The Future for Savanna and Tropical Grasslands: A Latin American Perspective

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Summary

The objective of the paper is to briefly review the main trends in the tropical lowlands of Latin America and the Caribbean (LAC) with particular emphasis in the neotropical savannas. These tropical native grasslands cover occupy approximately 210 million hectares, and constitute major portions of the territory of Bolivia, Brazil, Colombia, Guyana and Venezuela. Many analysts consider that intensification of their use is a valid alternative to the expansion of the livestock and crop industries into the rainforest.

The evidence reviewed shows that since the late 1980s, the LAC agricultural sector has shown dynamism not seen for many years. Despite a decreasing contribution to GDP, the sector in general grew at a rate of 2.9% per annum during the period 1990-95, with large between-countries differences. Yields increased at an average rate of 3.3% per year, compared with only 1.3% per year in the 1980's, with a simultaneous decrease of 2.2% per year in the agricultural area. There is ample evidence of agricultural intensification and modernization, largely driven by macroeconomic policies widely adopted in the region. Commodities produced by the region diversified, most notably through the production and export of fruits and vegetables, closely followed by oilseeds.Cattle-based production systems continued to be the dominant feature of the region on an area basis, since the ratio of land occupied by cattle to that of croplands is approximately 4:1. Nevertheless, there has been marked substitution of native grasslands with a narrow range of annual crops and sown pastures, so that plant biodiversity and the survival of many potentially valuable species are threatened.

These shifts in land use systems have been accompanied by a marked and continued rate of urbanization. At the same time, there is increasing evidence of close ties between urban and rural employment and urban residence. Similarly, an increasing proportion of rural dwellers works in urban settings. It is therefore hypothesized that these interactions have an important bearing on issues such as the development of new ethical and cultural values regarding natural resources, on technology adoption, and on the need for continued changes and adaptations in the institutions that serve the sector.

It is finally concluded that despite a somewhat chaotic process of change and experimentation with new systems, superimposed on long-term trends of resources degradation, there is reason to hope that at least in some countries and areas within countries the ongoing changes are leading to more resource-friendly agricultural systems. Nevertheless, reconciling intensifed grazing systems with natural resources cconservation and enhancement continues to be a major challenge.

Introduction

The crop and livestock sectors of Latin America and the Caribbean (LAC) have experienced dramatic changes during the last three decades, and some of these changes are still

ongoing. The contribution of the agricultural sector to the economy has decreased in relative terms, and there continues to be a substantial rate of rural migration. Nevertheless, these trends mask the fact that the agricultural sector across the region grew at an acceptable rate of 2.9% per annum over the period 1990-95 (Muchnik, Morales and Vargas, 1997), but with large between-countries differences. In effect, the growth rate varied between –4% for Haiti to slightly over 13% for Guyana. A similar variation can be observed between regions within countries. It is a general observation that technologically and market savvy sectors coexist with traditional agriculturalists and indigenous populations in varying states of "modernization".

The contribution of the agricultural sector to general economic activity across LAC varies greatly between 5% of the GDP in the case of Mexico and 40% in Haiti. In general, the agricultural sector contributes a larger percentage in most of Central America and the Caribbean, whereas it contributes the least in countries such as Mexico, Chile, Jamaica, Panamá and the southern cone. Nevertheless, the share of agriculture in total GDP has followed the well-known pattern that as income grows the relative importance of agriculture tends to decline, but some authors believe that the actual contribution of the "rural" sector, as opposed to just simply "agriculture", is significantly underestimated by the above figures (Echeverri, 2000).

Despite the variation noted, the economic and social relevance of the sector continues to be highly important. There is general agreement among analysts that during the 90's, the sector's dynamics has been dominated by the macroeconomic context that prevails across the region (Diaz-Bonilla, 1999). In effect, the opening up of the economies and the subsequent globalization of the technologies, knowledge and markets have had marked influence on land use systems, the adoption of new technologies and modes of production, diversification and, at the same time, a trend towards specialization and monocropping in some of the most favored areas. In general, these changes are still poorly documented. The coexistence of these trends (e.g., attempts to diversify the use of the land resources in some cases and to concentrate on a very reduced set of uses in others) adds to the complexity of the situation and attest to the dynamism of a sector considered until very recently as bound to traditions and reluctant to change.

