser extent Yasi, the current Turkestan). Consequently, with a very modest urban culture, the Kazakh population was in permanent mobility on a vast territory.



Figure 2: Kazakhstan. Source: www.kazakhstanlive.com

In the 19th century, nomadism and transhumance remained the main if not the sole rearing type. Pastures, steppe or desert, constituted the only feeding resource for livestock, as supplementation was not practiced. Three types of mobility were described: i) a completely nomadic system, ii) a seminomadic system comprising a permanent wintering point, and iii) an alpine transhumant system which mainly concerned horses and sheep (Kerven et al., 2009). About 80% of families traveled at least twice a year over distances ranging from 300 to 1000 kilometers on a north-south axis, except for families with alpine transhumance on shorter distances (30–35 kilometers). By the end of the 19th century under pressure from the Russian

administration, the beginning of sedentary activities was launched by attributing the best pastures to Russian settlers, forcing part of Kazakh nomads to become farmers (Olcott, 1981).

It was at this time that some of the livestock, dominated by sheep and horses in the steppe area, and by camels in the desert area, yielded a growing place to cattle. These were less adapted to the long-distance movements dictated by the constraints of the environment and the free pasture in winter, and they remained a minority. However, with the arrival of the Russian settlers, forage crops for cattle feeding were introduced in the North to meet the meat demand of the powerful neighbor. Nevertheless, before the Bolshevik revolution, nearly 70% people were still nomads across the territory.

Livestock farming: A considerable potential

With about 180 million hectares of steppes and mountainous territories, Kazakhstan ranks sixth in pastoral resources (after Australia, the Russian Federation, China, the USA, and Canada) and first place in pasture area per head of cattle. About only 10% of these lands are cultivated, and the rural population (which today represents 5.2 million inhabitants) mainly depends on traditional livestock farming. More than 29% of the population still lives in rural areas. The part of agriculture still reached 4.9% of the gross domestic product in 2014 (compared with 34% in 1990) – the country has experienced at the same time a sharp increase in the mining and oil sector, which has reduced the relative share of agriculture despite the agricultural development program.

Although agriculture has known a boom in recent decades (wheat, rice, cotton, sugar beet, rapeseed, sunflower, barley and forage crops), animal resources remain important both for drafting and production (Table 1). Moreover, the evolution of prices since independence differs according to the type of production but the trend is to a price increase of animal products, much consumed by the Kazakhs.

Table 1: Production according to the livestock species in Kazakhstan in 2014

	N	Meat (ton)	Milk (ton)
Cattle	6,032,742	766,976	5,020,353
Sheep	15,535,302	285,834	0
Goat	2,379,266	42,868	1,785
Horse	1,937,921	178,442	25,094
Camel	165,888	11,999	13,180
Pig	884,738	143,273	—
Deer (maral)		13,5	—
Poultry	35,020,019	172,815	—
Other animals		238	—
Total production		1,602,458	4,060,413

Source: Ministerial Committee of Economic Statistics, Kazakhstan, 2014

It should also be noted that farm species in Kazakhstan are marked by a large biodiversity whose preservation is an issue for the future. For example, the cattle population is represented by eight local or regional breeds (Kazakh White-Headed, Latvian Brown, Black-Magpie, Steppe Red, Alatau, Aouliyekol, Gallovei, Aoulieata) and four exogenous breeds. There are also many breeds of small ruminants, including the famous Karakul sheep bred for its fleece. Horses, bred for their meat and milk, are represented by a dozen breeds as well. The camel population is characterized by the cohabitation of two species, the Bactrian of the Kazakh Bactrian breed, with its three types (Oralbokeilik, Kyzylorda, and Ongtüstik Kazakhstan) and the Arvana breed (dromedary camel) to which it is necessary to add many hybrids (Faye and Konuspayeva, 2012).

UPHEAVAL OF THE BOLSHEVIK REVOLUTION

The beginnings of the Bolshevik revolution appeared rather beneficial to the breeders who recovered part of the land occupied by Russian settlers. Support from the new State even allowed them to develop small agricultural enterprises.

Stalin's ideology

According to Stalin's ideology, the nomadic way of life was not compatible with the modernization of the rural economy in a socialist society. Farming based on the mobility of herds and men, and its tribal organization had to be destroyed to the root. This was done in three phases, all of which had a significant impact on the organization of the traditional rural society. The first phase consisted of the 'dekulakization' of the society, in other words, destroying the traditional authority of the Bai, all assimilated to wealthy farmers ('Kulak'), although their status in terms of animal capital could be very contrasted. The policy of dekulakization resulted in the arrest and deportation of most of the Bai, at least those who had not migrated to neighboring countries (China, Afghanistan). In fact, the liquidation of the Kulaks (which largely exceeded the Bai group alone) was both physical and institutional.

In a second phase, the Soviet power of this time carried out the forced settlement of the whole population, banning, in a first step (despite common sense), any seasonal movement of the herds, even if the authorities reversed this decision in the face of the constraints of the environment. In the last phase, the power set up the collectivization of production systems, which was carried out under conditions of extreme violence as those in the previous phases (Ohayon, 2006). The 1927–1932 events led not only to the death of nearly one third of the Kazakh population and to the entire destruction of the previous space organization, but also to a dramatic decrease in the number of animals, especially those reared by nomads, i.e. sheep, horses and camels. In a population mainly consuming animal products, this led inexorably to a famine heightened by the effects of collectivization. More than 1.3 million people, mainly from the steppe zones, perished during these dark years.

Under such conditions, the sheep population fell from 18 million to 12 million head, and the horse population from 3.5 million to only 800,000. Camels lost 90% of their population, from 1.2 million in 1927 to 120,000 head only on the eve of World War II. Regarded as an animal of the past, unlike the cow seen as the animal of the socialist modernity, the camel, hindered in its permanent quest for mobility, suffered more than the other animals the consequences of the forced settlement of the breeders. The disastrous effects of this proactive policy have been felt throughout the Soviet period, even if adjustments were made as early as the 1930s and heightened after the war (easing on mobility, regeneration of the pastures, food security during winter).

At the same time, however, Soviet agronomic research grew considerably in a myriad of institutes and universities, enabling the promotion of scientific development of crops and livestock. However, the Soviet agronomists and animal scientists developed a very top-down approach, with science being responsible for applying the recipes concocted in laboratories. Such an approach was facilitated by the status of agriculture, now directly or indirectly in the hands of the state, supposed to promote “the collective ownership of the means of production”, and which was in fact only a form of administrative management of agricultural and livestock enterprises. These took two forms, the *sovkhoz* (or State farm) where the peasants were all salaried, the Soviet power having in view the proletarianization of the peasant world, and the *kolkhoz* (peasant cooperative), in which members were interested directly to the results of the enterprise and could benefit from a private plot of 4000 square meters for family needs.

These collective structures (which were initially based on volunteerism) were like the modernization of the traditional Russian *Mir*. The new structures, by bringing together many of the tiny farms of the prerevolution, allowed for economies of scale that were supposed to make agricultural production more efficient. The result, in the end, was in fact contrasted, the inefficiency of the Soviet system being able to coexist with real advances in agricultural productivity (Grigg, 1985). On the other hand, the collectivization in traditional Kazakh structures, based on mobility and tribal management of pastoral spaces, has durably affected the productivity of livestock. The establishment of collective structures has also had two important consequences on the organization of work: i) the specialization of the professions of agriculture, consequence of a kind of taylorization of activities (tractor driver, milker, reaper rather than ‘peasant’), and ii) a direction (*kolkhozes*) or an administration (*sovkhoze*) that was more a response to a demand from above (the five-year plan) than an answer to the needs of the population.

Agricultural grasp of pastoral lands and degradation of rangelands

Beyond, and despite the plummet in the number of livestock, the collectivization policy has also led to a degradation of pastoral resources. It had already started in Kazakhstan with the post-revolution sedentary phase, but it worsened in the period

1960–1980 because of i) the conversion of pastures into crop land, particularly under the influence of the ambitious Valorization of Virgin Land program, launched by N. Khrushchev in 1953, to transform Kazakhstan into a wheat granary of the Soviet Union, and ii) overgrazing related to the constraints imposed on herd movements. This deterioration was exacerbated by the drop in groundwater levels near rivers and streams, especially around the Aral Sea, whose supply waters declined because of the large-scale irrigation of cotton fields from the Syr-Darya River. A large part of the land was changed into desert and/or was salinized, making it unsuitable for pastoralism.

The changes in cycles and the magnitude of traditional mobility, the main guarantee of spatially balanced management, have led to a gradual fragmentation of the pastoral space (Kerven et al., 2006), concentrating livestock in certain areas (e.g. around water points) and thus increasing the pressure on pastoral resources that have become less available and less abundant than in the past. On the eve of independence, the Kazakh pastoral space was thus not only deteriorated (Schillhorn van Veen, 1995), but it was also affected by pollution of industrial or agricultural origin (Konuspayeva et al., 2011a). This situation had direct or indirect consequences on livestock and their productions (Kenesariyev et al., 2008a; Konuspayeva et al., 2011b), and on consumers (Kenesariyev et al., 2008b).

UPHEAVAL OF INDEPENDENCE

The independence of the Republic of Kazakhstan following the Soviet Union collapse in 1991 deeply altered, once again, the agricultural landscape of the country and the livestock sector. Three factors have played a major role in the restructuring of the sector: privatization, atomization of large structures, and the emergence of large agricultural enterprises in the process of modernization.

Collective structures dismantling

The privatization process began timidly shortly before independence, during the restructuring period (*perestroika*) initiated by M. Gorbachev. The land, animals and equipment belonging to collective structures were allocated to members of cooperatives to begin a gradual transition toward privatization (Vidon, 1998). The process accelerated after independence and took place in three phases: i) the Land Reform of 1991 which defined the duration of the leases accessible to private farmers (the land in fact continued to belong to the State), ii) the recognition, early 1993, of the rights of individuals to establish private farms, and iii) the inclusion of collective structures (*sovkhozes* and *kolkhozes*) in the privatization process in 1994–1995. The main part of privatization took place in the last two years. Privatization was not only about land, but also about production assets and animals.

In practice, the redistribution of the means of production was very unequal and sometimes was a real looting of all old collective structures, including collective

cultural or educational buildings, as cooperatives and state farms were integrated systems that included schools, dispensaries and culture houses.

The privatization of livestock suffered the same fate as the rest of the assets, but the State's part remained important for a long time. There were also strong regional differences, with smaller structures being more present in the South than larger ones. In 1994, 33% of the sheep still belonged to collective structures where the State's part prevailed.

Animal production decline

However, the main impact of privatization on livestock was the drastic decrease in numbers, which recalled the effects of the forced collectivization of the 1930s. The numbers had increased steadily after World War II (around 5% per year), but had generally stagnated or even declined since the 1980s because of poor livestock feeding, unequal management of production units and misrepresentation related to directed planning (Kerven et al., 2009). This stagnation phenomenon observed in the 1980s thus increased until independence, although the fall in numbers is difficult to assess because the available statistics of this period are subject to caution: probably overvalued to satisfy the demands of the plan in the 1980s, the numbers were under-reported after independence to avoid the payment of the tax introduced on private animals.

Nevertheless, the fall truly occurred because the breeders had to reduce their herds in order to face the cost of inputs now borne by them. Moreover, from a mono-active specialist, as reported above, the breeder was supposed to carry out the multiple activities of a peasant without having the skills, which led to management errors with sometimes disastrous consequences on the health or feeding management with an increase in livestock mortality (Delehanty and Rasmussen, 1995). The lack of cash also resulted in a drastic reduction in sheep number, which became a currency for exchange. The sheep population dropped from 33 million head in 1991 to 13 million in 1996. The same phenomenon was observed in all the former Soviet Central Asian republics (Vidon, 1998). The cattle herd was equally affected by the decrease in numbers, from 9 million head in 1991 to less than 5 million in 1997 (table 2).

Table 2: Changes in the number of livestock since the independence of Kazakhstan

	1992	1997	2008	2014
Cattle	9,084,000	5,424,600	5,840,900	6,032,742
Sheep	33,908,000	13,000,000	13,470,100	15,535,302
Goat	692,000	679,000	2,609,900	2,379,266
Horse	1,666,400	1,310,000	1,291,100	1,937,921
Camel	145,100	111,100	143,200	165,888
Pig	2,976,000	1,036,400	1,352,700	884,738
Poultry	59,300,000	15,296,000	29,400,000	35,020,000

Source: FAOStat

In 2014, only camels and horses had exceeded their numbers at the time of independence. The other species regained only partially their numbers. Even the swine population, particularly affected by the massive emigration of the Russian, Ukrainian and German populations in the days after the independence (the mostly Muslim Kazakh population does not traditionally consume pigs), kept decreasing. Overall, the numbers dropped between 1992 and 1997-1998 by 53% (cattle), 60% (small ruminants), 46% (horses), 44% (camels), 70% (pigs) and 75% (poultry) (Figure 3). This drop in numbers has also resulted in a drop in production, which decreased by more than 50% for beef, 36% for mutton, and from 5.5 million tons in 1992 to 3.3 million tons in 1997 for milk. The production also experienced its lowest level since independence in 2001. This fall could be attributed not only to declining livestock numbers by simple mechanical effect, but also to decreasing productivity, particularly in the meat sector: the average weight of bovine carcasses dropped from 185 kg in 1992 to 150 kg in 1997. At the same time, a decrease in the demand was observed with a fall of 14% in meat consumption, 12% in milk, and 16% in eggs (Vidon, 1998).

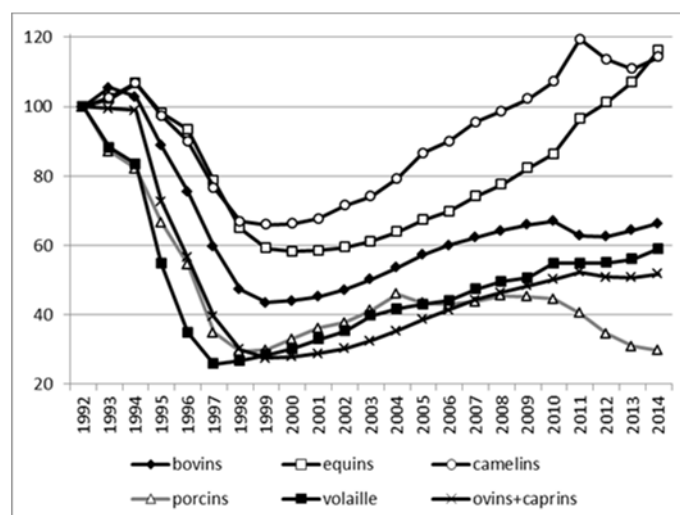


Figure 3: Changes in animal numbers in Kazakhstan since independence; Index 100 in 1992. Source: FAOSTat

CHANGES IN THE FARMING SYSTEMS

The main changes observed are in the size of the farms. Between 1990 and 2012, the number of agricultural production structures increased from 5000 to 188,616, attesting to the atomization of previous collective structures (OECD, 2013). The changes in livestock systems can be summed up in three major types: i) large agricultural enterprises more or less directly derived from the collective structures of the Soviet era, ii) large farms with varying statuses, more or less specialized, resulting from the concentration of bankrupt family farms, and iii) small family structures. There is a strong regional disparity as larger structures are more present in Northern and Northeastern regions, mainly cultivating cereals, whereas smaller

structures are usually present in Southern and Western regions and more oriented toward multiple crops.

