A comparative study of the impact of Argentine and Mexican agricultural modernization on land use and soil erosion

Alejandra Gutierrez

Rural Development Department, Faculty of Agrarian and Forestry Sciences, National University of La Plata, Calle 60 y 119, CP 1900, La Plata, Argentina
E mail: guepan@netverk.com.ar

Abstract

The purpose of this paper is to explore the impact of the agricultural modernization process on changes in land use and soil erosion in Mexico and Argentina. The process of agricultural modernization emerged as a result of changes in the international food system through which a feed grain livestock complex changed patterns of production, consumption and meat trade. This has caused an increase in livestock production in the South of Mexico and its decrease in the central region of Argentina, called the Pampeana Region. For this reason, the pattern of land use changed in the first case from forest land to pasturage land, through deforestation and, in the Argentine case, from land devoted to agriculture in rotation with pasturage to restore fertility, to land devoted only to intensive agriculture. In both cases, it results in high rates of soil erosion.

I Introduction

The aim of this paper is to explore the impact of agricultural modernization process on land use changes and its effects on soil erosion in Mexico and Argentina. The agricultural modernization process has led in Mexico, to a "very accelerated growth process devoted to cattle production, as well as to the sown surface with fodder crops (mainly alfalfa, sorghum and soya)" [1]. This process is called in Spanish "ganaderizacion", whereas in Argentina, in contrast, there has been a process called in Spanish "agriculturizacion" which is a process "by which the cereal and oil seeds sector has strongly grown, in contrast with previous periods of agricultural stagnation and a predominance of the cattle sector" [2], with a strong retraction in land cultivation of sorghum...
and alfalfa. This process occurred especially in a region called Pampeana Region which is linked to international markets.

As a consequence, in both countries there have been important changes in land use. In Argentina, there has been an increase and intensification of agriculture which caused high rates of soil erosion due to rain. On the contrary, in Mexico the "ganaderizacion" processes were possible by clearing land through deforestation in the South which, after a few years of pasture and agriculture caused high rates of soil erosion.

Both processes analyzed separately could be seen as brought about by the inner characteristics of each country, as isolated from each other. However, even though each one has its own dynamics because of the differences of both countries in agrarian structures, ecological systems among many other differences, what links them is their origin. Their common origin is the process of agricultural modernization which is, in addition, a consequence of changes in the international food system after the Second World War.

Therefore, to start with the origin, in the next part of this paper has been included an explanation of how the changes in the international food system have affected both countries. The changes in the international food systems, that is, changes in production, consumption, and trade, among others, can be analyzed through the working of three complexes [3]. One of them, the functioning of the livestock/feed grain complex, explains how both "agriculturizacion" and "ganaderizacion" processes came about and is found in Part III. The Argentine case will be analyzed in part IV and the effects of "ganaderizacion" process on deforestation and soil erosion in Mexico will be explained in part V. Finally, a brief conclusion will be given.

II Changes in the international food system and agriculture internationalization

After the Second World War major changes occurred with the establishment of a new international food system: changes in production, consumption and trade of agricultural products. This has been possible through a process of agriculture internationalization or globalization which resulted in three important changes.

First, there has been a transnational integration of production itself by mean of the introduction of new technologies, basically the technological package of Green Revolution with machinery, improved seeds, and agrochemicals. Second, it has encouraged the production of specific products to be sold in the international market and third, it has reshaped consumption patterns in developing countries which exerts specific demands, specially from those groups with higher income [1][4]. The production in agriculture was reshaped for all those factors from the demand side (external or internal) because of changes in consumption patterns in developed countries and mainly in the groups of higher incomes. Therefore, producers did not sell anymore
what they produced but they started to produce what they will sell. Besides, food was no longer something produced by farmers and directly or in origin bought by consumers, but became a profitable product of capitalist enterprise, transnationally or nationally sourced, processed and marketed. Thus, the agri-food sector became central to capital accumulation in the world economy and agriculture became internationalized and transnationalized.