As in any situation of rapid change positive and negative trends. On the positive side, the 90's have been characterized by a relatively sustained increase in agricultural output. Thus, yields increased in general at a rate of 3.3% per year, compared to the meager 1.3% of the 80's (Muchnik et al., 1997) with a simultaneous decrease of 2.2% per year in the agricultural area. Current data for South America during the 90's show this trend (Table 1). Therefore, and not withstanding large differences between countries, food and feed production have increased and have intensified. Furthermore, the suite of commodities produced by the region has diversified, and a number of authors have noted the emergence of fruits and vegetables as leading agricultural exports from the region in value terms. Similarly, oilseed production has grown very rapidly, whereas traditional export crops such as sugarcane and coffee have diminished their relative importance.

A different dimension of the issue is the continued rate of urbanization of the region (Echeverry, 2000). Contrary to developing countries in Asia and Africa, LAC is a highly urbanized region. The urban population in the mid 90's amounted to 75%, and it is predicted that it will reach 85% by 2005 (CEPAL, 1999). Nevertheless, these figures should be interpreted with caution since they can mask sources of employment with site of residence (urban vs. rural). In effect, the active *agricultural* population amounts to close to 70% of the *rural* population, and there is a rapidly increasing proportion of urban residents working in agricultural activities; the reverse situation is also true, i.e., rural residents working in urban settings. The former category represents 20% or more of the rural workers in Argentina, Brazil, Chile and Venezuela. It isn't

clear how many landowners and land managers are also urban residents, but this issue seems important at least from the point of view of access to information, knowledge, market intelligence and in more general terms, urban-based ethical and cultural principles regarding the use of natural resources. Complementary aspects of the complex and evolving relationship between cities, particularly medium-sized cities, the periurban regions and agriculture have recently been discussed in detail by Schejtman (1999) for the cases of Sao Paulo and of Peru among others.

Lastly, it should be noted that so far, the changes that have taken place in the 90's do not appear to have changed significantly the chronic and well documented problems of the region in terms of poverty (rural *and* urban) or the historic dichotomy in terms of land distribution.

Land resources

LAC has a relatively ample availability of land per capita (Vera and Rivas 1997) in contrast to other developing regions. Perhaps this fact, together with well-known and documented historical reasons, explains the large stock of cattle and sheep that characterizes the region. On average, the region houses 0.7 head of cattle per capita compared with a world average of 0.23. Large land availability and an equally large cattle population result in the region having only 8% of the world human population but 26% of the world's stock of cattle. Similarly, the ratio of grazing lands to croplands is 4:1 across LAC, whereas the world's average is 2.3:1.

The above figures clearly indicate that land use systems in LAC are peculiar to the region and are widely different from those of other developing areas. In turn, this should indicate that the technological and policy options appropriate to the continent should differ from recipes applied elsewhere. For example, it is obvious from the above cited figures that 70-75% of the region's landscape is highly influenced by the presence of grasslands and livestock, and cattle in particular. Therefore, the changes experienced in this major and complex land use system are bound to have a large impact on the conservation and management of the region's natural resources.