Direct heirs of large collective structures

After a dismantling phase of the sovkhozes and kolkhozes, the former presidents managed to maintain an entrepreneurial structure, either by purchasing at low prices the units of insufficiently competent members, unable to survive with the means of their production, or by integrating the former members into a kind of private cooperative. In the first case, the concentrated power evolved into a latifundium system, where the former members of the structure were reduced to becoming low-paid employees, with the owner sometimes absent. The structure has taken over the old assets and activities with a minimum of investment. In the second case, by involving all the members of the cooperative in the results of the company, the manager is committed to the modernization of the activities, looking for ways to invest in both tools and persons. These agricultural enterprises are often non-specialized (farming of different species, crops, sometimes processing). These structures include only a small proportion of cattle (7.6%), small ruminants are represented even in fewer numbers (4.3%). On the other hand, they rather specialize in pig production (almost 30% of them), and especially in poultry production (about two-thirds of the structures) (table 3). They manage large agricultural areas of more than 8000 hectares on average.

Tableau 3: Distribution (%) of farm species in the agricultural structures in Kazakhstan

	Agricultural enterprises	Large farm	Smallholder
Cattle	7.6	27.5	64.9
Sheep/goat	4.3	34.9	60.8
Pig	29.6	11.5	58.9
Horse	6.1	40.2	53.7
Camel	9.4	35.7	54.9
Poultry	65.2	1.3	33.6

Source: Ministerial Committee of Economic Statistics, Kazakhstan, 2014

Large farms: Result of the concentration

The large farms were formed by the aggregation of more specialized family farms that abandoned their activities by lack of adaptation to privatization and by a gradual investment to strengthen the means of production. They formed gradually with the lead of an investor-breeder in search of modernity, ready to invest the market by focusing on both production and processing. The diversification of activities occurred in a second step to bring an added value to the products. In the livestock sector, a good third of small ruminants and camels, a little more than that of horses, and slightly less of cattle have been present in these farms. On the other hand,

these farms have been less present in the pig sector (11.5%) and especially in poultry farming (1.3% only) (table 3).

Family farming, late for investment and modernization

Small family farms hold most of the livestock population (except for poultry), as more than half of the Kazakhstan's animal population is included in this type of structure (table 3). Family farms produce more than 80% of milk and 67% of meat (all species combined). They therefore play a key role in the supply of animal protein to the population, but also in food security for the rural population, the part of self-consumption being very important. They are part of often unstructured and very short commodity channels (direct sales to consumers or bazaars) and offer highly variable quality products. The meat productivity per animal appears significantly lower than in large structures: the average live weight at slaughter is 315 kg in family farms, 325 kg in large farms, and 399 kg in agricultural enterprises. The average dairy productivity of cows is higher in family farms than in large farms (2320 L vs. 1767 L), but it is much lower than in large agricultural enterprises (4252 L) which generally benefit from better genetics and feeding.

MODERNIZATION: A MAJOR ISSUE IN KAZAKHSTAN AGRICULTURE

Within two decades, the structure of farms has thus been completely reversed from the absolute domination of large structures to the predominance of family farms, often at the limit of subsistence. This drastic change in operating structures raises the issue of the modernization of agriculture.

Concerned about the challenges faced by agriculture, the State decreed for years 2003–2005 its support by investing 600 billion tenge (KZT, i.e. 4.6 billion USD at that time) in the sector. Since then, a sustainable development program for 2005–2010 has been decided (Act No. 184-185 of 12 July 2005); Agriculture is part of the government's priorities under its 2030 strategy program to exit particularly from 'all oil' and diversify export activities. In the years that followed, state aid to agriculture averaged 200 billion KZT (1.36 billion USD) per year. This amount represents an average of 11% of farmers' gross revenues, which is ultimately modest compared to farmers' support from OECD countries, averaging 21% (OECD, 2013). However, 82% of these public subsidies concern measures related to production and prices. Producers are therefore disconnected from the markets and their production decisions may be misrepresented (OECD, 2013).

Elsewhere, this support appears unequal. Family farming, although now predominant, is not being the most subsidized and appears rather cut off from technical innovation. To pursue modernization of agriculture, it is essential to invest public funds in agronomic research and training of all the stakeholders in the sector, and in technical innovation, transport infrastructure and protection systems. Producers

are often isolated in this huge, sparsely populated country. They have to face the remoteness of consumption centers that increase transaction costs and hinder the development of agriculture. Hence the priority has to be given to the building of rural roads. This situation mainly affects the meat and dairy sectors, as the lack of modern refrigerated storage and transport means often prevents sales beyond the local market.

CONCLUSION

After the main political and sociological events related to the Soviet revolution in years 1927–1932 and independence in 1991, the livestock farming in Kazakhstan has undergone significant changes marked by a dramatic decline in animal numbers and production, followed by a slight recovery accompanying the restructuring of the production systems. However, the interest of the Kazakh population in animal production is an asset to support livestock in this country. The modernization of this activity is a major issue for the next decades because the country has considerable potential.

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Qilian Mountains, Gansu Province, China: Tibetan Plateau biome

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INTRODUCTION

China has four million square kilometers of rangeland, occupying 42% of the total land area (MOA, 2010), where live about 17 million agroherders and herders (ECO-CAHYB, 2011). The land comprises 268 semipastoral and pastoral counties, mainly located in the provinces of Inner Mongolia, Tibet, Qinghai, Xinjiang, Gansu, Ningxia, Heilongjiang, Yunnan, Jilin, Liaoning, Sichuan, Hebei and Shanxi (MOA, 2013). Most of those areas are the traditional home of ethnic minorities, whose livelihoods and lifestyles revolve around herding and livestock (Long et al., 2008). As in many parts of the world, the rangeland in China fills essential ecological functions that affect both regional and global ecosystem processes. Although only a limited proportion of the national livestock production comes from pastoral areas (mutton 17%, beef 9%, cashmere 33%, wool 24%) (ECOCAHYB, 2011), animal husbandry is the primary livelihood source for local herders (MOA, 2011a).

Policies have played a major role in shaping rangeland management. Before the 1950s temples, monks, nomads, or tribes privately owned almost all the rangelands. People respected and depended on their rangelands, which ensured their livelihoods. They relied on the fact that the livestock depended on the forage from the rangeland, and humans depended on the livestock and the rangeland. The rangeland is at the basis of the livestock husbandry system, and this system was stable before collectivization but economic returns were low (Brown et al., 2008; Squires et al., 2009). After the 1950s, collectivization changed this notion and again de-collectivization promoted further change. In the 1980s, the introduction of rural reforms, notably the Household Contract Responsibility System (HCRS), led to economic benefits but accelerated to some extent rangeland environmental degradation in some regions (Banks, 2001; Han et al., 2008). HCRS policies promoted sustainable use and management of natural resources, especially in crop and grassland (cultivated pasture) areas, and consequently tried to achieve the two goals of alleviation

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of poverty and conservation of natural resources; they were enacted in the Grassland Law of China in 1985.

A few years ago, the government introduced HCRS in pastoral areas across China. Since 2000, the Chinese central government has paid closer attention to protecting rangeland areas and other ecosystems, because rangeland degradation has been accused of severe climatic events, such as sand storms, high mortality floods, and downstream impacts, especially those related to water for irrigated crops, human urban consumption and industrial use. In other words, rangeland degradation in Chinese pastoral areas impacts the Chinese agriculture, urban centers and industry. According to Wu and Richards (1999), there has been considerable variation in the way the national policy was implemented by Chinese local governments.

The main policies regarding rangelands and the lives of breeders have succeeded one another starting in the middle of the 1950s, just after the Chinese Revolution of 1949, until the middle of the 1960s, just before the Cultural Revolution, then from the end of the Cultural Revolution during the second half of the 1970s to the beginning of the 21st century, and over the last two decades. In all three periods, the central government policies strongly influenced the livestock systems in the rangeland areas, as well as in grasslands.

POLICIES INITIATED BETWEEN 1953 AND 1963

With the founding of new China in 1949, all land was to be communally managed and owned. In the 1950s, the first policy to address rangeland problems was developed. This was the “General Summation of the Pastoral Production in Pastoral Areas in Inner Mongolia, Sichuan, Qinghai and Xinjiang Provinces.” These provinces form the vast areas of rangelands in Northern and Western China. This policy had an important impact on rangeland management as it stipulated that the production of livestock on pasture land should be increased, and institutions should be developed to promote higher yields. The policy also aimed to replace crops with livestock production in marginal semiarid zones. Changing pastures to crop production was prohibited. The impact of this policy was limited because it was replaced by two new ones. The policy for a “National Program for Agricultural Development” in 1958 prioritized pastoral development. Again, the policy favored livestock breeding on rangelands and promoted conservation of pasture resources. It was recognized that the need to grow high-quality grasslands called for the provision of additional water points for livestock. This policy has led to more institutions promoting productivity and technological improvements on rangelands through research and outreach. However, the development of additional water points has increased local overgrazing in many zones (Banks, 2001; Williams, 2002). The “Regulations on Policies for the Minority Ethnic Groups and People’s Communes in Pastoral Areas” were enacted in 1963. The policy recognized that rangelands needed to be protected by maintaining water resources, killing rodents, and building water conservation

works. Instead of private investments, the central government began funding these activities. This was a radical shift in resourcing rangeland development. Because of these three policies, livestock numbers doubled in many areas (Longworth and Williamson, 1993; Huang, 1996). From 1966 to 1978, the Cultural Revolution interrupted more than a decade of policymaking, which resumed in the mid-1970s and intensified.

POLICIES INITIATED BETWEEN 1978 AND 2002, AND ONWARD

In 1978, China began rural reforms, and farmers, including the poor, benefited from steady income growth and increased food security. During the planned economy period in 1976, the per capita annual income of the national people's communes (agricultural collectives) was 60.2 yuan (¥), lower than that in 1956 at constant prices. At the time, more than a third of farmers were heavily in debt and about 100 million farmers faced food shortages. By 1978, China was no longer self-sufficient in grain and had to rely on imports to feed 40% of the urban population. In 1978, farmers set up the collective contract responsibility system for production, which was developed into the household contract responsibility system in 1981. The enthusiasm of the peasants received a positive response from the senior leaders, and eventually led to the abolition of the people's commune. The reform program implemented in the 1980s included the following measures:

- Family farms replaced collective farms. Small farms run by farmers have an average of 0.5 hectare of land use rights;
- Abolish the state monopoly on the purchase and sale of agricultural products, open the free market, implement the state contract purchase system, raise prices and change price and market policies;
- Develop structural policies to promote agricultural diversification. The formulation of rural non-agricultural economic development policy is to employ the surplus labor in non-agricultural activities.

The above measures were issued each year from 1982 to 1986 through the document of the CPC Central Committee, the top priority in decision-making by senior leaders. Firstly, Document 1 played a role in getting local governments to pay attention to food production and rural development. Secondly, it promoted measures to achieve the short-term objectives of the current year's policies referred to in the document. Thirdly, it reiterated medium- and long-term strategies and policies for food security and rural development.

For the period 2004–2013, Document 1 focused on the following issues:

- According to market signals, the minimum price guarantee system for rice and wheat growers should be established to protect farmers from price fluctuations. When the market price is higher than the guaranteed price offered by public

procurement agencies, farmers can sell their products to any other buyer. The minimum purchasing prices for public procurement have steadily increased. For example, the price of first-grade paddy rice was 1.64 ¥/kg (~0.27 US\$) in 2008, whereas it was 3.0 ¥/kg (~0.5 US\$) in 2013, and the price of first-grade wheat was 5% lower than that of paddy rice in the same period;

- Subsidies are offered to grain growers, payments are made directly to the planting areas, for high quality seeds (and animal breeds), agricultural inputs and tools, and machinery, such as diesel and chemical fertilizers;
- Increase public investment in infrastructure improvement and agricultural research. For example, in 2011, the central government spent 130.99 billion ¥ (21.1 billion US\$) on building irrigation facilities, rural roads and power;
- Expand key demonstration zones for agricultural technology extension. In addition to providing extension services, mechanization of small farms is promoted by the production of small machines and tractors. This is to drive the rich farmers to specialize in machine service and enter the agricultural service market. The modernization of small-scale agriculture has led to a dramatic increase in grain yield, from three tons per hectare in 1984 to 4.88 tons per hectare in 2008;
- More investment is assigned to capacity building for disaster mitigation and prevention, as well as to land amelioration and consolidation. Fiscal spending of central government on these items amounted to 104.2 billion ¥, equivalent to 16.8 billion US\$, in 2011;
- The agricultural growth of 1978–1985, together with the acceleration of industrialization and urbanization since the 1990s have enabled most rural households to achieve food security and escape from poverty. Table 1 shows that the average commercialized rate of grain output per household increased with the gradual decrease of cultivated land area. As the share of non-farm labor rose, the share of farm income as a share of total household income declined. Firstly, such a trend reflects the shift from part of agricultural land to non-agricultural use. Secondly, agricultural productivity was enhanced. Thirdly, about 260 million rural workers migrated to cities each year and provided substantial financial support to their families in their home villages or towns every year.

With the advance of the rural reform process, the central government implemented the poverty alleviation plan in 1982 in a few Western provinces, and launched the national poverty alleviation strategy in 1986, aiming to solve the problem of food and clothing for the poor by promoting the development of poor areas. By 1994, the goal of food security was achieved. Subsequent antipoverty schemes chiefly aimed at eliminating income poverty. Among the major anti-poverty measures to date, socioeconomic and human resource development projects have been implemented. According to the poverty line set by the World Bank (US\$ 1.25/day/capita consumption or income), the incidence of urban poverty in China dropped from 44.5% in 1981 to 0.9% in 2008, and the incidence of rural poverty dropped from 94.2%

to 22.3% in the same period. In 1978, China began the rural reform and identified 250 million rural poor. It is measured in terms of the poverty line, which is defined as 200 kilograms of food per person per year.

Table 1: Household income and off-farm activities

Year	Household size (person)	Family labor (person)	Non-agricultural labor (%)	Cultivated area (mu*)	Sold quantity / total grain output (%)	Annual net income / capita (¥)	Farming Income (%)
2000	4.2	2.8	29.7	7.43	44.8	2253	46.2
2005	4.1	2.8	37.9	7.09	59.0	3255	42.4
2008	4.0	2.8	41.0	6.86	63.9	4761	38.3
2010	3.95	2.85	ND	6.50	ND	5919	ND

15 mu = 1 ha; 1 US\$ = 6-7 ¥ to 8-9 ¥ depending on the period; ND: no data available

Source: Ministry of Agriculture, China, 2009 and 2012, China Agricultural Development Report, Beijing, China Agriculture Press

Public support has greatly strengthened food supply and food production has been increasing. The total grain output exceeded 400 million tons in 1984 and 500 million tons in 2010. Edible oil production exceeded 16 million tons in 1990 and doubled in 2010. Meat production of 29 million tons in 1990 increased by 189% in 2012.

The first major policy emerged from the United Nations Rio Conference on Sustainable Development in Rio de Janeiro and led to Agenda 21 that spelled out China's priorities and environmental goals. At the same time and since 1978, the Chinese rural economy has undergone three major reforms. The first was the introduction of HCRS. Because of its importance to pasture development in the 1980s, it is evaluated separately further on. The second one was the proliferation of "Town and Village Enterprises" throughout the 1980s. The third one was the "Tidal Wave" of the Chinese rural economy and began in 1995. It embodied the concept of agro-industrialization (*nongyechanyehua*) but it was preceded by other measures that were gradually introduced from 1979 (Brown et al., 2008).

