Climate change and animal production

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The terms greenhouse effect and climate change are frequently treated indistinctly by mass media, even though conceptually they make reference to totally different processes. While the first is a natural phenomenon, resulting from gas capturing by molecules present in the terrestrial atmosphere of the thermal energy reflected by the surface of the planet, that warms the planet in a similar way as it occurs in a greenhouse; the second is a process originated by the peculiarities inherent to the socio-economic systems and by their moving forces, which together determine the emission levels to the atmosphere of natural and artificial gases which are a consequence of the development, and that have the capacity of warming the atmosphere additionally to the greenhouse effect.

As this additional contribution to the natural process is prolonged in time, the average global temperature of the superficial air starts increasing at much lower time intervals than it occurs with the greenhouse effect, and as the temperature forms part of the group of variables of the climatic system, its interaction with the remaining ones starts to modify the system as a whole at an unusual speed. This also gives place to generate alterations in other environmental and biological systems that, finally, end up by affecting the socio- economic systems where the emissions were originated, a process that as a whole is identified as climate change.

The climate change arose as a consequence of the Industrial Revolution in the second half of the XIX century. However, it is not until the eighties of the XX century that the international community starts to take actions devoted to define what was occurring with the climate, which were the causes, what could be done to reduce them, what effects could be expected and what could be done to reduce the negative consequences.

Consequently, the atmospheric gas concentration of greenhouse effect was estimated and its change speed was calculated. While in the year 2000, 3.3 $GtC*y^{-1}$ were emitted to the atmosphere, seven years later in 2007, that value increased to 12.0 $GtC*y^{-1}$ with a mean increase of 1.24 $GtC*y^{-1}$ (IPCC, 2001 and 2007). In this context, the main emission sources were identified (in the first place, energy generation and in the second, the livestock sector) and the main carbon drains (forests and oceans). Also, actions were undertaken devoted to the decrease of the emissions (as the development of renewable energies) and each economic, social and environmental sector tackled the identification and evaluation of the expectable consequences by climate change and their environmental effects, either by increase of the temperature, by rainfall modification or by the increase of the mean sea level and, in consequence, actions for the adaptation were proposed.

The livestock sector, characterized as an open production system, is one activity which is most linked and that is more vulnerable to climate change. While in 2000, livestock productions were responsible for 1.6 $GtC*y^{-1}$, in 2007 this figure was of 8.0 $GtC*y^{-1}$, with an annual mean increase of 0.91 $GtC*y^{-1}$. From these emissions, livestock productions were responsible for the greatest part, since enteric digestion and the lack of feces management from large herds, both generating methane, a gas of greenhouse effect with a warming capacity 23 times higher than that of carbon dioxide (IPCC, 2001 and 2007).

The constant increase of the mean air temperature, the modification of rainfall and the increase of the mean sea level vary their effects depending on the animal component and the conditions of the country.

In continental countries, the typical cattle and pig productions of temperate countries or of high zones start to be affected by the temperature increase. However, in subtropical and tropical countries, where cattle production is more adapted to higher temperatures, it is severely affected by the reduction of water availability due to rainfall decrease, the extension of the dry season or to the modification of the rainfall regime, while pig production in warm countries is already practically in the bearable temperature limits for the species and their breeds.

In the small insular states, such as Cuba and other Caribbean countries, the negative effects of the increase of the sea level and of the wedge of saline intrusion in the underground aquifers are added. These processes affect the quality of the subterranean waters; decrease their availability and also, start to generate negative effects on buffalo cattle production including some breeds that are developed in coastal muddy zones.

Poultry production specialized in egg production is damaged by temperature increase, since it influences on poultry performance, reduces their coefficient of conversion and affects animal productivity, while

apiculture receives the effects of the phenological changes of the plants supplying nectar and pollen to the bees, as a consequence of the temperature increase and rainfall modification. In this way honey yields and of other associated productions are affected.

Tropical cyclones, extreme environmental events of importance for all the watershed Caribbean countries are added together to all these conditions, which have registered in the present century a sensible increase in intensity. These phenomena compel to carry out important herd movements to high zones. The destructive power of their winds sensibly affects livestock facilities, which are not characterized by their structural solidity.