The importance of the grasslands-based ruminant sector as a major land use system is clearly recognized in some countries, typically Argentina, Brazil, Colombia, Mexico, Venezuela and Uruguay, but its importance is much more widespread. If the data for Argentina, Chile and Uruguay is excluded and the remaining countries are considered as tropical and subtropical LAC, it can be verified that during the first half of the 90's the yearly rate of growth of the beef supply was 2.9%, and that for cow's milk was 3.2%, in contrast to the previous decades where this figures were less than 2% (Tables 2-4). It is important to note that the growth observed in the 90's was not due to the increase in the cattle herd (0.6% per year) nor the pasture area (0.2% per year), which would indicate that the sector has intensified. This is particularly the case in Brazil and Costa Rica, whereas it tends to be less marked in the remaining tropical countries. The evolution of the grasslands area vis-a-vis that of annual crops in the Brazilian Cerrados is shown in Figure 1 which illustrates two major trends observed in the neotropical lowlands during the last two decades, namely, the growth of annual crops (largely for export, and most notably, soybeans), and the expansion of sown pastures respectively, both at the expense largely of native grasslands. Nevertheless, during the second half of the 90's there was also expansion of sown pastures at the expense of croplands, at least in parts of the Brazilian Cerrados (Alburquerque David et al., 1999).

Income elasticies for meats and milk continue to be very high relative to most agricultural commodities (see for example CEGA 1996 for a recent study in Colombia), thus anticipating a continued growth of the demand if real incomes increase. This trend appears to be part of a

generalized phenomenon in most developing countries and is particularly noticeable in S.E. Asia (Delgado et al., 1999). It should be noted that, as indicated by Seré, Steinfeld and Gronewold (1996), some of the reported growth figures are comparable to those that characterized the Green Revolution.

Grasslands-based production systems

In view of their importance as a major land use system it is advisable to consider the diversity of grasslands- and cattle-based systems and some of their implications. Table 5 attempts to summarize some of the main spatial and other characteristics and reflects the views of the author regarding issues relevant to their sustainability. Opportunities for technological and policy interventions can also be inferred from this summary. Important changes have occurred during the 90's regarding pasture-based cattle production systems with a trend towards more management-intensive systems particularly in the dairy sector. This phenomenon can be observed in both the tropical and the temperate areas (Table 6) which clearly shows the growth of dairy production in comparison with a relatively stagnant beef sector. Intensification of tropical milk production is currently associated with genetic improvement of cattle. Genetic improvement in turn increases the nutrient requirements of dairy cattle but the majority of currently available tropical grass species and varieties in the lowland grasslands and savannas will not be able to meet these increased nutrient needs. This lack of match between nutrient requirements and supplies add incentives to the use of other forage resources and supplements. To a lesser extent, semi-intensive grasslands-based beef systems face a similar situation. In summary then, intensification of ruminant production systems in the lowlands of tropical LAC is beginning to face the consequences of important interactions between the relatively quick process of genetic improvement of cattle, and the need to adapt suitable feeding strategies based on a relatively narrow range of low- to medium quality grasslands resources.

It should be noted that so far, there is a dearth of systematic, holistic studies on the environmental impact of these systems, not withstanding a more general and worldwide treatment of the subject in recent conferences (RIMISP, 1998; de Haan, Steinfeld and Blackburn, 1998). Table 7 suggests some of the possible impacts that appear to be relevant for the region and that would need to be quantified if a serious and systematic analysis of trade-offs is attempted.

In grasslands-based neotropical grazing systems a number of serious concerns can be identified (de Haan, Steinfeld and Blackburn, 1998). Firstly, it is the widespread phenomenon of pasture degradation, and its associated phenomena of decreased animal yields, soil erosion and compaction, and various others (Costa and Rehman, 1999; Ayarza et al., 1999; Klutchcouski et al., 1999; Macedo, 2000). Despite its common occurrence across the neotropical lowlands, the consequences of pasture degradation are still imperfectly documented (Vera, Hoyos and Moya, 1998; Vera et al., 1994). Secondly, sown pastures in the neotropics are dominated by a very small number of genotypes, leading effectively to a form of monocropping (Macedo, 2000; Valls, 2000). It is estimated that 28 of the 50 million hectares of sown pastures in the Brazilian Cerrados (according to IBGE, (1995/96) by 1996 the area planted to sown pastures in five states of the Cerrado was closer to 55 million hectares) have been planted with a single genotype of *Brachiaria decumbens* (Macedo, 2000). The two former problems are intimately interrelated, and so are the technical solutions (Macedo, 2000) that include increasing the diversity of species and genotypes to reclaim degraded pastures and to diminish risks associated with monocropping. The third major issue is the maintenance, and in some cases the recuperation of soil fertility. Large areas of grasslands located in hillsides and in the foothills of tropical America have been depleted

of their original fertility due to many decades of extractivist production systems (e.g.Barbier and Bergeron, 1999), whereas the majority of the grasslands located in the lowlands are supported by soils of inherent low fertility (oxisols and ultisols; Macedo, 2000).