In 1979, the policy "Resolution on Several Problems Related to the Speeding up of Agricultural Development", aiming at solving problems regarding agricultural development and improving pasture management, was introduced. This policy was similar to that of 1959 and focused on building water conservancy facilities, fostering rotational grazing, improving livestock breeds, and increasing the carrying capacity. This resolution also issued contracts to families to use rangelands for their livestock. By 1982, the household contract problem had become a top priority. The government extended HCRS to the whole of China. This significant policy clarified regulations for expounding grazing land agreements to households in rangelands and families were given safeguards, such as lands given for livestock to graze. This transfer from public use to family use had a deep effect on the people and the status of grazing lands.

Since 1978, because of the contracts issued, the successive Chinese governments had become aware of rangeland degradation and the importance of developing environmental policies for rangeland protection. Thus in 1984, the policy “Instructions on the Campaign of Making the Countryside Green” was issued and included more severe punishment clauses for degrading forests or rangelands. This policy resulted in reducing landscape degradation. To reinforce the measures to protect against land degradation, land tenure included, the “1985 Grassland Law” was also issued. Among others, the policy authorized local governments to fine people who degraded rangelands or to condemn them to restore them. To enforce the “1985 Grassland Law”, several departments were created within the Animal Husbandry Bureau of the Central Government. The local sector was developed with the aim to alleviate poverty with an emphasis on sustainable management of natural resources; in particular upstream of Yellow River and Yangtze River, plans included improving infrastructures and empowering local institutions to address social vulnerabilities and protect rangelands (Liu et al., 2001). Since the mid-1990s, a national development strategy has emerged through the “Great West Development Program”, which lays the framework for sustainable development.

In 1998, the “Natural Forest Protection Program” was implemented to prohibit logging in natural areas (~30 million ha) upstream of the Yangtze River and upstream and middle stream of the Yellow River. The central government provided financial aid and granted tax reductions so that local governments could assist workers who had lost their jobs after the shutdown of timber enterprises, and help new businesses get started (CCICED, 2002). The “Conversion of Cropland to Forest and Grasslands Program” (CCFGP), also known as “Grain for Green”, was implemented starting in 1999. Thus, 6.07 million hectares on steep slopes qualified for the program, among which 70% was located in Yangtze River and Yellow River areas. In all, about 17.8 million hectares, i.e. 52% of Western China cropland area was concerned by the program (CCICED, 2002).

CCFGP main goals were to alleviate poverty while preserving water and lands. Supported by many government agencies it aimed at converting steep slopes from crop production to forests and pastures and thus contribute to helping millions of land users while preserving the environment.

In the mid-1980s, HCRS initially concerned the main grazing zones, it has however extended today to the main pastoral provinces of Northwestern China. “By 2011, the total contracted rangeland areas accounted for 79% of China’s usable” rangeland (MOA, 2011b). According to HCRS rangeland degradation is caused by overgrazing of these open-access areas. The policy aimed thus at defining household’s property rights, i.e. the carrying capacity of the grazing land should equal or exceed the number of livestock there. This approach was assumed to prevent further rangeland degradation, even restore it. “By 2011, grazing had been excluded from 40.33 million hectares of rangeland in the main pastoral areas, representing about 15% of useable grassland in these areas being taken out of use” (MOA, 2011b). As these

measures had a major impact on local herders, the government granted them subsidies so that they could either give up open-range livestock breeding or develop intensive livestock farming.

POLICIES INITIATED BETWEEN 2006 UNTIL NOW

The “1985 Grassland Law” was amended to develop further the measures related to rangeland protection, and its new version was implemented in March 2003. Figure 2 sketches the livestock policies set up in Chinese rangelands since 1949. Originally, the policy focused on increasing livestock production on farms but after the Cultural Revolution, there was a strong demand for user rights. However, to confer these rights caused many land use problems, especially with the increased public awareness of environmental degradation along with economic consequences in China (World Bank 2001). These have led to further policies to reduce flooding and adapt to climate change. As shown in Figure 2, the local government of Qilian Mountains included the regulations of the provincial and county governments when implementing these policies.

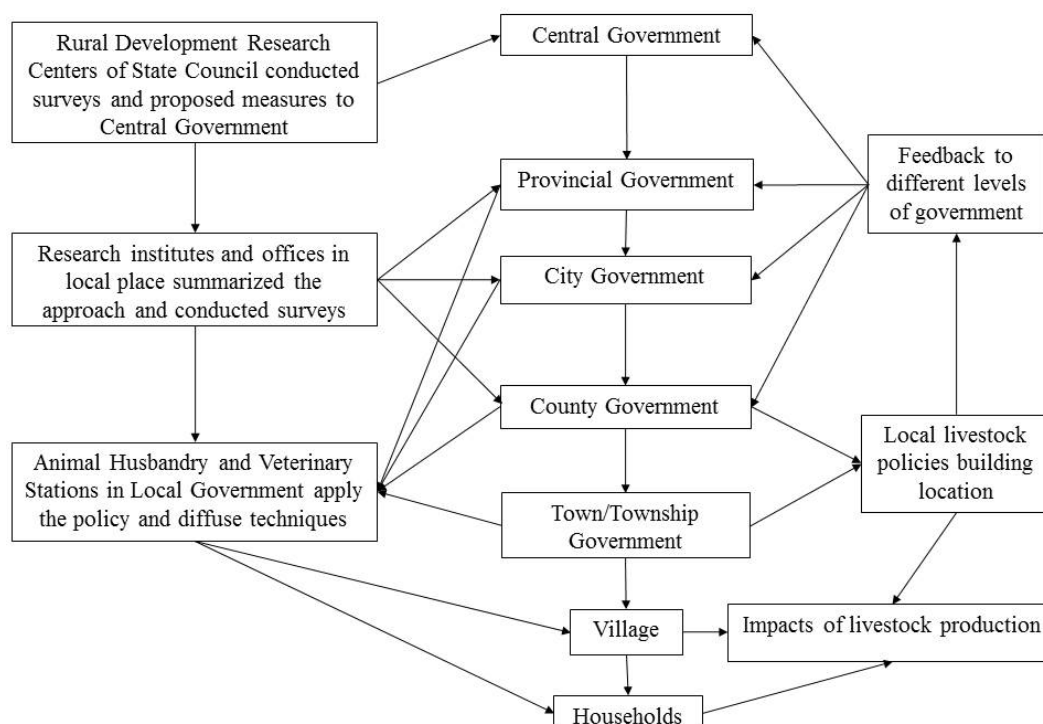


Figure 2: Flow chart of the top-down livestock policy development in the rangeland areas of China

EFFECTS OF POLICIES ON LIVESTOCK FARMING IN QILIAN MOUNTAINS

The Chinese Revolution then the Cultural Revolution implemented very constraining policies on the land then on herds, which destroyed the traditional complex rules set up by the monks, temples, tribes, or breeders, with severe consequences, especially in terms of pasture degradation and water depletion. After terrible crises, public policies have been progressively implemented, especially HCRS, in order to reduce or limit the environmental impacts of livestock activity in the rangeland. They mainly focused on the pasture, as a source of feed, and on the herd.

Effects of public policy on the pasture

Regarding the use of the pastoral resource over the past three decades in Qilian Mountains, the main public policy effect, and above all that of HCRS, is the presence of fences on pastures (Long et al., 2018). Fences on rangelands indicate the right to use the land, not the right to own it, by the family to which it has been assigned, as it remains a community good: the community is always the landowner and the diverse families of the community receive pieces of land to develop their rural activities. For these authors, “The concept of usage right seems to be evolving. Indeed, it means that not only can the family graze its herds on the allocated land, but it can also rent it out and earn income from it – or even rent additional land from others if required.” They add: “Usage rights can be transmitted from the parents to the children under certain conditions, but it seems more advantageous for the families that the young couple settling down asks the community for its own and separate usage rights to land” (Long et al., 2018).

Furthermore, the new rule on the use of fences in the rangeland has been often adopted without considering the local topography, and the use of water and roads. Under certain conditions, this can lead to harsh conflicts between families. In addition, these dividing lines were established about 30 to 40 years ago, when families varied in number. Today, the situation generates problems, e.g. during the transmission process of usage rights.

The grant of land-use rights applies not only to pastures but also to grass plots used for the production of supplementary feed for herds in winter and spring, especially during calving, lambing and kidding. However, there are differences between villages according to the ethnic populations, the available surface of winter plots, feed demand, etc., so that it is relatively fairly attributed while remaining flexible. Long et al. (2018) also observed that “the putting up or the repair of fences provides an opportunity for mutual assistance between households, especially since households in the same family often have adjoining usage rights on the same mountain pastures.” These authors add: “Collective forms of pastoral resource management still exist within the extended family, between parents and children, between brothers and between cousins, and between neighbors.” For example, when a family member or the whole household has to take leave, or in the case of dual activity, family

or neighbors take over the care of their mountain pasture and village plots. Specific arrangements exist at village scale. This solidarity is also reflected in the reciprocal relationship of winter forage fields when they are plowed when necessary or rented at preferential prices.

Long et al. (2018) noted that “surface areas allocated vary according to a number of factors, including locality, year of allocation, and household size.” In other words, within the same zone or between two counties there may be differences between the surface areas allocated. Furthermore, Long et al. (2018) wrote: “a difference in rainfall exists with about 600–800 mm in Huang Cheng, and only around 500 mm in Tianzhu. In addition, the rangeland’s productivity depends on the orientation, the altitude, whether and how much it slopes and, of course, the practices implemented, in particular the respect of recovery periods.” The allocated surfaces for winter forage are around one and two hectares per household, according to the village, the county and above all the available area. These areas are usually located in the valleys, close to villages where the herds stay during cold months.

Long et al. (2018) reported that “rental of forage plots is common. It allows large herds to obtain the feed they need and, at the same time, the owners of smaller herds can earn an additional income.” The rental income is around 10 ¥/mu (~20 €/ha) for summer and autumn rangelands, and around 25 ¥/mu (~45 €/ha) for winter rangelands and forage plots. It is a significant income, especially for older farmers as it brings them a supplementary revenue.

In conclusion regarding the public policy effects, HCRS has considerably changed the rangeland context, especially through the land use allocated to the households. HCRS became the rule but the norms can be adapted at local scale, especially at village level according to the available grazing and winter forage areas, the number of households, the climatic conditions, the specific demands, etc. These norms are defined both by the local administration and the leaders of the community and consequently there are accepted and respected by the households.

Public policy effect on herds

The public policy effect on herds is a bit different from that on pastures, even though the two are linked. To understand this, key information on herds is necessary. A typical breeder family has two herds, one consisting of 30–40 yaks and the other of 100 sheep, frequently with some goats. Breeding bigger herds, e.g. 100 yaks and/or 200–300 sheep, requires extra labor. Rangeland breeders are generally from minorities and are not limited to one child per couple. Children go to school but they help during weekends and holidays, especially for the transhumance. However, the main part of the work is carried out by the couple, eventually with one or two grandparents.

Among the constraints that face the herders, yaks are milked in the morning, and, as anywhere else on the planet, milking takes place every day all year round. Yaks

often eat grass also in the evening. There may be goats present in some farms that also need to be milked. Newborn calves, heifers and bulls require attention. Sheep have to spend the night in barns or corrals to save them from predators such as wolves and foxes. Inspection and eventually care are carried out in the morning before going to the pasture, or in the afternoon when the herd comes back. During grazing time the shepherd identifies animals requiring special care. According to Long et al. (2018) “the rest of the time available is devoted to other activities directly related to animal husbandry, such as the stocking up of feed for the winter, or the sale or purchase of livestock or inputs, and to more general farm activities such as maintenance of equipment, upkeep of buildings, shopping for the family, etc.”

Transhumance usually begins in late May to mid-June, when the summer pastures have begun to grow. The highest pastures are at an altitude of 3500–4000 meters, at the limit below the rocky parts. They are usually located dozens of kilometers away from the villages. The transhumance departure is decided collectively at village level depending on weather conditions, and the quality and quantity of pastures in the alpine meadows.

Most of the family income (60–70%) comes from the sales of animals (Long et al., 2018). A secondary income may come from other products such as wool, leather, milk, cow dung for heating. The yak bulls are sold 4000–6000 ¥ (450–700 €) at 4–5 years old, according to the size, weight and fat cover, at a live weight of 200–250 kg. Cull yak cows are sold 2000–3000 ¥ (250–350 €) depending on the weight and fat cover, at the end of their reproductive career, usually at 12 to 18 years. The lambs are sold at six months old 450–600 ¥ (55–75 €) according to their size and live weight (15–17 kg) in June–July, just before or at the beginning of the transhumance. Long et al. (2018) noted “a few variations in sale conditions and prices depending on the breed and the practices of breeding and feeding.”

Regarding the production, there are about 100 sheep in a flock that produce around 95–100 lambs per year (~one lamb/ewe/year). Around 20 female lambs are retained for the herd and 75–80 lambs are sold. In a herd of approximately 50 yaks, there are 12–15 cows that calve and about as many heifers. About 4–6 yaks are sold each year. Female yaks produce one calf every two years, or two calves every three years, depending on the breeding conditions, especially the quantity and quality of feed. According to Long et al. (2018), smaller intervals have been reported. The age at first calving is 5–6 years old.

A farm breeding 40 yaks and 80 sheep annually sells for about 40,000–45,000 ¥ (~5,000 €) of meat animals. The income from wool increases by 5–10% with Tibetan sheep, 15% with Merino sheep, and 20–25% with White yaks whose tail is also valuable. A Merino sheep produces 3–4 kg of wool yearly which is sold 25–35 ¥/kg (3–4 €/kg). Leather is sold to the butchers at 80–100 ¥ (10–12 €) per skin.

According to Long et al. (2018) different subsidies and allowances per head of livestock are received by families, especially through HCRS. Household incomes thus

increase by about 10%, regardless of other subsidies such as those to buy tents and other equipment for transhumance, or to repair farms or build new ones that will be better adapted to the harsh winters, or to buy apartments in the city for near-retirement farmers.

Additional activities exist to increase the farm income, for example entertaining visitors in tents and offering them a traditional meal or *Cordyceps* harvest (*Ophiocordyceps sinensis*). Other activities, particularly those related to trade and services, cause longer periods away from the farm. In those cases, the remaining family members rely on parents, siblings, or neighboring farmers to lessen the labor burden.

The main cost of a herd is the feed (including sometimes concentrates), and grassland rental. The building of stables and sheep pens had been a major investment but the decline in mortality and increase in livestock weight seemed to have balanced out the expense, especially since these facilities had been largely subsidized.

CONCLUDING REMARKS

Since 1953, about 10 major policies have been enacted to benefit rangelands and those who live off them. In Qilian Mountains, over the past 60–70 years, herders have gone through three stages. The first stage began in 1949 with the Chinese revolution and continued until the Cultural Revolution in the mid-1970s. Both revolutions have completely changed the traditional land structure, which was until then owned by monks, nomads or tribes and where sustainable pasture management prevailed. The second stage began in the 1980s with large-scale public action, organized around HCRS, which aimed at improving the living conditions of families while seeking to reduce pasture degradation. In the third and current phase that began in the early 2000s, the high local demand for livestock products has further emphasized the positive impact of HCRS on livestock breeding. The successive policies over the last half century have clearly impacted livestock in Qilian Mountains, and more generally in Chinese rangeland areas.