All these changes can be seen in the functioning and changes of the new international food systems, which, according to Friedman, worked through three complexes: wheat, the durable food and the livestock/feed grain complexes, which brought new international division of labour in agriculture by which developed countries were mainly devoted to basic grains and less developed countries were devoted to "non traditional" crops or activities such as soya in Argentina and livestock production in Mexico.

As a consequence, new technologies, new agricultural and rural activities according to the internationalization or agricultural modernization emerged because of new crops or livestock production emerged in developing countries. It brought about a new use of land and other natural resources which became internationalized as productive structures have been approximated to international patterns through technological and managerial internationalization [5]. The functioning of one of those complexes, the livestock/feed grain complex, originated the "Agriculturizacion" and "Ganaderizacion" processes in Argentina and Mexico respectively, and will be described in the next part of the paper.

III The origins of "agriculturizacion" and "ganaderizacion": the functioning of the livestock/feed grain complex

The livestock/feed grain complex is one of the three complexes which regulate the functioning of the international food system. According to Friedman, "the transnational integration of intensive livestock production within the advanced capitalist sphere creates the livestock/feed complex; this movement extended commodity chains across national frontiers, so that apparently national sectors, such as livestock, came to be tightly linked for inputs and sales to international trade" [3].

This situation emerged as a consequence of from great increase in meat consumption due to the changes in the diet patterns based on meat (poultry, veal, beef, pork, mutton and lamb), dairy products and oleaginous consumption after the Second World War. This change in the dietary patterns started in USA, has been transferred to Europe and, later on, to the medium and upper classes of developing countries. This increase in meat consumption in developed countries has been in regard not only to high quality meat but mainly to consumption of industrialized and cheapest meat such as hamburgers, hot dogs, among others.
This differentiation into both types of products brought about "new trend and redefinitions of the productive structure and the world commerce of beef" [1]. Therefore, developed countries specialized in producing high quality beef by intensive techniques, while the increase in the demand of low quality beef has been met by beef imports mainly from some tropical developing countries, like Mexico, Nicaragua and the Amazonas region of Brasil.

This is because intensive systems of production were established in the United States and so there has been a reduction in the production of old cows which were the main source of industrialized meat. Thus, with a growing internal demand and having reduced the internal production of cheap meat, the United States promoted the production outside their frontiers, what constitutes the known 'hamburger connection' [4].

In this way, Mexico became an important supplier of cheap meat, mainly to the United States, according to the new international division of labour [1]. Besides, the United States and other developed countries created two other markets, one free of foot and mouth disease and another one not free has segmented the international meat markets [5].

This sanitary restrictions have also affected Mexican cattle production, leading to the establishment of two cattle productive areas: the North of the country entering into the free disease market exporting to the United States and the South into the foot and mouth disease circuit, specializing in production for the local market.

This fact has also affected negatively the meat exports of Argentina, which was until 1995 under the foot and mouth commercial sector, facing quota restrictions. For instance, in the early 60s, the Argentine participation in the international beef trade reached 31%, diminishing to 11% at the beginning of the 70s, reaching only 6% in 1991"[7]. On the Argentine productive side, it has caused the retraction of cattle production in the Pampeana Region, where it is produced for internal and external markets.

In addition to the above mentioned process, in developed countries and later in Mexico and Argentina, livestock producers became increasingly linked with agri-food corporations to buy inputs. Accordingly with the changes in the productive techniques, one of the most important inputs have been that used in the feeding system of animal production. Therefore, livestock sector demanded specific feeds, which were purchased from corporate feed manufactures. At international levels, this has increased the demand for fodder to be used for animal feeding, mainly soya, which is used for the protein content taking part of a huge mix of animal-feeds components. Thus, the world demand of pellets is related to the evolution of cattle and poultry production in developed countries at least at the beginning and the pellets of soya became the most important ones in the international market due to their high level of protein[2].