Given the intensification processes referred to above, and the economic and environmental challenges faced by grasslands systems in the region, the need for better quality management of these systems is becoming increasingly recognized (Vera, 2000). Until fairly recently, grassland production systems were based mostly on physical resources (soils, pastures and animals) subject to minimal management. During the 90's, and associated with the increasing incorporation of the region to the world markets and their requirements for quality assurance, the need for improved quality of management is being prioritized (Macedo, 2000; Oficialdegui, 2000). In other regions and countries it has been suggested that the management ability of the producers conditions the success or failure of new farm-level technologies (Scifres, 1987; Pearson and Ivon, 1997), and it is possible that the same concept applies in LAC. This need become more urgent as the demands not only for efficient production but also for social and ecological responsibility placed upon grassland systems in the region increase.

Possible future paths

As indicated above, the tropical and subtropical grassland area of LAC has been subjected to intense and drastic changes during the last 15-20 years. The growth of croplands and sown pastures largely at the expense of native and naturalized grasslands has significantly altered the landscape of the region. Throughout the region there are few incentives to maintain native grasslands, although it can be anticipated that in the near future this situation may change, a subject further discussed below.

Some of the changes experienced by the region represent a definitive improvement in terms of a more sustainable use of natural resources. This is most notable in the case of the lowlands crops, which have witnessed an explosive increase in soil conservation practices such as minimum- and zero-tillage. Some of these practices have been implemented on areas previously covered by degraded sown pastures and may augur well for much of the remaining tropical lowlands since farmers are increasingly aware of the economic and ecological benefits of conservation.

Grassland-based cattle production has intensified and this process is likely to continue in the remaining years of the present decade. Cattle production, and dairy in particular, are increasingly dependent on forage resources other than grasslands. The rapid spread of maize silage and other annual forage crops, as well as the sporadic use of crop residues and stubbles, imply an increasing spatial integration between crops and grasslands. Forage conservation techniques continue to improve and their increasing reliability will most probably assure them a continuing important role in the wet-and-dry tropics. The temporal integration via planned rotations is much less common, except for the sporadic use of degraded pastures for the establishment of zero-tilled crops, an event that may eventually lead to planned rotations and some form of tropical ley-farming. Even in this case, it is anticipated that if present trends continue, grass-only pastures are likely to predominate as in the recent past. On the contrary, the use of grass-legume pastures is still minimal, and tends to occur in small geographical niches despite many years of research by numerous institutions in various countries. Their well-proven benefits in terms of individual animal performance and soil conservation have not been able to overcome management constraints and the need to maximize production per hectare, particularly in dairy and intensive beef production systems. The use of pure legume forage crops and of

supplementary forages such as the brassicas, both of which are increasingly common in the temperate and subtropical areas of LAC and that contribute towards diversification of the grasslands resources have not yet found equivalence in the tropics.

On the other hand, all LAC countries are striving to increase their exports of agricultural commodities and specialty agricultural products. The importing, developed, countries have increased their demands for products produced `naturally`. The debate over extensification versus intensification in the EU is an additional indicator of the developed-country consumer preferences. Even in some of the LAC countries for which evidence is available (The Economist, 2000), consumers show preference for `naturally` produced agricultural commodities. These trends, together with the growth of agro-ecotourism, and the slowly increasing recognition of environmental services may lead to a more balanced evolution of grazing systems in at least parts of the region, such that the traditional driving forces are modulated by the newer concerns shown in italicized letters in Figure 2.