Progressively the livestock sector has become highly dependent on the policy focused on animal and pasture, but also on environmental and social issues. However, no action has been taken to date toward sustainable pasture management. Instead, the pressure on the land has been increasing because of the increasing herd size. Significant efforts have to be made to reverse the situation and improve the sustainability of livestock in the rangelands. In addition, many young people give up livestock breeding to find jobs in the cities. This is a problem but also an opportunity for rural populations to move on to more social sustainable practices where animal husbandry is redefined, especially since public authorities have committed their support.

The herdsmen in Qilian Mountains have overcome drastic changes but without redesigning their management of pasture resources. Nevertheless, the ongoing social

changes, particularly the lack of interest among young people for animal husbandry, might be offset by the access to new social and technological alternatives provided by the New Information and Communication Technologies and pave the way to greater sustainable opportunities.

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Livestock development, land-use reforms and the disinterest for pastures in the Northern highlands of Vietnam

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INTRODUCTION

In the last sixty years, livestock policies and land-use regulations have encompassed tremendous changes. These institutional transformations have particularly affected the northern Vietnam region. The Northern highlands refer here to the northern provinces of Vietnam with a high elevation characterized by mountains, uplands and midlands. The General Statistical Office uses the terms 'Northern Midlands and Mountains' (*Trung du và miền núi Bắc Bộ*) to describe this group of 15 provinces, surrounded by the Chinese and Laotian borders in the north and the Red River delta in the south. The present work focuses on the northwestern part of this ecoregion (Figure°1).

Ruminant production is an important component of farmers' livelihoods in this region. However, policy changes have not been accompanied by a major evolution of the ruminant production systems. Farmers continue to rely on natural grasslands and forest shrubs to provide fodder to their cattle. Moreover, the expansion of cash-crop cultivation on uplands has dramatically altered the landscape and reduced the availability of natural fodders (Eguienta et al., 2002; Le Thi Thanh Huyen et al., 2006; 2013).

Recent studies conducted in the Northern and Central highlands show the potential for sustainable development of ruminant production through forage cultivation, intensification of crop-livestock systems, and pasture development (Le Thi Thanh Huyen, 2010; 2014; Castella and Dang Dinh Quang, 2002; Stür et al., 2013). In order to assess better the potential of those solutions, the present chapter exposes the institutional dynamics of these agrarian systems. In particular, we show how public policies in the last 60 years have failed to recognize formally the existence and the importance of natural pastures.

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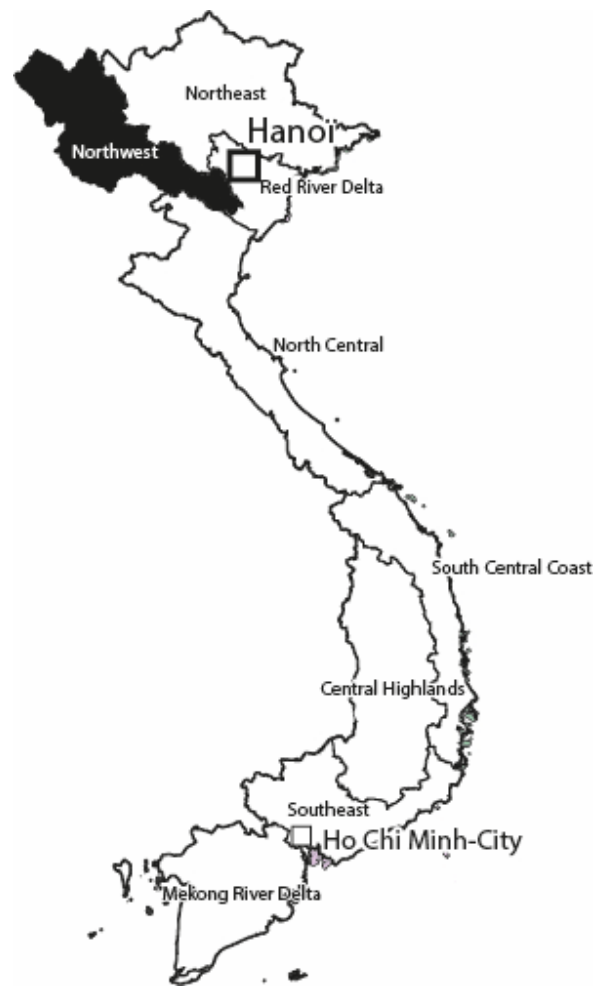


Figure 1: Northern region of Vietnam

AGRICULTURE IN THE NORTHERN HIGHLANDS

The Northern highlands account for about 30% of the total surface area in Vietnam and comprise more than 2000 administrative communes. Around 39% of the communes are located at a medium altitude of 200–600 m, and 39% at an altitude higher than 600 m. There are different mountains ranges, with some peaks exceeding 3000 m (Fansipan 3143 m), and several large intermountain basins. Due to this topography, the region is characterized by a wide range of ecosystems, from warm irrigated valleys in the low mountain zone (200–300 m elevation), to rain-fed hilly landscapes in the mid-elevation mountain zone (300–800 m), and a high mountain zone (> 800 m) (Vien, 2003).

The Northern highlands counted around 11 million people in 2009, i.e. 13% of the population with only 16% of the inhabitants living in urban centers (compared to 30% for the whole country). The region is characterized by a medium population

density with on average 116 inhabitants per kilometer square. This population density is only half that of the national average (256 inhab./km²) and one eighth of that in the Red River delta (950 inhab./km²) (GSO, 2016).

Around 40% of the population is composed of the Kinh ethnic group mainly located in urban centers and valleys. The remaining population (60%) is composed of ethnic minorities also called 'Montagnards' (Highlanders). In the low mountain zones that are closer to the roads and market infrastructures, the main ethnic minorities are the Thái (20% of the ethnic minorities in the region) and the Mường (17 %). In the mid-elevation mountain zones, the main ethnic groups are the Thái (23%), the Nùng (13%), the Dao (9%), the Khơ Mú (1%), and the Hà Nhì (0.2%). In the high mountain zone, which is a more remote area, the main ethnic minorities are the H'Mông (5%), the Lô Lô and, in some places, the Dao (Michaud, 2000).

Development constraints in the highlands are related to steep slopes, uneven grounds, soil limited fertility and remoteness, poor infrastructures, and a high poverty rate (Minot et al., 2006; Vien, 2003). These regions are considered as favorable areas for forestry, cash crops (e.g. maize, cassava, coffee) and livestock including fish. Ruminant production is widespread based on available natural pastures, as well as extensive pig and poultry rearing. Animal husbandry is therefore an important component of households' livelihoods (Minot et al., 2006) and accounts for more than 22% of their incomes (Epprecht, 2005).

Cattle are considered the most important ruminant species in the Northern mountainous regions and contribute to the livelihoods of nearly 70% of households (Maltsoglou and Rapsomanikis, 2005). Beef cattle and water buffalo "are raised in extensive mixed farming systems in hilly and mountainous landscapes of high altitude and steep slopes" (Dixon et al., 2001). Each family usually owns between two and five head. Cattle are largely multifunctional in those systems. They are used for drafting, manure, reserve of capital, offerings in cultural events, and their proceeds from market sales. However, market orientation is not dominant, and cattle contribute to a relatively small share of the total income of households (Epprecht, 2005). Furthermore, the cattle population is regularly affected by diseases and high mortality rates in winter because of poor health care services and feed shortages, especially for cattle grazing in natural pastures in the hill tops (Le Thi Thanh Huyen et al., 2011).

Smallholders in the uplands of Vietnam are mostly dependent on natural pastures for cattle feeding. Northern and Central highlands occupy more than half of the total grassland in Vietnam (Phong, 1995; Mui, 2003). "Free-grazing and tethered grazing are the main feeding systems, in which cattle are generally grazed every day on natural pastures in the forest land far from the homestead with little or no use of crop by-products" (Mui, 2003; Le Thi Thanh Huyen et al., 2006; Phung, 2009). However, the grazing area is declining because of crops expansion, resettlement or reforestation programs. As a result, and because there has been only little formal grazing management until now, available native pastures tend to be overgrazed.

The recent history of agrarian systems in the region explains the importance of natural pastures and grazing areas, and the emergence of new constraints that threaten current production systems. The following text presents an insight in the historical development of policies affecting livestock systems in these provinces. Land tenure, in particular, has had a major impact on cattle breeding systems and on the structure of cattle herds.

EXTENSIVE AGRICULTURE IN THE COLONIAL PERIOD (BEFORE 1954)

Northern highlands have long been separated from the main development programs of the Red River delta and other parts of the country. Until recently, the political control of the area had been influenced by complex relations between ethnic minorities and the central government.

During the colonial regime, feudal entities were recognized in the Indochina Confederation on the basis of ethnic groups and traditional chieftaincy or kingdoms (Michaud, 2000). At this time, forests dominated the landscape with some important clearings. The main crops that were cultivated were sticky mountain rice (*Oryza sativa* var. *montana*) and corn on slopes. Millet, buckwheat, sorghum, job tears (*Coix lacryma-jobi*) and sesame were also grown. Non-wood forest products and meat were used as a supplement in the diet. Shifting cultivation (*rai*) was an extensive agricultural technique widely used for slash-and-burn, in complement to intensive cultivation of lowland irrigated rice fields. The organization of the shifting cultivation differed from one ethnic group to another. Some villages used to cultivate plots on the western slopes of the mountains, others on shale and sandstone soils, others again defined the area customarily. In addition to this shifting cultivation focused on cereals, farmers cultivated vegetable crops, fruit crops and cash crops such as tea, tobacco, hemp, opium, cotton or nettle (*Urtica dioica*).

The subtropical forests of northern Indochina offered bioclimatic conditions favorable to cattle breeding. The buffalo were used for plowing irrigated lowland rice fields. When the old *rais* (1600 m²) were covered at the beginning of the rainy season with green grass, animals grazed those excellent pastures. But during winter, the pastures were reduced and dry. Animals had to rely on forest natural grass and fodder trees. Large ruminants were most often kept under traditional stilt houses. Manure was used on vegetable and rice cultivation plots. Rice growers also raised pigs and chickens in free grazing and scavenging in the villages, using swills and agricultural by-products. Livestock thus played a secondary though important role in the household economy.

On the foothills of these mountain areas, colonial farms and other commercial farms gradually established mostly for cash crops such as coffee or tea. Some land owners invested in cattle in order to use the manure to fertilize plots. This was the case of Mr. Borel in the Sơn Tây region at the foothills of Mount Ba Vì, who developed an important cattle farm attached to his coffee plantation in the beginning of the 20th

century (Duteurtre et al., 2015). Many of those large commercial farms benefited from natural pastures: colonial authorities viewed subtropical forests in North Indochina as 'livestock zones' as forest stands are spaced enough to allow the development of pastures (Demarez, 1919). Based on these cattle herds, a small number of dairy farms were created, very sparsely, near French population establishments such as Ba Vì or Sa Pa Elevation Station. These farmers imported dairy cows from India, Australia or Europe. However, the development of colonial land grants remained limited in mountain areas because of remoteness, poor infrastructure and resistance of local populations.

STATE FARMS AND COOPERATIVES DURING THE COLLECTIVIST PERIOD (1954–1986)

Until 1954, the region was hardly affected by the war against the French. In April 1955, the government of North Vietnam created the autonomous regions of Thái-Mèo (in the West) and Bắc Hà (in the East). They were renamed the Northwest Autonomous Region (Khu tự trị Tây Bắc) in 1961 and were separated again after the Vietnamese reunification of 1975 into different provinces. Between 1954 and 1956, the lowlands of the Red River delta lived at the rhythm of the agrarian reform, but in the mountains, the customary feudal system still prevailed. According to the land reform map of Võ Trường Sơn (1989), mountain areas were little affected by land reforms.

After 1954, colonial farms located in the piedmont regions were taken over by the army and progressively nationalized. Nearly one million animals, mostly cattle and buffalo, were transferred to militarized production units (Cesaro, 2016). In 1955, a contingent of troops settled down on the Mộc Châu plateau. This plateau had been noticed by the French administration to develop concessions in the 1930s. But it was the Vietnamese government who carried out this ambition. The 'Red Star' Mộc Châu military farm originally specialized in milk production. It remained a strong national symbol. Apart from Mộc Châu, several state farms settled in the mountains taking by force the best land for modern agriculture. These state farms participated in a broader program of transmigration of the Kinh population from the deltas to the mountains (Cesaro, 2016).

After the agrarian reform, the government decided to collectivize the land and form large cooperatives as early as 1960. This process went very quickly in the plains but was more difficult to implement in the mountains. The Thái who lived in the valleys were little involved whereas the H'mông living on the mountain peaks and the small enclave valleys were mainly outside the system. Ethnic minorities, however, were gradually driven to settlement and this forced them to progressively abandon shifting cultivation. The *rai* cultivation system was progressively replaced by more intensive cultivation systems of shallows, which led to the progressive closure of the grazing areas. Kinh migrants, who had been more receptive to political trainings and

propaganda than ethnic minorities contributed to building cooperatives in the mountains. Because of the lack of interest of local populations, the dynamics of co-operatives had been dwindling since the end of the 1960s. Moreover, mountain rice collective farming hardly managed to feed all the population. The management of land was then influenced by both the collectivist system and the customary rights of local ethnic minorities. To limit the expansion of the mountainous ethnic groups and slash-and-burn (swidden), the authorities prohibited land clearings. At the same time, the government encouraged clearings by cooperatives and state-owned enterprises. The result was rapid deforestation of the mountains in the 1970s and 1980s and a reopening of grazing lands.

THE RUSH OF FAMILY FARMING AFTER THE ĐỔI MỚI (1986–2010)

Đổi Mới (Renovation) reforms were launched in 1986 after the Sixth Congress of the Communist Party, following a major economic crisis faced by the cooperative system. These reforms resulted in a mix of policy decisions aiming at promoting a ‘socially oriented market economy’. In the agricultural sector, the priority was officially given to ‘household agriculture’ (Resolution 10 issued in 1988 by the Politburo).

In the first years of the Đổi Mới, the legal status of the hillsides was not clearly defined. Land allocation and cadastral registration policies focused on valley bottoms. “This led to an abrupt return to traditional shifting cultivation practices and an uncontrolled rush for each family to clear and appropriate as much upland area as possible. Within a few years, most of the forests in the province of Bắc Kạn had been cleared” (Ducourtieux and Castella, 2006).

Some of the main institutional reforms that were made in the following years to foster private agricultural production were the 1990 Law on Companies and Enterprises, the 1993 Land Law, and the 1996 Law on Cooperatives. The new land law, in particular, defined the ‘land-use right certificates’ as basis recognition of land use rights for private producers. The new law on cooperatives defined the new role of private cooperatives in providing services to farmers (Figure 2).