Results related to these effects have been reported from Mexico, Colombia, Brazil and Cuba, among other Latin American countries. Nonetheless, once taken conscience of the relevance of the climate change for livestock productions, a question arises: what to do in this regard?

The cause originating climate change is the gas emissions of greenhouse effect of anthropic origin. Thus, a first objective would be the decrease of the emissions related to animal production.

An alternative frequently reported for the decrease of methane emissions through enteric digestion is the modification of the animals' diet. The reduction of emissions derived from feces has been undertaken through the development of biodigestors capable of substituting the delivery of methane to the atmosphere, due to their controlled supply as domestic biofuel.

Recently, the Food and Agricultural Organization of the United Nations (FAO) has published the report entitled "Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities" (FAO 2013). This document is considered to be the more comprehensive estimate produced to date on the contribution of livestock production to global warming, as well as on the potential of the sector to help in resolving the problem.

According to the report, the cattle productive chain emits 7.0 $GtCO_2$-e*y^{-1}, which equals to 14.5% of the total emissions of anthropic origin. The main sources of emission in the chain are the production and processing of animal products (45 % of the total), the methane emissions by enteric digestion (39 %) and feces decomposition (10 %), while the rest is attributed to the processing and transportation of animal products.

Similarly, the report points out that the adoption of the best existing practices and technologies for the preparation of the animal feed, for the herd care and health and for the feces management, could allow the reduction of up to 30 % of their emissions. This turns it into a more efficient activity, reducing energy loss at the same time.

In the interests of reaching these objectives, FAO has established a global action agenda, whose three priority areas are: the promotion of more efficient practices, the improvement of pasture management and a better feces management.

A second objective in the work of animal production would be directed toward the adaptation to the expectable effects of climate change. However, in contrast with the mitigation of emissions, that accepts general action strategies, the evaluation and adaptation to the impacts is a process of local and specific character for each type of animal production.

Nonetheless, the accumulated experience in this sense has allowed the identification of some alternatives, whose use can have quite a general character. Among them it is possible to indicate:

- Increase of shade availability for the cattle through the establishment of certain amount of trees of wide tops in the paddocks.
- Design, orientation or cover modifications in the housing facilities destined to animals for decreasing the inside temperature.
- Execution of engineering works facilitating the harvesting and water storage during the rainy season to palliate its shortage during the dry season.
- The establishment of perimetral breaking winds barriers, with an appropriate design in the facilities housing animals will decrease the effect of hurricane winds.

Apart from these alternatives, animal production can also develop adaptation measurements derived from the application of the results from the animal breeding improvement, on introducing breeds more tolerant to high temperatures, capable of maintaining their productivity with lower water consumption or possessing other traits adequate for the environment in which they are managed.

In spite of this, the development of these activities must implicitly bring about an important change in the way of thinking of geneticists, who instead of selecting animals better adapted to present environments as it is usual, they will have to consider primarily the selection according to the characteristics of the future environments foreseen by the climatic scenarios, at a distance not less than 20 years.

Finally, in the context of the adaptation to the effects derived from the modification of the climate, animal production must not let out of sight the possible changes that could experiment the agents causing the diseases, which after all as populations of live organisms, will also react in some way to the climate change, whether by increasing their aggressiveness, extending their usual action area or maybe by reducing their relative importance, while other less common agents start to increase their effects.

A third objective that must be considered by animal production in its confrontation to climate change would be associated with the creation of facilities and communication.

The existing knowledge level on the climate change topic among those devoting to a productive activity in general, and even among those taking decisions, is not so extended as desired and in spite of the frequency with which mass media deal with the topic as news, it is usual finding that perspective plans and development projects for periods of 10, 15 or more years of duration, do not take into consideration how it is foreseen that the climate will change in the same time term nor how this variation will affect the objectives intended to attain, with which in fact increases the vulnerability to the effects of climate change.