Undoubtedly, ruminant production in tropical LAC will continue to be based largely on grasslands. These systems will increasingly be expected to provide a wide range of products and services beyond cheap meats and milk. Nevertheless, reconciling the drive for increased productivity and economic efficiency with the demands for sustainable use of tropical grasslands will remain the major challenge of the sector.

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Table 1- Areas sown to arable and permanent crops, and permanent pasture in South America during the 90's, as % of 1991 (FAO, 2000).

Land use system	1991	1995	1998
Arable and permanent crops, %	100.0	105.7	105.4
Permanent pasture, %	100.0	100.1	100.3

Table 2 - Growth of beef and milk production in Latin America and Caribbean

	Beef & veal 1990-1998	Cow milk 1990-1997
	% per year	
Tropical LAC	2.02	2.95
Southern Cone	-0.60	6.33

Source: FAO, analyzed by author

Table 3 - Beef production in Latin America and the Caribbean, and growth rate per country

	Production in 1998 Million metric tons	Yearly growth rate, % 1990-98
Brasil	5.230	2.75
Argentina	2.250	-1.70
Mexico	1.380	2.44
Colombia	0.690	0.25
Uruguay	0.438	4.59
Venezuela	0.363	-0.67
Chile	0.265	2.35
Paraguay	0.226	1.25
Bolivia	0.155	2.24
Peru	0.127	0.92
Cuba	0.075	-5.67
LAC	11.808	1.29
Four largest producers	81%	

Source: FAO, analized by author

Table 4 - Milk production and yearly growth rate in Latin America and the Caribbean

	Production in 1997 Million metric tons	Yearly growth rate, % 1990-97
Brazil	19.241	3.16
Argentina	9.405	6.67
Mexico	8.212	2.90
Colombia	5.408	4.00
Chile	2.060	5.75
Ecuador	1.937	3.63
Venezuela	1.475	-1.06
Uruguay	1.411	5.07
Peru	0.967	2.87
Cuba	0.640	-5.47
Costa Rica	0.595	4.27
LAC	51.351	3.68
Four largest producers	82%	

Source: FAO, analized by the author

Table 5 - Diversity in neotropical cattle-based systems (modified from Vera y Rivas, 1997)

System	Based on		Integration With Crops	Use of purchased inputs	Market orientation	Management intensity	Examples[1]:
	Native grass-lands	Sown pastures					
Extensive cow-calf	+++	+	0	+	Comerccial	+	Agricultural fontier in neotropics
Semi-intensive fattening	0	+++	+	++	Comercial	++	Savannas, interandean valleys & hillsides, numerous others
Feedlots & intensive fattening	+	+++	+++	++/+++	Comercial	++/+++	Central west Brazil, some irrigation areas, highlands tropics
Tropical dual purpose (beef/milk)	+	++	+	++	Comercial	++	N coast of Colombia, Venezuelan & Brazilian savannas, andean piedmont of Colombia, Ecuador, Venezuela; C. America mid altitudes and lowlands
Opportunistic tropical dual purpose	+	+	0	+	Household consumption and occasional sales	+	Parts of Amazonia, andean piedmont and C. America
Tropical *Ley-farming*	0	+++	+++	+++	Comercial	+++	South central Cerrado
Incipient systems: e.g. organic beef & milk, exotic meats, sheep milk	++	++	0/+ ??	+	Comercial, for high income urban households	+++	Incipient, in numerous, dispersed areas

[1] References in Vera y Rivas (1997)

Table 6 - Changes in the cattle stock, beef cattle slaughtered and cow milk production as % of 1991, in two contrasting groups of countries: Brazil+Colombia+Venezuela, representing the tropics and Argentina+Uruguay as representative of temperate areas (Source: FAO 2000, calculated by the author)

Item	Countries	1995	1998
Cattle stock	Brazil+Colombia+Venezuela	100	106
	Argentina + Uruguay	104	106
Beef & veal stock slaughtered	Brazil+Colombia+Venezuela	96	113
	Argentina + Uruguay	93	93
Cow milk production	Brazil+Colombia+Venezuela	110	135
	Argentina + Uruguay	132	148