In the Northern highlands, the 1993 Land Law was promulgated “to regulate the runaway exploitation of the uplands by applying the same solution that had worked in the lowland areas: allocating forest land to individual households” (Ducourtieux and Castella, 2006). Forests were classified into three different categories that included the majority of sloping lands in the mountainous regions (Ducourtieux and Castella, 2006): i) Protected forests, supposed to be managed by local communities or organizations for the preservation of water resources, the prevention of erosion, natural disasters, climatic risks, and the overall protection of the environment; ii) Special-use forests, supposed to be managed through national parks or reserves, and focused on the conservation of nature, plant and animal species, scientific research, and the protection of historic, cultural and touristic sites; iii) Production forests, primarily designed for timber and other forest products. In addition, a land-use

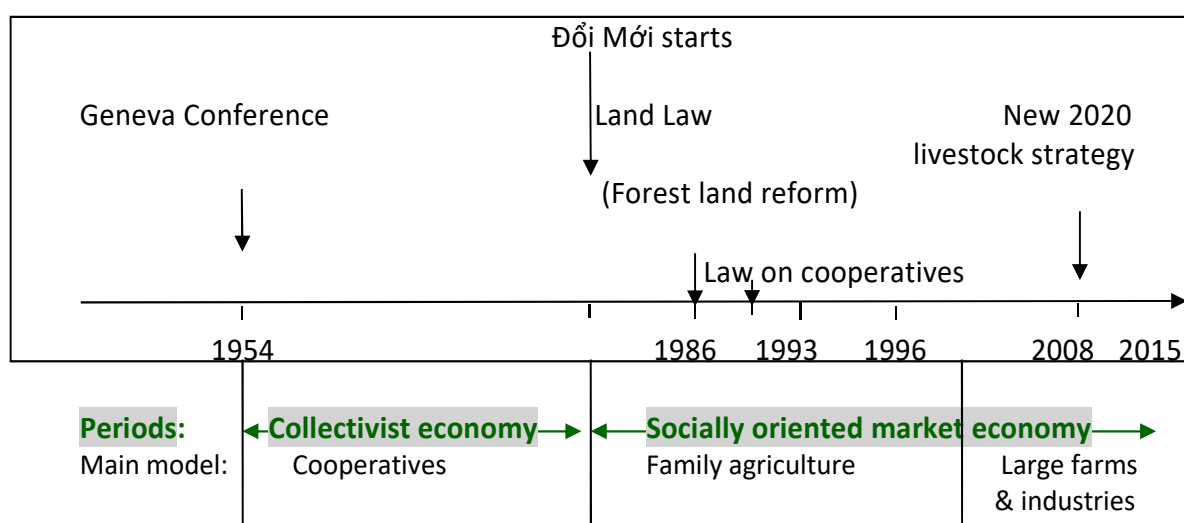


Figure 2: Main sequences in livestock development policies in North Vietnam

planning exercise was planned in each commune prior to land allocation “to make sure that the local distribution of land uses was compatible with the existing land-use plans at provincial and district levels.” In practice, this rarely happened (Ducourtieux and Castella, 2006).

Between 1990 and 2000, major forestation programs were launched, largely driven by state organizations on protected state-owned land⁴. The forest-cover increased from 30.2% in 2000 to 37.6% in 2005. However, since forestry was not a significant component of household economic activities, forestation did not concern the land that was used by individual households (Clement et al., 2009).

Those reforms did not consider the specific role of forests in providing pastures and fodder for ruminant livestock. Rather, they neglected to enforce the management of pastoral resources, which resulted in lower incentives to conduct cattle breeding on collective forest pastures. Cattle production yet slowly developed. In Sơn La province, for example, the cattle population increased from 120,000 to 170,000 head (Duteurtre, 2014).

Between 2000 and 2010, the government promoted the development of private ranches in the Northern highlands. This was in line with the implementation of a new production model based on land attribution to individual enterprises. In Sơn La, six large scale livestock beef cattle enterprises were created in 2002-2003, supported by a government program. However, these experiments mostly failed. They suffered from various technical and organizational constraints. According to Le Thi Thanh Huyen et al. (2010), these breeding farms “were established with financial help from the province (30% of the total farmland value). Originally, the aim was to

⁴ In 2015, a total of 319 state-owned enterprises still kept a leading role in the economy and managed 2,853,164 ha of agricultural and forest land nationwide (Government of Vietnam 2015 cited in Wells-Dang et al., 2015).

supply cattle to new residents for the development of smallholder beef production. In fact, all six farms belong to building companies that could dispose of sufficient capital to invest in such large farms.” However, smallholder farms were not willing to rear exotic cattle produced by these farms, while these farms did not meet the demand from supermarkets for high-quality beef outside the province. Moreover, they focused on developing high productivity cattle breeds (such as Brahman zebras) that were not adapted to the seasonal drop in pasture production during winter. They also had to cope with limited land for growing forage and pastures. In 2011, only one of them was still operating in Sơn La (Duteurtre, 2014).

EMERGENCE OF INDUSTRIAL FARMING (FROM 2010 UNTIL TODAY)

In this context, and because of the rapid growth in the demand for meat products during this period, the government decided to promote intensive livestock throughout the country. Decision 10/2008 of MARD proposed a few new policy orientations aimed at large farms and livestock industries to respond to the domestic demand. In the Northern highlands, this policy helped develop large-scale pig farms. However, it did not manage to create favorable conditions for industrial cattle breeding. Apart from Mộc Châu dairy company, the industrial model did not take off in the ruminant livestock sector (Duteurtre et al., 2012).

CONCLUSION

There has been a number of governmental policies for development of livestock production in Northern Vietnam, in general, including cattle production. Most of these policies have focused on breeding to improve cattle performance, with some forage production programs and projects, in particular in former state farms, mainly focusing on the dairy sector. However, there has been limited interest and support by government and local authorities regarding pasture management and the improvement of grassland use.

Collective action is lacking between the local authorities and the livestock sector stakeholders in the Northern mountainous regions (Le Thi Thanh Huyen et al., 2013) compared to the livestock sector in the Central highlands (Stür et al., 2013). In order to promote smallholder beef cattle production in the Northern mountainous regions, there is a need to remove historical barriers and renew the interest by local authorities and the main stakeholders for pasture management and forage production programs.

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Livestock policy in Indonesia: Case of the dairy subsector

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HISTORY OF THE DAIRY SUBSECTOR IN INDONESIA

Historically, dairying came from the Middle East and spread to the Mediterranean and Europe, the Indian subcontinent, West Africa, East Africa, and South and Central America (Moran, 2005). According to Moran (2005), milk is not a main component in the diet in Southeast Asia. People prefer consuming 'milk' from coconut than from cows. Nevertheless, milk products have also been necessary to the nomads of Asia and Africa.

In Indonesia, the history of the dairy subsector is divided into three main periods: the development period (before 1980), the rapid population increase period (1980–1997), and the stagnancy period (1997 until present) (Sudaryanto and Hermawan, 2014). Subandriyo and Adiarto (2009) refer to a period before 1997, including the Dutch colonization period (before 1942), the Japanese colonization period (1942–1945), the rehabilitation period (1945–1961), the national development period (1961–1969) and the new order period (1969–1998).

Dairy production started in the 17th century (Subandriyo and Adiarto, 2009), long before the independence of Indonesia (1945). The dairy subsector was introduced by the Dutch authorities which imported 150 Holstein-Friesian bulls from the Netherlands (1891–1893) and before that some cows of the Ayrshire, Milking Shorthorn, and Jersey breeds had been imported from Australia (Subandriyo and Adiarto, 2009). The aim was to meet the domestic demand for dairy products, especially that of Dutch workers (Nurtini and Muzayyanah, 2014; Subandriyo and Adiarto, 2009).

Since the beginning, the dairy subsector has been mainly located in Java Island where farmers manage more than 95% of dairy cows (Figure 1). Developing dairy cattle started at the beginning of the 20th century in the mountain area of Central Java (Boyolali, Salatiga, and Ambarawa), then extended to West Java (Bandung area)

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and East Java (Nongkojajar, Malang and Batu) (Nurtini and Muzayyanah, 2014). Subandriyo and Adiarto (2009) report that by the end of the 19th century, dairy cattle (Holstein-Friesian) had already been mated with local breeds in Pasuruan, East Java.

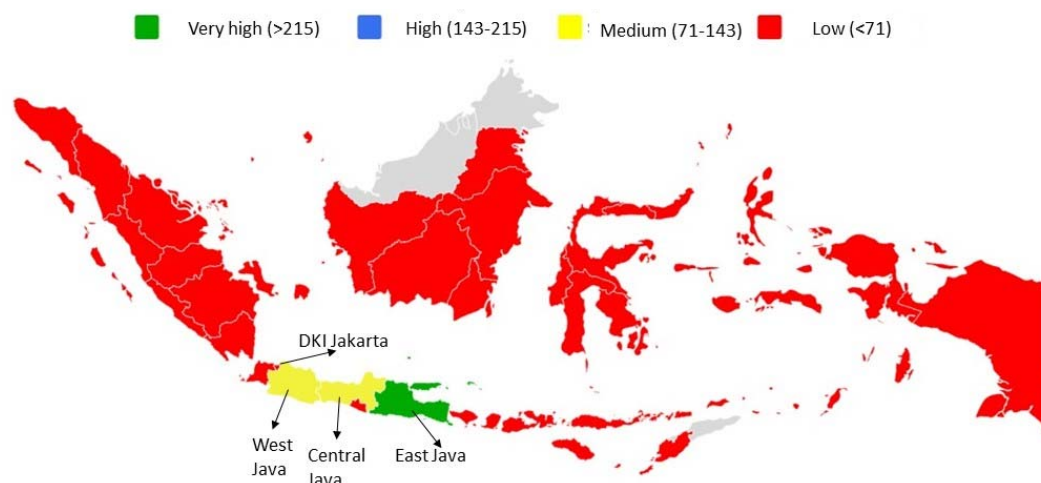


Figure 1: Dairy cattle population (x 1000 head) in Indonesia in 2019; Source: <https://ditjenpkh.pertanian.go.id/>

At the beginning of the 20th century, dairy cattle were mainly managed by Dutch enterprises. However, in Jakarta and surrounding area there were also local dairy producers (Subandriyo and Adiarto, 2009). The situation was difficult for these producers because they managed dairy cattle traditionally, which resulted in low quality milk. The strict regulation from the Dutch authorities made it difficult for the local producers to develop.

During the Japanese colonization period (1942–1945) and the revolution period (1945–1950), the dairy subsector was in an emergency. The milk output drastically decreased and the concentrate feed price was very expensive (Subandriyo and Adiarto, 2009). Some owners gave up their dairy enterprises. Consequently, some dairy cattle were slaughtered and others were distributed to the local farmers. It was a starting point for smallholder farmers' dairy units (Nurtini and Muzayyanah, 2014; Subandriyo and Adiarto, 2009).

In the rehabilitation period (1945–1961), the government made a plan called 'Rencana Kemamkuran Istimewa' to meet people's minimal needs. The food subsector was a priority. Developing the agricultural sector including the dairy subsector was the main concern (Nurtini and Muzayyanah, 2014; Subandriyo and Adiarto, 2009) although it faced a blockade from the Dutch. The government helped the dairy subsector through increasing the calving rate, decreasing illegal slaughtering, and promoting milk consumption (Subandriyo and Adiarto, 2009).

In the national development period (1961–1969), called ‘Rencana Pembangunan Semesta’, the government focused on people prosperity. Increasing food production and purchasing power became a priority. Dasuki (1983) reports that the aim for the dairy subsector was a 7.9% increase of milk production per year. However, the political situation was not conducive and the government did not achieve that goal.

In the new order era called ‘Repelita’ (1969–1998), the agricultural sector gradually improved (Nurtini and Muzayyanah, 2014; Subandriyo and Adiarto, 2009). In the dairy subsector, regulations were written to increase the cattle population, improving farmers’ productivity and increasing the domestic output to fulfill the demand.

Today, the dairy subsector faces a stagnancy period (since 1998). Sudaryanto and Hermawan (2014) indicate that this period is influenced by the economic and political crisis, which began in 1998. In addition, the government issued Decree No. 4/1998 about removing milk ratio between imports and local milk because of the international pressure (free trade). In other words, the local producers were no longer protected. In 2017 the Government of Indonesia (through Ministry of Agriculture) made a regulation (Permentan No. 26/2017 revised to Permentan No. 33/2018) to bring the dairy subsector back into the golden era.

IMPORT AND DAIRY DEVELOPMENT POLICIES

In Southeast Asia, because of the high population pressure and changes in consumption habits, the demand for dairy products has increased (Moran, 2005). The rapid economic growth and awareness to consume nutritious food become important factors to boost milk consumption. Consumption of dairy products per capita in Indonesia tends to increase (Table 1), but it remains relatively low, as the national production cannot cover the demand. In 2015, the national production only amounted to around 835,000 tons (Figure 2). Imports became a necessity.

Table 1: Consumption of dairy products in Indonesia from 2009 to 2014

Product	Unit	2009	2010	2011	2012	2013	2014
Fresh milk	L	0.002	0.002	0.003	0.003	0.002	0.003
Preserved milk	250 ml	0.016	0.018	0.022	0.028	0.028	0.031
Sweet canned liquid milk	397 g	0.058	0.064	0.063	0.052	0.058	0.059
Canned powder milk	kg	0.014	0.015	0.014	0.007	0.014	0.015
Infant powder milk	400 g	0.023	0.023	0.026	0.027	0.027	0.028
Cheese	oz	0.001	0.001	0.002	0.002	0.001	0.002
Other dairy products	oz	0.006	0.007	0.007	0.008	0.004	0.006

Source: Ditjen PKH, 2016

Starting at the beginning of the introduction of the dairy subsector, hundreds of cows had been imported from the Netherlands and Australia (Subandriyo and Adiarto, 2009). Since the end of the 20th century, milk import tends to increase (Figure 3) and reached 2.4 million tons milk equivalent in 2012 (FAO, 2017).

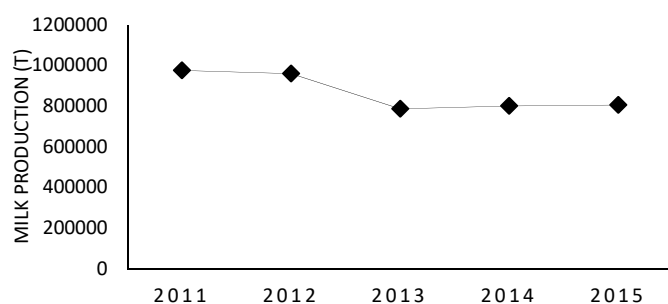


Figure 2: Milk production in Indonesia from 2011 to 2015; Source: Ditjen PKH (2016)

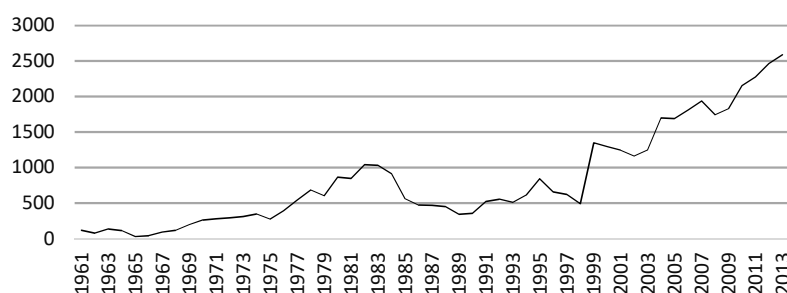


Figure 3: Import of dairy products from 1961 to 2013 (x 1000 tons); Source: FAO, 2017

In the development period (before the 1980s), the government imported cows mainly for genetic improvement. More than 1000 Holstein-Friesian cows were imported from Denmark in 1962. Two years later, another 1300 cows were imported (Sudono cited in Subandriyo and Adiarto, 2009). Another breed (Red Danish) had been tested but proved to be unadapted to the local conditions (Sudono cited in Subandriyo and Adiarto, 2009). High genetic breeds as well as frozen semen were imported from New Zealand, Australia and the United States of America to improve the dairy herd (Subandriyo and Adiarto, 2009).