In the same way, a recurrent subject is also that even though the countries have a home meteorological system at their disposal with a national network of recording units of the climatic variables, from whose information the specialized agrometeorological forecasts are emitted one week in advance, the effectiveness with which this information reaches the agricultural producer (including the animal producer) for using it in its management, is influenced by a communication system at local and community scale that not always is within the reach of them.

In consequence, mechanisms devoted to the creation of capacities related to the climate change must be organized and implemented among those taking decisions and producers and the search for alternatives facilitating the access of producers to specialized agrometeorological forecasts, where the way of using them is included, would constitute actions to be developed in the immediate future.

Lastly, is the expectation of how will be the future climate at a short term regarding the last decades, one of the aspects in which the International Panel of Climate Change has been totally absorbed during the last years. Its results have started to be known from September of last year, when Group I of the panel, devoted to the analysis of the scientific premises of the climate change, finally approved the content of the first volume of the Fifth Assessment Report, that must be concluded at the end of 2014.

In general terms, the conclusions of greatest relevance of Group I for Latin America animal production can be summarize as follows:

- During the next 20 years (until 2035), mean temperature of the air at global scale will probably increase between 0.3 and 0.7ºC regarding the mean value of the period 1986-2005, a process which will very probably occur more rapidly on land than on sea areas. Thus, in the majority of the regions the frequency of warm days and nights will probably increase in the next decades, while cold days and nights will decrease.

- Mean rainfall will very probably increase in high latitudes and in some mean latitudes and it will be most probable than improbable that they decrease in the subtropics, but at a short term the frequency and intensity of intense rainfall on land zones will probably increase regarding the average.

- Increases in the specific humidity close to the surface are very probably on lands, while evaporation increases on lands are probable in many regions.

- Warming over the Arctic in winter will very probably be, in turn, greater than the mean global warming during the same period. Therefore, it is very probable that an additional melting will occur and a thinness of the Arctic sea ice cover; decreases of the snow cover at the high North latitudes during springtime and of perennial ices close to the surface, with the consequent increase of the mean sea level.

- Scopes at watershed scale on the changes in the intensity and frequency of tropical cyclones until the middle of the XXI century have a low reliability.

It can be expected more heat and more warm days and nights on land zones, more mean rainfall in high and mean latitudes, but probably lower in the subtropical zone, although in general more intense rainfall will arise and this will entails an increase of the humidity and evaporation. Also, small insular states will face additional increases of the mean sea level, but what will happen in the Caribbean watershed with tropical cyclones still have much uncertainty.

This is the future scenario that Latin America animal production will face in the next 15 or 20 years. According to it, each production type, in their specific conditions, will have to identify what negative impacts must be expected and design the alternatives allowing their most possible reduction.

Concerning Cuba, it can be indicated that regarding the agrometeorological service, the Meteorological Institute facilitates a national forecast for the following 24 hours on temperature and rainfall, as well as on the comfort indices for the cattle and on the areas with meteorological conditions favorable for the occurrence of forest fires (usually near or around cattle areas). This forecast if it is of interest can be extended to more prolonged periods (Provincial Meteorological Center of V. Clara 2013), as well as with an early alert system for drought. However, the achievement of the usual access by communities and producers to these data still constitutes a challenge.

On the topic of the inventory of greenhouse gases, the Institute of Animal Science and the Meteorological Institute have reported important progress in obtaining specific coefficients of the country for evaluating the emissions of greenhouse effect gases by animal production and substitute with them the other extreme values supplied by the Intergovernmental Panel on Climate Change. These results are being used by the National Inventory Team on preparing the balances it performs and Cuba presents within the framework of the United Nations Convention on Climate Change.

Regarding the evaluation of impacts and formulation of adaptation strategies, the Institute of Pig Research has rapidly advanced in this field in the last two or

three years and its results will be included in the Second Communication of Cuba to the Convention. This document is in the finishing stage, although they are also present and in detail, in the book whose summary in digital format was presented by the Institute of Meteorology at the III Congress of Climate Change, realized in the context of the IX Convention on Environment (Planos *et al*. 2013). However, other institutions, as the Center of Apiculture Research together with the Institute of Agroforestry Researches have also made incursions on the evaluation of the phenological changes shown by forest species affecting the production of bee products.

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