Argentina could enter into the international market after 1973 and soya became a boom and therefore, changes in the external demand, through the reduction of beef demand and the increase of soya demand, led, in Argentina,
to an "agriculturizacion" process, in which soya plays a predominant role, displacing cattle production and bringing great changes in land use and soil properties [2].

In Mexico, both the increased agroindustrial integration with a phenomenal growth of the livestock sector and the incorporation into the new international beef trade have led to the "ganaderizacion" process.

Therefore, having made clear the common roots of such changes, the next two parts of this paper will be devoted to analyze the specific internal dynamics of both processes and the changes in land use and their impact on soil erosion rates.

**IV The effects on land use of the "agriculturizacion" process with the soya boom in Argentina**

The soya was introduced in Argentina at the beginning of the 70s, and it was first introduced and adopted in the Pampeana region, because this crop is particularly suitable for large scale, capital intensive production and these characteristics are to be found in this region. Its production experienced an explosive growth and Argentina became the fourth largest soybean producer in the world. Soya is almost entirely exported, either before or after internal processing in the form of pellets and expellers and soybean oil [6], and it is the main source of external currency.

Soya (a summer crop) fit perfectly into the agroecological characteristics of the region and it can also be cultivated in rotation with wheat (a winter crop) in the same year. This has been possible due to the strong diffusion of techniques to produce the double crop wheat-soya in the same year along with the introduction of the whole technological package and its knowledge in the production of soya [2].

The causes of soya boom have to be seen in the existence of an avid external market, the retraction of cattle exports, the promotional national policies which fostered its incorporation, the promotion of this crop by transnational enterprises which had imported the whole technological package, and the comparative better rentability compared to any other agricultural activity.

The retraction of the area under cattle production has been covered by agricultural crops, from 39.278 thousand hectares in cattle production in 1974 to 36.196 thousands of hectares in 1986 ( -7.8%), while the area under "second soya" (that is area under wheat-soya in the same year) has increased in the whole region in the same period of time from 165 to 990 thousand of hectares [7]. However, the overall of area devoted to soya in the Region reached a total of 3.934.362 hectares in 1988 while in 1970 no soya was cultivated.

The changes in the land use have been different according to the agroecological division of the region. In the Pampeana Region there are three
areas: the Agricultural zone, in which the soil to be cropped is excellent; the Mixed Zone suitable activities vary between agriculture and cattle production; and the cattle zone which is suitable almost only for cattle production. Considering only the soya/wheat area, the most important area is the called Agricultural where the area grew from 156,000 hectares in 1974 to 826,000 hectares in 1986. In the Mixed Zone, the growth was less important from 9,000 hectares to 164,000 in the same periods, and there was no adoption of soya/wheat in the cattle Zone [7]

The increment of the area is one of the components of the soya explosion, which contribute to 49 % of the total production increase while a great increase in productivity, in terms of yield per hectare, contributed to 51 % of the total production increase. Therefore, within the Pampeana Region, the Agricultural Zone contains the 70.3% of total soya and contributes to 73% of the production, with an output of 21.55 qq/ha. In this area the major quantity of second soya (wheat/soya in the same productive year) can be found, which results in an intensification of land use with continuous practice of agriculture and started a process of soil erosion.

The process of erosion and soil degradation were within the tolerable limits until the middle of the 70s, when the process of agricultural expansion, mainly with soya, broke one of the most sustainable ways of combining cattle with agricultural production in temperate areas, a production system characteristic of the region. This practice consisted of rotation between agricultural cycles and pasturage periods and, after four or five years of agriculture, the fields were left under pasturage, allowing them to restore the soil fertility and physical soil conditions. Within the agriculture cycle (crop rotation) sorghum and maize were used and they contributed with much volume of organic matter due to the vegetal volume they have. However, both crops have diminished during this process of agriculturization and soya almost does not incorporate organic matter into soil worsening the soil conditions.