In 1980–1997, previous policies were continued and improved. It was a golden period for the dairy subsector. The government focused on enhancing the cow population, improving the genetic merit of cows, and improving management. More than 125,000 cows were imported early 1980s. The cow population almost tripled (Sudaryanto and Hermawan, 2014). In 1985, Presidential Instruction No. 2/1985 was issued to boost dairy farms and improve milk consumption at an appropriate price. The government controlled the farm gate milk price and consumers' price and set a milk ratio for the dairy industry. Based on this policy, the dairy industry had to purchase the local milk as the main ingredient and the rest from imports. Consequently, the ratio of imported milk to local milk drastically dropped from 20:1 to 3.5:1 (Tawaf et al., 2009) or even 2:1 (Subandriyo and Adiarto, 2009; Sudaryanto and Hermawan, 2014). This policy was also known as 'Bukti Serap-BUSEP' (Nugroho, 2010; Sudaryanto and Hermawan, 2014). To improve the dairy herd, an artificial insemination center was created in Lembang (Subandriyo and Adiarto, 2009). High quality semen

was produced and aimed to reduce dependency on imports. The government also focused on improving management. Based on the 1985 Presidential Instruction, the dairy-related subsector was led by the Minister of Agriculture of Animal Husbandry and Fisheries Products, and helped by the Minister of Youth Development and other related ministries.

The golden era of the dairy subsector met a turning point in 1997-998. The global economic crisis impacted negatively almost all the sectors, including the dairy (Sudaryanto and Hermawan, 2014). It was aggravated by Presidential Instruction No. 4/1998, which ended the milk ratio because of international pressure and thus left the farmers unprotected. The milk industry no longer had the obligation to absorb the local milk and the local producers had to compete with imported dairy products.

ROLE OF COOPERATIVES

Milk cooperatives have become a key player in the dairy subsector. In Indonesia, they have a long history of boosting the dairy production to enhance dairy farmers' livelihoods and to improve the economic growth of rural areas (Subandriyo and Adiarto, 2009). Tawaf et al. (2009) mention that cooperatives and private collectors had direct relationships with farmers in the dairy agribusiness. Groups of farmers join other groups; together they build a dairy cooperative.

In 1949, during the national development period, 'Gabungan Petani Peternak Sapi Perah Pangalengan' (GAPPSPP) was created in the south of Bandung (West Java Province). It was the first dairy cooperative in Indonesia. However, fourteen years later, due to the unfavorable economic-political situation and the increase in milk processing enterprises, GAPPSPP was closed. In 1969, a milk cooperative, 'Koperasi Peternak Bandung Selatan' (KPBS), was created and replaced it. Two years later in North Bandung, 'Koperasi Peternak Sapi Bandung Utara' (KPSBU), was established (unpubl. KPSBU, 2012). In East Java Province, SAE Pujon was founded in 1962 (Sulastri and Maharjan, 2002). It was then followed by other milk cooperatives including 'KUD Batu', 'Koperasi Setiakawan', and 'Koperasi Sukamakmur' (Subandriyo and Adiarto, 2009). In 1978, there were 11 milk cooperatives, with 2800 members (Nurtini and Muzayyanah, 2014).

An association of dairy cooperatives, 'Gabungan Koperasi Susu Indonesia' (GKSI), was created at national level in 1980. The initial members were 17 dairy cooperatives. Its role was to enhance the communication between members and to build a supporting system for the dairy business (Subandriyo and Adiarto, 2009). It also helped with supplying cows, with milk marketing, training, feed production and supply, veterinarian services, and technical support (Sulastri and Maharjan, 2002).

During the years 1980–1997, the government supported the dairy subsector through policies. New farmers enthusiastically entered the dairy business. The policies also had a good effect on the development of dairy cooperatives. The amount

of cooperative milk drastically increased (almost 20 fold) (Subandriyo and Adiarto, 2009; Sudaryanto and Hermawan, 2014). They played a major role in boosting dairy production, improving milk quality and increasing the cow population.

In West Java, a secondary cooperative, 'GKSI Jawa Barat', was established in 2000. There are 22 primary cooperatives which members include KPSBU and KPBS Pengalengan. Their functions consist in coordinating, monitoring and evaluating the members' activities. In addition, training for good dairy farming practices, processing milk, enhancing milk quality and cow population is provided. GKSI Jawa Barat has a main plant (PT ISAM), which processes around 10% of fresh milk in West Java (<http://gksi-jawabarat.co.id/>).

The main role of a cooperative is to provide services to its members (e.g. credit, veterinarian service, feed supply) and to improve farmers' know-how in dairy practices (Nurtini and Muzayyanah, 2014; Sulastrri and Maharjan, 2002), enhancing thus farmers' livelihoods. This may be so but the role of a cooperative still needs improving. Tawaf et al. (2009) indicate that four strategies can develop a dairy cooperative: i) maximize potential resources to access market opportunity; ii) improve human resources to reach economic efficiency; iii) enhance professionalism in terms of asset management and collaboration with the cooperative; and iv) increase services to the members. Furthermore, improving the role of a cooperative is emphasized. Cooperatives should in particular have the skill to improve the bargaining position of farmers vis-à-vis the dairy industry.

CONTRIBUTION OF THE DAIRY SUBSECTOR TO THE ECONOMY

Indonesia has a rapid economic growth which reached on average more than 5% a year from 2011 to 2014 (Ditjen PKH, 2016). The agricultural sector plays an important role in this growth. Ditjen PKH (2016) reports that in 2015, the crop, fishery, and forestry subsectors had the second-highest gross domestic product after the manufacturing industry. It contributed by 13.5% to the total GDP. The livestock subsector in particular was important as it accounted for around 15% of the agricultural GDP (Ditjen PKH, 2016). In addition, over five years (2011–2015), this subsector GDP increased by more than 56% (Ditjen PKH, 2016).

Ditjen PKH (2016) reports that the three main provinces in the livestock subsector, East Java, DKI Jakarta and West Java, accounted for around 47% of the total GDP from livestock. Furthermore, in West Java, from 2011 to 2014 the livestock GDP increased by 8%. The livestock subsector is an important contributor to growth as it generated around 167 trillion Indonesian rupiahs (IDR) in 2014.

The agricultural sector makes an important contribution through employment. Of all sectors, it absorbs the highest numbers, accounting for more than 40 million workers (Ditjen PKH, 2016). Furthermore, the livestock subsector is an important

contributor with 10% of total labor in the agricultural sector, the majority being unpaid workers as family members. Ditjen PKH (2016) reports that during three years (2013–2015), the number of workers however decreased by around 10%.

The livestock subsector is important to enhance economic development, rural livelihoods, to alleviate poverty, and to meet people's needs for animal protein (Moran, 2009). At global scale, the livestock contributes more than half the value of the agricultural output. Furthermore, it has been observed that by integrating crops, the livestock subsector plays a role in enhancing rural livelihoods.

The dairy subsector has become an income-generating activity for crop farmers in South and East Asia (Moran, 2009). Crop farmers can generate enough income and even start saving when they add a small-scale dairy activity. According to Moran, (2009), in the livestock subsector, the dairy business brings in among the fastest returns in developing countries. In Indonesia, it also has a good economic potential: around 518,000 cows in 2015 produced 835,000 tons of milk (Ditjen PKH, 2016).

Generally, there are two types of milk producers: dairy enterprises and smallholder dairy farms. Badan Pusat Statistik (2015) reports that there were 35 dairy enterprises in 2015. Smallholder farms play an important role in the dairy subsector; they kept more than 90% of the total dairy cattle in 2013 (Badan Pusat Statistik, 2013). Both types are important to enhance rural income and to meet the needs of the fast growing urban population (Moran, 2009).

The dairy enterprises employ together around 1300 workers (Badan Pusat Statistik, 2015). They are mostly (65%) located in East Java and West Java. Their performance is higher than that of smallholder farms. With a population of 18,500 cows in 2015, they produce around 70,700 tons of milk. The average milk yield per cow and per day is 16.4 liters. In terms of economic performance, they generated 431 billion IDR in total revenue in 2015, which increased by 22% since 2013.

DAIRY MARKETING

Moran (2009) explains that there are several ways to market milk through the dairy value chain. He defines this chain as stages of milk and dairy products from farmers (producers) to consumers. The author adds that milk marketing can be divided into two groups: informal markets which are usually small scale and involve few actors; and formal markets which are medium to large scale, involve more actors and the milk is processed into final products. In Indonesia, the milk trading system is divided into three models. Tawaf et al. (2009) explains that East Java and West Java have the same dairy value chains, whereas Central Java and Yogyakarta have different models, as follows:

- farmer – group of farmers – milk cooperative – milk industry (West Java and East Java)

- farmer – private collector – milk cooperative – milk industry (Central Java and Yogyakarta)
- farmer – private collector – milk industry (Central Java and Yogyakarta)

In West Java (in particular Ciater area), Duteurtre et al. (2016) report that there are two main models of the dairy supply chains, cooperative and non-cooperative (Figure 4). With regard to the milk flow, milk from dairy farms is distributed to cooperatives. Then, milk batches are sold to dairy enterprises that process them into final products, which in turn are distributed to retailers and or direct consumers. Cooperatives like KPSBU have final products such as pasteurized milk and yogurt that are sold directly to retailers or consumers. Non-cooperative farmers sell the milk to private collectors. Tawaf et al. (2009) write that the non-cooperative model is developed in areas with inactive dairy cooperatives. It may also be an extension of dairy enterprises.

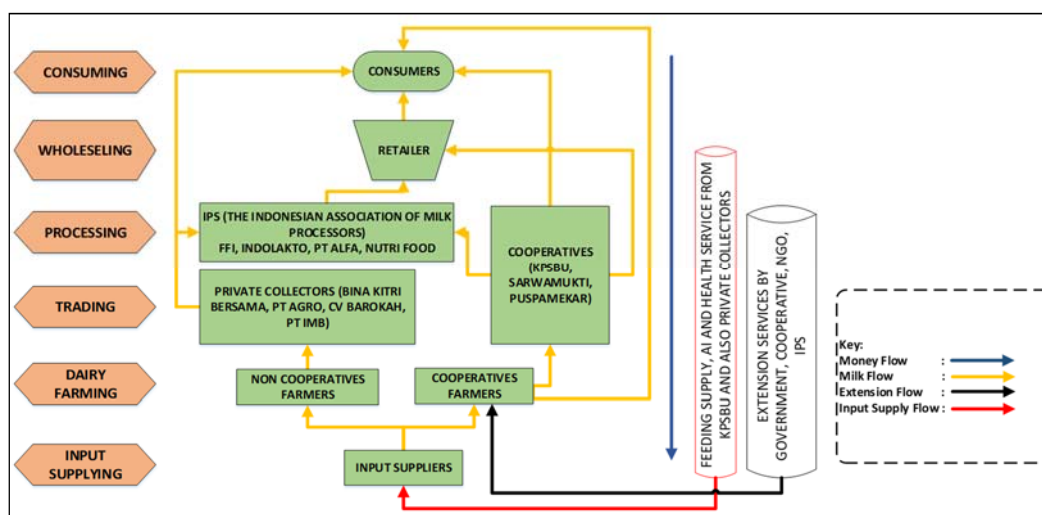


Figure 4: Value chain in Ciater, West Java Province; Source: Duteurtre et al., 2016

CHANGES AND THEIR DRIVERS

Three main changes exist in dairy farming in Indonesia: i) from large farms (milk enterprise) to smallholder units; ii) from smallholder dairy farms with off-farm activity (multiactivity) to specialized farm; and iii) from smallholder specialized farms to multiactivity farms. Each change had different drivers.

The change from the milk enterprise to the smallholder farm mainly occurred in 1942–1950. The drivers of this change were mainly external. The Japanese came to Indonesia and took over the power from the Dutch (1942–1945). After Independence in 1945, the revolution broke out to defend Indonesia's independence against the Netherlands. It resulted in an emergency for milk enterprises which were run

mainly by Dutch people. The price of feed soared and affected milk production which sharply dropped. As a consequence, the owners gave up their dairy business. Many dairy cows were slaughtered, some were distributed to local smallholder farmers. It was a turning point from milk enterprises to smallholder farms.

In the change from smallholder specialized farms to multiactive farms, farmers added off-farm activity as a complement to their dairy farming income. Discussions with farmers revealed that the drivers of change derived from internal and external factors. Internal drivers are limited capital, limited farm income, off-farm income, limited access to land, and risk from the dairy business. These farmers have limited capital, i.e. not only physical capital such as cows, barn, and owned land, but also human capital (know-how). It results in limited incomes from the dairy business. Farmers have difficulties to cover their daily expenses if they only depend on this activity. In addition, land opportunities to grow forages are generally limited. Some farmers live in the center of a district where the land is mostly used for housing. Some others who are located near a forest or a tea plantation can have access to forest land or unused land in tea plantations to grow forage. However, this situation is uncertain because in the future Perhutani or PTPN will probably use these lands for their business. By practicing a multiactivity, farmers can reduce the risk from the dairy business such as the uncertainty in milk and input prices, and the limited access to production factors. Some farmers even state that off-farm activity such as trading and being hired as wage workers generate more income than the dairy business.

The external drivers explaining why farmers add an off-farm activity are job opportunities and land conversion. This is often the case in areas located in touristic resorts, which present job opportunities such as souvenirs trading, food selling and being hired as wage workers. In Subang, tea plantations offer job opportunities to smallholder farmers as wage workers. Land conversion from agricultural land and unused land to housing is also a major external driver. It reduces the access to land with forage. Reduced land access and forage access generate a low income in the dairy business. As a consequence, farmers add another income-generating activity as a complementary income.

In the change from multiactivity farms to specialized farms, an in-depth interview with farmers indicate that some farmers give up off-farm activity because of five drivers. The three internal drivers of change are limited family manpower, improved dairy business, and increased dairy income. Two external drivers are subsidies or grants from a dairy development project and easy access to credit. In families with a limited number of workers, considering a change in the activities is a central issue. One farmer mentioned that after a family worker had passed away years ago, they gave up the multiactivity and focused on the dairy business. This farmer had difficulty managing two activities at the same time. On the other hand, the physical capital increased and improved the dairy business. Since the number of cows increased, the farmer needed more time to focus on managing the dairy business. It boosted

the milk production and farm income. Giving up the multiactivity was a solution to keep his dairy farm well managed.

With regard to the external drivers, the government, milk enterprises, cooperatives and stakeholders supply cows to the farmers to boost the dairy cow population and milk production in Indonesia. For example, a dairy development project in 2007 helped new dairy farmers to purchase pregnant cows through a credit scheme. In 2012, this project also provided 'revolving cows' to selected farmers: these farmers were given a cow and after two calvings each gave the cow to another farmer. Each selected farmer thus obtained milk and two calves. This model of grant has existed for a long time in Indonesia. As it increases economic performance, the farmer only focuses on his/her dairy business and gives up off-farm activity.

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Socioecological system approach to incorporating biodiversity in landscape change

Ruth Beilin¹ and Liz Wedderburn²

INTRODUCTION

In the 19th century frontier landscapes of New Zealand and Australia, there was the intention that early white settlers and their subsequent brethren would carve productive fields from the 'virgin' lands and bring that produce to the markets of the Empire. The sentiment behind this initiative was made manifest in the labelling of Aussie farmers as 'battlers', and the elements of the landscape as 'enemy', evoking the conflict between the ecosystems of the time and the agroecosystems that were to follow. "The forest was 'seen as a curse' by those that were attempting to clear it and farm" (Fox, 2004).