Table 7 - Possible social, economic and environmental impacts of neotropical livestock systems (based on Vera y Rivas, 1997)

System	Impacts	
Cow-calf and extensive beef breeding	Income maximization Low inputs and outputs Efficient use marginal lands Slow if any, grasslands degradation	Capital expectation Low nutrient exports Very low labour use
Fattening on sown pastures	Income maximization Tends to favor subdivision of large ranches Native grassalnds replaced by monocrop pastures Produces low cost beef for urban consumption	Low labour use May lead to deforestation, land degradation, soil compaction Excellent potential for integration with crops in ley-farming systems
Neotropical dual purpose	Maximizes use low opportunity cost family labour Regular cash income Minimizes risks Small farms viable	Soil mining May lead to deforestation, land degradation, soil compaction Increased equity, food security
Neotropical milk production based on pastures	Income maximization Generates agroindustry employment Low cost milk for urban dwellers	Can lead to contamination soils, water courses Economies of scale can lead to vertical integration
Tropical *Ley farming*	Maximizes resource use efficiency Negative environmental impacts unknown Increases landscape diversity	Frequently capital-intensive, with exceptions Very knowledge-intensive Economies of scale ?? Integration with native grassalnds ?? Conserves soils, reclaims degraded lands
Organic products, delikatessen, and similar	Highly management- and information-intensive High value-added Many linkages with other sectors	Conservation and management of natural resoureces Modest market niches

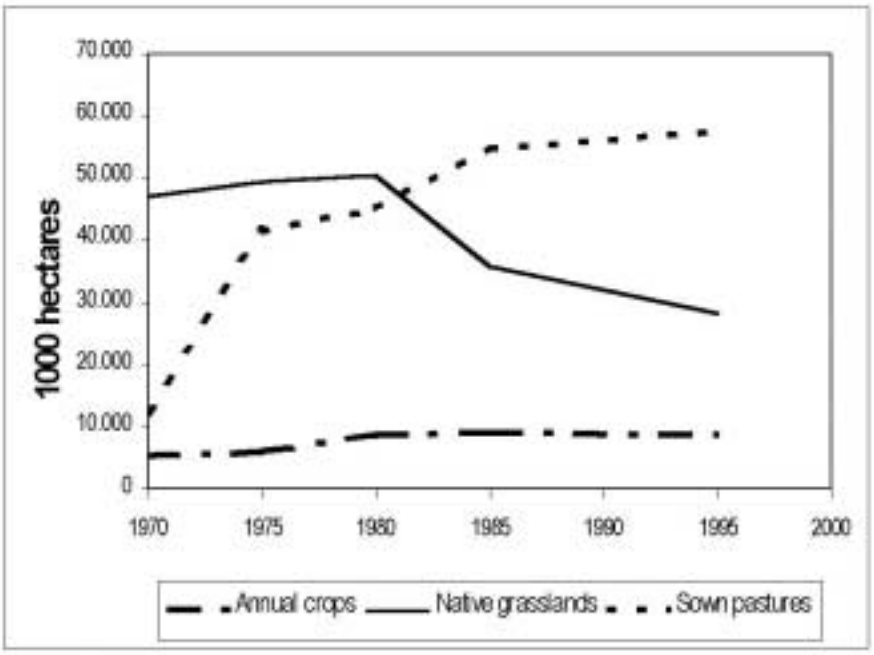

Figure 1 - Evolution of the area under annual crops, native grasslands and sown pastures in the main states of the Brazilian Cerrados (Distrito Federal, Goias, Minas Gerais, Mato Grosso, and Mato Grosso do Sul). Source: http://www.ibge.org calculated by the author.