Soils became more time plugged, soils nutrients are extracted by two crops in the same year, there is less organic matter contribution, and there was no fallow. Brailovsky and Foguelman summarized the process in this way: "international technological models were adopted. Even though they ensure an immediate profitability, they imply aggressive practices to the soil, an increase in the artificialization of agroecosystems, growing restrictions to few practices and management styles and to a few crops, machinery each time more heavy and speedy but at the same time more aggressive, and to an agricultural specialization which eliminates the pasture rotations"[9]

The outcome was a dramatically increased process of soil erosion by hydric soil erosion, which affects 32 % of the total area (1.3 millions Hectares) of the total Pampeana Region [10]. This effect has been more intense in the agricultural zone (where soya is most important) where 25 cm of land were lost by hidric erosion [11].
V The impact of the "ganaderizacion" process in Mexico

The outcome of modernization in Mexico has been a great increase in the cattle heads, and in the area under pasturage and sorghum production as fodder crops (to feed specially the transnational feed companies) particularly in the irrigated areas of the North. In terms of occupied land, between 1950 and 1980, the land used for cattle production grew from 50 to 78 millions hectares[1], and the growth of the area under pasturage has been possible by displacing the land previously devoted to basic grains.

The international market, mainly the United States, and the internal one has lead to the creation of two areas of cattle production. In the irrigated North, free of 'aftosa', cattle production responded to external demand exporting live calves and lean meat. Moreover, Mexico began to export boned, frozen, and fresh beef to the United States, after the elimination of sanitary barriers and the establishment of the processing plants in the border frontier [5]

In this part of the country there has been an important increase of cattle herd in extensive production system based on fragile pasturage which, due to the cattle overpopulation has led to overgrazing, with the outcome of soil erosion (for instance in 1983, 128 millions hectares had been degraded). In the South, cattle production was mainly used for local market, mainly urban markets. In all cases, the growth of livestock production has been historically in an extensive nature, with a coefficient per hectare below the national average (1.81 hectare per animal unit). For this expansion more land has to be incorporated and it was made through deforestation which varied according to the different type of forest considered. For instance, in tropical evergreen and tropical deciduous kind of forests, livestock production contributes 58 and 57 % to deforestation respectively (137.460 has and 183540 has deforested for 1980 respectively), decreasing in the case of temperate forests to 28%. However, taking into account that the land devoted to agriculture that is finally used for pasturage, the total importance of cattle production growth in both types of forests to 68 %, 61% and around 45% in the case of temperate forests[12]. In each case, it represents an annual rate of deforestation of 2,44% in tropical evergreen forests, 2% in tropical deciduous, 0,96 % in temperate coniferous and 0,96 % in temperate broadleaf [12].

The forest of Mexico is considered one of the richest areas of biodiversity but deforestation brought loss of biodiversity and great rates of soil erosion.

Concluding remarks

The aim of this paper was to explore the impact of agricultural modernization process on land use changes and on soil erosion in Mexico and Argentina. Both agricultural modernization emerged as a consequence of the changes in the
international food system one of which is the changes in the pattern of consumption and meat trade. That have been analyzed by the functioning of the livestock/feed grain complex which caused in Mexico the "ganaderizacion" and in Argentina the "agriculturizacion"

The changes in the land use were different, in Mexico there has been an increase of livestock production whereas in Argentina there was a soya boom. Thus, in the first case, land use changed from forest land to pasturage through deforestation in the South part of Mexico. In Argentina, the changes was from a combined system of rotation between agriculture and livestock production in the Argentine case to an increase and intensification of agriculture. In both cases, the final outcome was high rates of soil erosion by rain.

In this sense, this paper shows the influence of the international food systems changes jointly with the integration of national agricultures into international markets on productive systems and therefore in land use. However, in both cases the high rates of soil erosion have been consequence of the lack of internal measures to avoid the negative impacts of such changes in each country which shows besides the lack of consideration for their natural resource base.

References


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