This paper explores the role of resilience in the landscape change associated with white settlement and following Walker et al.'s (2002) attempts to parallel the "loss, creation and maintenance of resilience" to the historical record that links agriculture policy and the decline of indigenous biodiversity. In this analysis, we give substantial weight to the importance of scale and time, and ally Beilin's (2001) work in landscape sociology with Walker et al.'s (2002) use of three scales (local, regional and multiregional), invigorating the metaphor of 'landscape' as a way of placing humans centrally within the socioecological system. People, time and scale are vital as both thresholds and drivers creating a multiplicity of states in the complex analysis comprising socioecological systems (Walker et al., 2002).

Agroecosystems are examples of socioecological systems that include land manager decisions coevolving with ecosystem properties to preserve a particular set of functions (production, biodiversity, water quality). Until the 1990s, New Zealand and Australian agroecosystems were dominated by an economic production imperative. "During the 1990s there was a realisation, substantially driven from community level, that

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the pursuit of production goals had compromised other resources for human well-being [i.e. biodiversity] and water quality. This has led to land managers now having to take into consideration the relationship between [working] for production gains or providing outcomes more commonly aligned to public good" (Wedderburn et al., 2015). In this, the immediate and distant community of observers (non-land managers) have played a sizable role in reinforcing what the look of the landscape means to our citizens (Beilin, 1999). Productive landscapes are understood as farm landscapes or more lately farm and plantation forestry. Meanwhile, recreational landscapes are readily recognised and articulated as those harbouring conservation values. The two together—conservation and production landscapes—comprise what viewers identify as multifunctional landscapes.

A historical timeline (Figure 1) is used to map the activities that drove the evolution of production landscape change and a review of the resulting impacts on land use and biodiversity is described. The Australian continent is undoubtedly affected by external environmental forces that have shaped the ecological system and over time wrought significant alterations to the landscape, such as changes by fire. Fire, climate change and, to a certain extent, technological innovation represent uncertainty and risk as described by Walker et al. (2002). These changes also indicate thresholds for ecosystem management as indicated by Walker and Meyers' (2004) discussion on how to establish thresholds.

We have placed our historical analysis within the metaphor of the adaptive cycle (Figure 2) (Walker et al., 2002; Gunderson and Holling, 2002; Allison and Hobbs, 2004). By 1840 the total forested area of New Zealand had been reduced from 85% to about 53% (14.3 million ha). The remaining 15% of New Zealand's indigenous biodiversity was in the conservation (K) phase. The settler drive for clear land and the economic imperative resulted in actions (felling, burning, clearing) by land managers that collapsed the system releasing nutrients and space for the introduction of new species (grass and animals) to utilise the resources and rapidly develop a new dynamic agroecosystem 'configuration' (Walker et al., 2002).

As a landscape sociologist, Beilin (1999) is interested in how the early settlers understood their role in managing the new colonies. The case study she describes is located about two hours from Melbourne in the jurisdiction of the West Gippsland Catchment Management Authority and that of Port Philip Bay and Westernport Catchment. In detailing the initial impressions of these settlers, Beilin is also able to parallel contemporary farmer managers' responses to their significant landscapes across the same region. Historically settled from the late 1800s, "the scrub country then—sometimes called the Great Forest of South Gippsland—started within a few miles of the east coast of Westernport, and extended eastward for some sixty

Drivers	Time	Indigenous biodiversity	Agroecosystem
Community Initiative Biodiversity Strategy	2000 1998		16M ha
International convention On Biological Biodiversity	1993		
Resource MOT Act	1991	K	K
Subsidy Removal	1990		R
Market LED			α
Incentives	1980		Ω
Innovation			
- Genes		K	
- Fertility			
- Health			
	1960	K	
Korean War	1956		R
Top Dressing	1940	R	α
Depression	1930	α	Ω
	1921		17.6 M ha 80,000 farms
Resettlement Bill	1915/1916	Ω	R
	1900		10,000 farms 4.5 M ha
	1890		
	1881	Ω	27% reduction of remaining 15% R
			1.4 M ha
Lands Act	1877	$\rightarrow$	
		Ω	α
Aborted Forests Act	1847	$\rightarrow$	
$\downarrow$	1840		
Maori use and burning		85% reduction	< 70,000 ha

Figure 1: A historical timeline of agricultural development in New Zealand

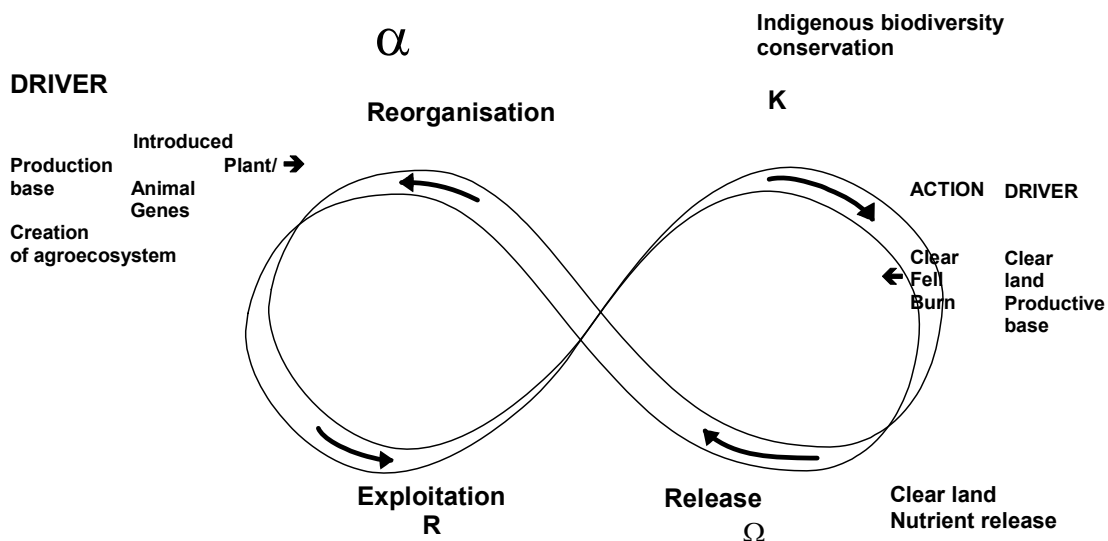


Figure 2: Historical analysis placed within the metaphor of the adaptive cycle

or seventy miles... covering an area of roughly two thousand square miles of rangy³ fertile country..." (Coverdale, 1920/1972). As reported by the Forests Commission (1976), Strzelecki Ranges comprise mesozoic sandstones and mudstones, in parts capped by basalt and small amounts of lower tertiary formations; the valleys are newer and at the base of steeply sloping ridges; the top of the Ranges is 730 metres; maximum rainfall on average in this area is about 1400 millimeters. These steep hillsides were covered in trees and as one intergenerational farmer in the 1990s said: "they [the original white settlers] couldn't have even known how steep it was because the height of the trees and the density of the forest meant the underlying terrain was masked. You cleared what was in front of you with no idea where the valley lay" (Beilin, 1999).

In the pioneer account of the country, 'scrub' is distinguished from trees and has no economic value. Clearing scrub was the settlers' duty if they were to be successful farmers. However, it is clear from the historical record that the settlers paid some attention to the diversity of plants and the different manifestations of scrub, even as they set about removing the bulk of it from the landscape. An indication of this focus on existing biodiversity is apparent in the naming and noting of indigenous vegetation. Scrub is located in the middle and lower canopies and includes everything that is not

³ 'rangy' here refers to The McDonald's Track Range 2000 feet high, which "is the backbone of the country[...]rises gradually as it makes eastward[...]some of the ridges run into a height of three or four hundred feet above the creeks and gullies that divide them" (Coverdale, 1920/1972).

Eucalyptus regnans (Mountain Ash)—the most valuable timber tree. It includes smaller eucalypt species such as *E. rubida* (white gum), *E. globulus*, *E. obliqua* and *E. gunnii* (Coverdale, 1920/1972). *E. regnans*, growing to enormous heights over 300 feet with a diameter of 8–10 feet was commonly called blackbutt. *Acacia melanoxylon* (blackwoods) also grew to substantial heights with some having 2–3 foot diameters. The quantity of big timber to an acre varied though it was noted that in the hazel country (*Pomaderris* spp.) there were 100 or more to the acre. Approximately 29 species are identified as making up the scrub and these include bushes, grasses and ferns, small trees and tree ferns. Some of these tree ferns grew to a height of 40 feet in the gullies (Coverdale, 1920/1972). The sheer size and majesty of this forest was a challenge to early settlers and its memory lingers. One contemporary farmer at the top of the ranges identified a particular pasture as having good soil because that was where the tall timber grew. As this farmer had lived on this farm for only 21 years at the time of the interview in 1997, and as the tall timber had been totally cleared since 1898, the idea of good soil and tall forests can be associated with a ‘collective memory’ of the connection between the ecosystem and the developing agroecosystem.

Coverdale (1920/1972) distinguishes three types of scrub at the time of white settlement in this area. These are the hazel, the musk and the sapling scrub. Again it is worth noting the detail of his understanding of indigenous species. The dominant hazel scrub (*Pomaderris* spp.) grew on the ridges with a few *Acacia melanoxylon*, *A. implexa* and saplings. It also contained large tree ferns and big timber. Along the creeks and in the gullies, wattles proliferated and *Dicksonia antarctica* tree ferns clustered at the base of big eucalypts. The musk scrub (*Olearia argophylla*) is described as growing on heavier soils and is interspersed with *Pittosporum* and *A. melanoxylon*, and with *E. regnans* and *E. globulus*. The sapling scrub was described as being the most difficult to clear because the saplings were 60–120 feet high and could be three feet in diameter. Coverdale (1920/1972) also notes that all of the foliage except for the eucalypts was edible to stock.

Coverdale (1920/1972) described the effect of fire on these types of scrub. “Burn off one kind of scrub, and frequently another variety came up[...]But nothing ever came again after a good burn, from the roots or butts of the original scrub; it was always from seed in the ground, except in the case of musk”, also commonly known as ‘daisy bush’. Such a description suggests the system was relatively resilient at the time of white settlement. Adaptation to eons of firestick management by indigenous people and fire generated through lightening strikes meant that the system was able to undergo change and still maintain function and structure as described by Walker et al. (2002). Similarly, the ability to regenerate after fire suggests a considerable level of self-organisation. However, the diminished number of noted species suggests that the system was in the K (conservation) to Ω phase of the adaptive cycle (Kinsig, 2004) and

the fire heralds a time of rapid change that may lead to another cycle of the same type or to reorganisation. Coverdale (1920/1972) states that in his opinion fire had occurred periodically every 40 to 60 years according to whether there was sufficient debris, a hot summer and a black fellow's fire⁴. Longstaff painted a notable fire in the region, *Gippsland, Sunday Night, February 20, 1898* (National Gallery of Victoria), which depicts the incendiary force that burned most of Strzelecki Ranges along McDonald Track on that night. Coverdale (1920/1972) concludes that "Probably the scrub was never all burnt at one time, but some portions in one fire, and others in another many years later."

Coverdale (1920/1972) also argues that Aboriginal people lived in the shelter of the forests and were not just passing through because there was substantial evidence of their possessions throughout the forest, found as the white settlers cleared it. In considering Walker et al.'s (2002) seminal point that management and managers are part of the system and not outside it, we can recognise how important firestick management and aboriginal habitation of these forests were to the ongoing survival of both. The removal, eradication or disappearance of aboriginal people from these ranges (K to Ω) indicate the second threshold change to the ecosystem as we currently reconstruct it. However, an official government publication of the Forests Commission (1976) presents two scenarios about aboriginal habitation. The first is that they only lived in the forests in spring and summer, as food supplies were insufficient to sustain them for longer times. The second is that there were two tribes in the Strzelecki area, and that they were enemies, with one in the tall forests and the other inhabiting the undulating plains. Either way, the disappearance of opposition or representations of difference with regard to aboriginal land management established that the dominant paradigm for the new settlers was one that reflected three myths. The first myth was that of *Terra nullius*—there was no one present before the white settlers arrived. The second was that of European landscapes—these Australian settings were to be managed in the way of European ones, so differences in soil types, soil profiles, water systems and similar biophysical differences were overcome without being explored or exposed (Beilin, 1999). The third was that the yeoman farmer was the ideal class to settle the landscape despite the fact that the majority of it was taken up by a few individuals and their extensive "runs" (Barr and Cary, 1992; Beilin, 1999).

At the beginning of what Wolfe and Dear (2001) refer to as the exploitation phase (1861–1891), wallabies, opossums, koalas, dingoes, wombats, platypus, lizards, bandicoots, bush rats, echidnas, 'tiger cats', 'flying squirrels' were noted as part of the life in

⁴ Manning Clark notes in his *History of Australia* that February 6, 1851 was known as 'Black Thursday' because of the massive fires in Gippsland and in the Western District of Victoria. The fires sent black clouds over Melbourne and the surrounding countryside; Coverdale also refers several times to 'Black Thursday' and how the intensity of the fire meant that settlers saw only dead *E. rubida* and *E. regnans* on many of the ridges.

the scrub (Elms, 1920/1972). Birds were especially plentiful before the clearing of the forests, including lyrebirds (*Menura novaehollandiae*). Elms notes that the dense smoke and heat from the fires drove the birds off. Foxes and hares were introduced and birds new to the area, such as magpies (*Gymnorhina tibicen*), rosellas (*Platycercus elegans*, *P. eximius*) and mudlarks (*Grallina cyanoleuca*) appeared. As well, swallows, kestrels, finches and starlings were seen and starlings were credited with eating all the grasshoppers that had previously been responsible for destroying grass in the settler paddocks (Elms, 1920/1972) (Latin names are inserted by authors using Simpson and Day [1993]). In reading these early writings on flora and fauna, there is evidence of a close alliance with the land—a dependency based on socioeconomic stress. Farming the land was meant to provide security, freedom from stress and in their daily practices, white settlers had to be innovative, creative and self-organising in order to survive.

A lack of knowledge about the behaviours of forest ecosystem soils and the inability to manage vegetation meant that the adaptive cycle has had many iterations indicating the lack of resilience in the system and the use by land managers of adaptive management to maintain the system within the conservation phase and maximise efficiency. The control and command management was directed at retention of a productive state but the management practices used evolved out of adaptive management, where observation and experience were used to develop innovative solutions.

POLICIES

In an attempt to slow the pace of forest destruction, the New Zealand government introduced the Forests Act 1874, but it was immediately repealed as it was seen to be an obstacle to the main driver of development. The 1877 Lands Act made provision for preservation of steep land forests in an attempt at soil erosion and flood control, function of biodiversity, and retention of aesthetic quality (wonderful mountain vistas). These forests today form the basis of New Zealand national parks. This Act however, did not impede deforestation on potentially productive land. In this Act we see a government response to achieve an environmental goal that would positively impact on economic development through protecting against soil loss with subsequent prevention of downstream flooding.

The deterioration of tussock grasslands was noted in 1868 (Heaney and Douglas, 2000), but it was the early 1900s before government intervention occurred in the shape of pastoral land commissions and legislation. The requirement to prevent widespread soil erosion by mitigating pastoral management strategies was implemented through the 1948 Land Act (Heaney and Douglas, 2000). The legislation created a dichotomy where production and conservation were two goals to be achieved and when they were incompatible, production always won.