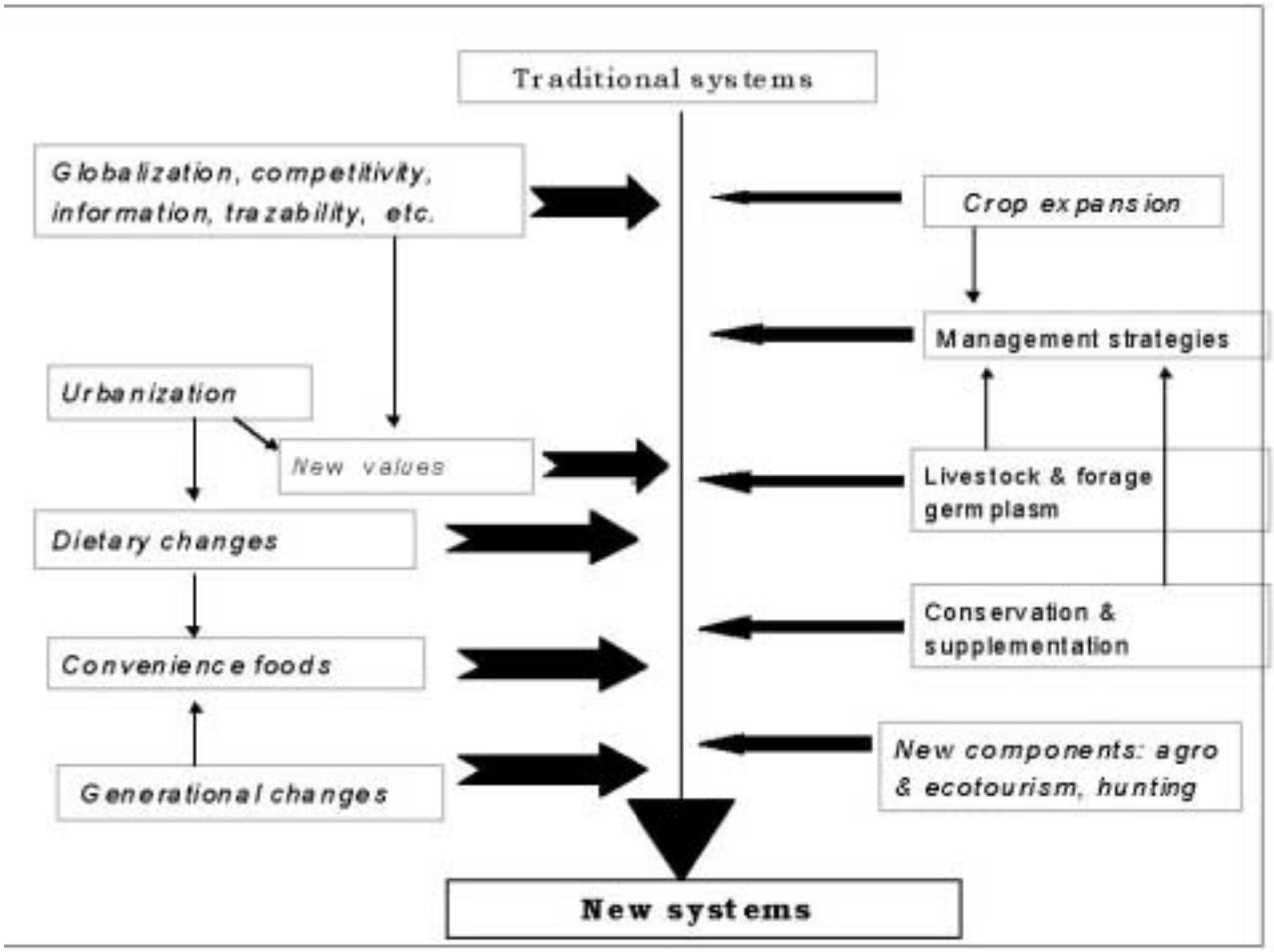

Figure 2 - Driving forces influencing the evolution of grazing systems in the tropical lowlands of Latin America. Factors identified in *italicized* characters represent newer, emerging, trends (modified from Vera, 2000).