In New Zealand, the Great Depression of the 1930s was a driver resulting in low farm product prices. It is from this time that we see a response from the government in the form of agricultural assistance. Assistance to agriculture was the means by which the government could compensate an exporting industry for the import licences that were put in place to foster domestic industry.

Continuation of protectionist policies into the postwar era was accompanied by a growth in wealth, attributed to a world hungry for agricultural produce. “During the 1960s the government considered that an improvement in export earnings was necessary for long-term economic growth. The resulting 1963 budget had three incentives: loans for development, subsidies on fertiliser, and tax write-offs for capital expenditure associated with development” (Wedderburn et al., 2015).

By the mid-1980s, where land was marginal and required nutrients to sustain grazing the dropping of government interventions resulted in reversion occurring particularly in hill country. The removal of pests and weed subsidies had a detrimental impact because of the spread of unwanted organisms. Even with the introduction of modern technologies the systems were not resilient to removal of nutrients and stock.

The original policies behind Australian land clearing were for closer settlement by yeoman farmers and in ecosystem terms, rapid exploitation of the landscape; in the vast terrain of the continent, it proved impossible to control the public pressure and determination to claim land. Exploitation occurred at varying landscape scales and these policies were often in opposition to each other—that is intending to operate at one scale but being reinterpreted and acted on at a very local level. For example, illegal squatting and large land grants quickly took over the early governors’ intentions of setting up yeoman farmers on small blocks of land (Wells, 1989). The 1842 Land Act stated that there was to be no free land and land must be surveyed before auction, with a minimum price of £1/acre; in Victoria, 31 million acres were held by 800 people with 938 squatting licenses by 1851 (Wells, 1989). Clearly, whereas the government intended to effect change at a local level, entrepreneurs intended to control land with a regional perspective in mind.

Walker et al. (2002) acknowledge how difficult it is to map or predict such interpretations of the same policy when analysing models for socioecological system planning. Individual agency and governmental ineptitude or physical distance effectively assured that the landscape reality of a policy such as the 1842 Land Act had markedly different outcomes to the initial stated intention. This disparity of outcomes is noted in a famous historian’s (Manning Clark) description of the population of the countryside at this time. He saw it as comprising four principal groups by the 1850s. These were the Aborigines, the country gentry with productive properties in the “more closely settled area of southern and south-eastern Australia, the bush barbarians

living in squalor, and the squatters who ‘presided in grandeur over vast tracts of land for which they paid minimal rent, jealous of their privileges and ever fearful that a change of policy in London would see their rent increased, their land sold, their domination of the legislature undermined or their access to cheap labour further eroded’ (Clark in Cathcart, 1996). In Kinsig’s terms (2004), the Ω to α phase again symbolises the opportunity for reorganisation, this time in terms of human capital. However, an inability to recognise the conditions of a new landscape also impaired the ability of politicians and planners, allowing a perpetuation and imitation of distant European social and economic ways of managing production.

In Australia, this pattern continued with key land grant acts in Victoria, such as the Nicholson Acts of 1860, Grant and Duffy Acts of 1862, 1865 and 1869 allowing access to land for free selection (Davidson, 1991). The Duffy Land Acts authorised a million acres to be sold, though two-thirds were bought by one hundred men (McQueen, 1970). Victorian selectors in the 1870–1880s required £250–300 initial capital to acquire 320 acres. This situation meant that absentee landlords dominated and that in the case of owner-occupier, the marginal character of many of these landscapes ensured poverty for the families unless they had off farm incomes or relentlessly sought improved technology to assist their development of the land. Many over cropped and under capitalised their land, using family and seasonal labour to manage their production systems, and credit was hard to get (Wells, 1989).

There was a Victorian Lands Commission review of the failure of selection in 1878–1879. It noted that small holdings were significantly under capitalised and recommended that less viable land be consolidated into larger holdings (Wells, 1989). Fox notes in his history of Josiah Mitchell that by the 1860s there was some recognition that “the colonial farmer could not depend on traditional history handed down through generations to farm on these more infertile Australian soils”; Mitchell wrote critically of the Selections Acts because he saw they encouraged an agricultural practice that depended on continuously ploughing on blocks too small for proper crop rotation (Fox, 2004). He argued for a minimum selection of 640 acres. Returning to Walker et al.’s (2002) characteristics for resilience as being central to survival for socioecological ecosystems, it is imperative that we recognise how much stress a system can undergo, the degree to which a system can be self-organising (that is survive shocks and rebound or reorganise), and the degree to which a system is reflective. This is the conundrum for analysts of Australian rural agricultural history and development. Despite an acknowledged early recognition of the fragility of Australian soils and the necessity for extensification in most land management pursuits, the government policies continued to emulate the same land use patterns and policies that created this initial dissonance between the system and the practical reality of landscape experience.

Arguably Australia was always an urban nation, founded by convicts and settlers from largely urban English and European environments. By the 1890s more than 66% of the population was living in towns, a global urban phenomenon for a new frontier nation like Australia (McQueen, 1970). This pattern was to go on into the 20th century as the returned soldiers who made up the next group of rural migrants were also predominantly urbanites with little knowledge of farming in Australian conditions. Their difficulties were enhanced by the continued allotting of small holdings unlikely to be economically or environmentally viable in the Australian context. By 1914, 44.7% of all Australian holdings (except in Queensland) were under 100 acres each (Davidson, 1991). At a regional landscape scale, there was never an integration of ecosystem management between the needs of urban areas and the construction of rural production networks largely for export. The complete dissonance that this indicates haunts Australian landscape management into the 21st century.

In New Zealand the exploitation phase parallels that of Australia with the release (K to Ω) of space and nutrients that led to regeneration of woody weeds in the 1900–1960s. There is also a parallel release of learning as the expectations of how to manage production break down in the Australian context and are challenged in New Zealand. Ironically, Australian farmers continued to apply high levels of inputs to mask the degradation and depletion. Heightened pressures based on different economic scales in New Zealand did not allow the majority of New Zealand farmers to follow this route for as long as their neighbours across the Tasman. The advent of deregulation and Piggy Muldoon's economic rationalism in the mid-1980s further escalated the contradictions between system states within the New Zealand ecosystems' configuration. This highlights Walker et al.'s (2002) point that each configuration is defined by desirable or undesirable outcomes, and in the New Zealand situation, the removal of subsidies at this time, breached the threshold with the result that many farmers went bankrupt and walked off the land. This story is repeated in an Australian government document about Strzelecki Ranges (Forests Commission, 1976). In fact, many inexperienced farmers bought into this region because land was cheap, then they were confronted with the difficult terrain and their inexperience... that the Government of the time labelled the Strzeleckis, the Heartbreak Hills.

TECHNOLOGY

Josiah Mitchell writing as Hodden Gray in the *Australasian* in 1881, commented that "the grain grower will find no more interesting exhibits in the great Exhibition than the automatic reapers and binders" (Fox, 2004). As for Walker et al. (2002), they note that technology is a key driver of ecosystem change. We argue that technology is not value neutral with regard to ecosystem management. New Zealand and Australian farmers

are historically technologically innovative and this characteristic plus the fact that ecosystem change is notoriously unpredictable and non-linear in outcome increase the likelihood of experiential learning occurring at differing landscape scales even if it is unlikely to occur within federal government.

Technology in agriculture has historically tended to mechanistic approaches to change, for example, with regard to clearing—the stump and chain method was notorious for destroying the bush as well as removing trees. Plant breeding and fertiliser improvement are generally targeted at maintaining or improving production outcomes for European crops and animals, and tended to ignore the appropriateness of these production systems relative to Australian depleted soils. During the 1960s, given the fact that all of the potentially useable land in New Zealand was in farms, it was recognised that to increase export earnings from agriculture, there was a requirement to intensify through use of technology, and research and technology were seen to be the key to success. Plant genetics improved the utilisation of nutrients and built resilience into the maintenance of animal productivity as did improvements to animal health.

The release (Ω) of space and nutrients that led to regeneration of woody weeds in the 1900–1960s was due to the lack of knowledge and technology to prevent the system from crossing thresholds such as soil fertility, animal health, vegetation composition, that moved it from an agroecosystem to woody vegetation scrubland. It could also be understood as a threshold for change. The recolonisation of the bush by woody weeds was a profound lesson for land managers. Within a few years, they could see evidence of their intrusion literally turning to dust.

Introduction of technology such as aerial top dressing allowed the application of manufactured nutrients that retained soil fertility within productive thresholds. Electric fencing contained animals and allowed full utilisation of feed through maintenance of grazing pressure that sustained the threshold for productive vegetation composition and quality. Fencing also emphasised the demarcation between the wild, untenanted lands outside the fence, and the neat orderly sites within its boundaries. Similarly, plant genetics improved the utilisation of nutrients and built resilience into the maintenance of animal productivity. Innovation and land manager decisions around monitoring social ecological system targets within the system and adapting their management in response, has built resilience into the system so that it is maintained in the K phase. However, as with the landscape, the scale of material resilience is everything. Animals such as cattle and cows are bred with attention to detail associated with heightened production. Sometimes the welfare of these animals is not the focus of the breeding program. So there are Limouges double muscled cattle that have to have caesareans at parturition because they are incapable of the normal stretching for vaginal delivery. Similarly genetic ‘improvements’ to milk cows create four-year life

cycles—then they become obsolete as their milk output diminishes below an economic threshold, and they become inefficient for the particular farm system.

Government agriculture departments in New Zealand and Australia have acted as change catalysts in this area with an emphasis on increased and more lately improved production systems (Barr and Cary, 1992) arguably aimed at keeping ecosystems in the conservation phase so that thresholds that threaten this phase can be overcome. Over time it is likely that this holding pattern diminishes the ability of the system to adapt to shock or stress, meaning that more inputs are required by land managers to sustain production in both ecological and economic terms. These higher costs are mitigated by technological changes that diminish the labour required and, in family farm situations, are associated with increased dependency on family units, including off farm labour to sustain social connectedness within the landscape (Beilin, 1999).

In terms of ecosystem scale, most technologies are aimed at local level change. However, as the ecosystem is an integrated landscape force, the individual changes, such as flood irrigation or increased aquifer mining of water, have regional and catchment level ramifications that are not immediately obvious to the local level decision maker. In Australia, biodiversity has been linked to conservation rather than production values, and this dualistic approach has further isolated the science associated with technological change to the area of pasture or animal improvement during both what Wolfe and Dear (2001) refer to as the exploitation and the consolidation phases of agricultural development.

As with the Western Australia example described in Allison and Hobbs (2004) the agroecosystem will continue to rely on technological solutions and substitutions to add resilience and maintain adaptive capacity. However until we understand the thresholds within which ecosystem processes operate there is a danger of relying on technological solutions that mask when thresholds have been breached and the trajectory towards a non-desirable state is irreversible. Evidence of the breach of the threshold is seen in Australia with salinization, acidification and erosion, and in New Zealand in deteriorating water quality, and erosion. The quest is to align resilience across coexisting ecosystems so that achieving a resilient stable configuration filling the function of food production does not perturb a coexisting ecosystem and place it on a trajectory to a less desirable state as has happened with indigenous biodiversity.

The transformation of Australia's forests to pastures created cultural and ecological values not widely questioned until the early 1990s. Aware of serious land degradation, the government response in the early 1990s was to encourage conservation on the 63% of land held privately, through a program called Landcare. In the 21st century, Landcare farmers comprise approximately 40% of Australia's primary producers. As a voluntary program, however, Landcare changes, representing biodiversity gains, have been kept on the margins of agricultural production by literally reconstructing and

planting indigenous vegetation at the edge of paddocks and properties. It is argued that improved biodiversity does not provide immediate economic gains and this reinforces the limited land areas devoted to conservation zones. It also limits the ability of these typically narrow patches, comprised of significantly long and exposed edges, to be self-reinforcing at even this very local level.

New Zealand is signatory to the Convention on Biological Diversity, and it has developed a national biodiversity strategy for the conservation and sustainable use of biodiversity. One of the top priorities in this strategy is the maintenance and enhancement of indigenous biodiversity on private land, outside the present network of protected areas. Remnants on these lands are now critically important as they are under represented in protected parks and reserves. The strategy outlines a mix of public and private efforts to manage and maintain biodiversity. The role for public agencies is to provide direction and advice about biodiversity priorities, develop effective management systems, coordinate and monitor biodiversity management, and provided funds have been made available, to encourage landscape change.

Production of products from 'Clean and Green' New Zealand and Australia are marketing tools employed by the agricultural sector with the development of quality assurance systems. These systems have little emphasis at present on indigenous biodiversity. International consumers will have to demand this before significant on-farm change will take place. In part, the uptake of organic production systems to market as Clean and Green produce overseas is also serving a purpose at a local level. The cost of fertilisers and pesticides, or just chemicals, can be a reason that farmers want to be in the Clean and Green campaign.

Identifying functions that indigenous biodiversity can fulfill as part of a farming system could include sediment control, shelter, and protection of water quality. These integrate the landscape with material expressions of how the landscape 'acts'. This landscape framework has the potential to achieve integration between conservation and production, between the outward manifestation of the ecosystem (i.e. salinity) and its hidden underbelly. Land managers can learn and reflect on how to 'read the landscape'. They are the frontline for recognising a crisis in this area. As representatives of local communities, they have already instigated Landcare in Australia and, in its approximately 15-year history, Landcare farmers have tested the science of revegetation. In reflecting on the role of farmers in building resilience, it is clear that the initial historical representations of landscape form a benchmark for contemporary farmers. However, their ecosystems are hugely changed from those of 200 years ago and the fledgling science of reconstruction.

Progress in achieving biodiversity goals on agriculture land is linked in the shorter term not to international trade issues but to local communities and urban dwellers through regional planning. Landcare has created a significant awareness of landscape

change and is developing a critical faculty among its membership with regard to the simplistic division between agricultural and conservation landscapes (Beilin, 1999). In a process that Walker et al. (2002) describe as 'co-discovery' scientists and farmers recognise that sustainable production systems depend on protection of the underlying resources. Even though the market impetus remains unchanged, and it is that which drives science research and funds its development, declining terms of trade and de-regulation of industries also act as catalysts in the reflexive process. Walker et al.'s "adaptive capacity" of communities is increasing, even as there is still considerable debate about whether we are in Ω progressing to α .

CONCLUSION

As we previously reported (2005), "We make the case that building awareness of ecosystem dynamics through understanding historical processes enables contemporary players to locate desired outcomes—in this case the creation of a landscape mosaic that incorporates diverse production, conservation and tourist values—as part of an ecosystem management approach that will contribute to the resilience of the new social-ecological system.

The capacity to manage multiple drivers as part of interlinked or complex ecosystems highlights the need for strong communities able to imagine and sustain the desired socioecological state and contribute to evolving resilience. In the formation of various land stewardship groups there is a perceived opportunity to assess the ecosystem services and to build socioecological resilience to a new and imagined landscape."

In the context of the Australian case study, we hypothesise that the consequence of crossing an ecological threshold in several states or configurations has had significant effect on contemporary ability to or interest in maintaining or sustaining agricultural landscapes. This coupled with changes to economic markets and more recent and persistent incursions with the advent of dormitory suburbs indicates that biodiversity is not a priority issue for regional planners. The loss of high-rainfall pasture production in a country where there is generally low rainfall is also significant (i.e. where other pastures may need to be irrigated). However, these local land use changes do present the possibility of carbon sequestering through plantation management and a resurgence in recreational values associated with monotypic forest landscapes.

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