BRAZILIAN CONTRIBUTIONS TO THE KORONIVIA JOINT WORK ON AGRICULTURE, DECISION 4/CP.23

The Government of Brazil welcomes the opportunity to submit its views regarding the Koronivia joint work on agriculture in the context of the joint work to be initiated between the Subsidiary Body for Scientific and Technological Advise and the Subsidiary Body for Implementation on issues related to agriculture.

In Brazil's view, it is necessary to emphasize the vulnerable nature of agricultural systems to climate change and the centrality of efforts that ought to be invested to address food security. Brazil firmly believes that scientific and technological development, coupled with sound implementation strategies, is key to ensure the proper balance between production, resilience and emissions of greenhouse gases (GHG) in the agricultural sector.

It is paramount to align national priorities to address the vulnerability of the agricultural sector to the adverse impacts of climate change, and to promote adaptation as well as to contribute to food security. Improve agriculture and livestock management systems continues to be of strategic importance for the development of present and future research strategies in Brazil.

Brazil believes that the Koronivia Joint Work on Agriculture could play an important role to broader the perception of benefits, as well as co-benefits, associated with the implementation of sustainable agriculture practices.

As the challenge of climate change increases in complexity, new research areas ought to be explored and closely considered as priorities. In that sense gaps and demands for future investments in research have been identified, including the development of methods and approaches for assessing adaptation needs, adaptation co-benefits and resilience as well as for evaluating the socioeconomic dimension of the impacts of climate change in the agricultural sector.

Brazil believes that some of the elements that should be taken into consideration for further research and implementation aiming to achieve a sustainable agriculture production and intensification are:

1. Further develop advanced analytical and experimental techniques.
2. Continue to improve techniques and practices that contribute to enhance the control of GHG Emissions by agricultural systems.
3. Enhance vulnerability assessment including the use of mobile two-way communication technologies.
4. Enhance technologies and practices that contribute to the adaptation of agricultural systems to climate change.
5. Enhance monitoring and evaluation of socioeconomic and environmental co-benefits of sustainable agriculture at the landscape level.

6. Integrate existing data banks and advance in metadata analyses to support decision making and evaluation of public policy implementation performance regarding adaptation.
7. Expand the use of drones as well as automated remote sensing equipment to enhance the resolution of data acquisition on diverse types of crop, crop systems and integrated crop systems.
8. Advance in the use of modern molecular biology to generate crops and animal breeds that will better tolerate salinity, water stress, heat and pests with increased production.

Towards the future, Brazil´s intention is to develop a platform to support decision making by public managers (WEB platform) as well as by rural producers (cellular platform) - the Center for Agricultural Climate Intelligence (CICLAg). This initiative is currently in the conceptual design phase, and will comply with the principles of the National Adaptation Plan (2016) to the impacts of climate change, also aligned with the Sectoral Plan for Mitigation and Adaptation to Climate Change for the Consolidation of a Low Carbon Economy in Agriculture - the ABC Plan.

The CICLAg ought to be composed of two convergent and complementary operational nuclei: 1) "SiMoRAg - Agricultural Risk and Vulnerability Monitoring and Simulation System" and 2) "CICLAg - Center for Agricultural Climate Intelligence - focused on Climate Risk Management as part of the Brazilian Agricultural Policy ". The construction of this analytical infrastructure, as well as the implementation of a situation room for the operation of the CICLAg (S2Ag), will be made possible through the design of a strategic partnership between the Ministry of Agriculture, Livestock and Food Supply (MAPA) and the Brazilian Agriculture Research Corporation (Embrapa) in collaboration with other research institutions.

In this context, it is particularly important to highlight the relevance that a strategy that jointly addresses scientific development and implementation actions plays to unfold benefits to food security. Brazil would like to take this opportunity to report about its experience and show how the interaction between public and private institutions has led to the development of scientific knowledge and technologies that transformed, supported by a set of national policies, the way how agriculture and livestock sustainable management became so relevant for the country.

Before the 1970’s, Brazil was a non-food secure nation often suffering from deficient food supply and dependent on international donations of dairy products. Additionally to the low food production, concentrated along the coastal regions, urban population was rapidly increasing. Also, in Brazilian backlands such as the Cerrado, a neotropical savanna, large areas were unsuitable for agriculture due to high acidic and nutrient poor soils. At that time, structured agricultural technology to produce food in such conditions was non-existent worldwide.

Immigrants brought soil tillage systems such as plowing and harrowing the soil for seedbed preparation. These were conducted exactly at the start of the rainy season and bare soils on an ondulated relief led to devastating soil erosion particularly in the Southern States. Due to the formation of gullies, many farms suitable for mechanization were no longer able to have neither crop nor cattle ranching.

The challenge to produce crop and livestock in the acidic and nutrient poor soils of the tropical region made Brazil reexamine its management practices, and start a process of developing and applying scientific knowledge to create tailored tropical agricultural solutions. This has been translated into technologies applied to the field in an evolving process from the early 1970's up until today.

The edaphology and climatology of tropical regions can be fundamentally characterized as energy intense and a resource limited environment. Energy comes in the radiant form from the sun, resulting in stress to the soil plowed under traditional agricultural practices. The high availability of energy is also systemically expressed in tropical regions in the form of high temperatures throughout the year, torrential rains in the summer season and drought in the not so cold wintertime.

Interactions between agriculture and the environment might differ between regions, but in tropical areas it is characterized by the complexity of ecological interactions as well as intensive biological cycles that together potentialize challenges and at the same time create opportunities. The intensity of interaction between those elements therefore result in accelerated biogeochemical cycles, weathering soils with low capacity to retain plant nutrients such as calcium, magnesium and potassium while strongly fixing phosphorus and accumulating toxic levels of aluminum.

Faced with the challenge to increase the productivity of the land and hence, food security, the Brazilian government decided to implement a long-term investment strategy and planning process to develop solution oriented scientific research. The priorities were the development of soil management techniques for soil acidity control; recommendations for the use of mineral fertilizers; production of high quality and certified seeds, and integrated pest management. The establishment of a federal extension service was undertaken hand-to-hand with bank credits to allow criterions use of agricultural inputs such as pesticides and machinery.

At that time, the Brazilian Agricultural Research Corporation (Embrapa) was established and delegated with the challenge to develop, in close coordination with other research partners (National Agriculture Research System – SNPA), a tailored tropical agriculture system for Brazil, capable of handling the adversities of the Cerrado and its tropical climate and fostering benefits from the natural abundance of solar energy in this region. The result of the last 45 years of research and development of the Brazilian tropical agriculture system can be highlight in numbers. The Cerrado region, once inhospitable is, today, responsible for 50% of the Brazilian production of grains; the production of cattle beef and swine has increased up to four times; the production of poultry has increase by 22 times. Those advances, among others, have contributed to shift Brazil's condition from a vulnerable country (food importer) to one of the major food suppliers and therefore, contributors to world food security.

Knowing that only technology would change the landscape, a strategic decision to invest in the formation of specialized human resources at top Universities in the USA and in Europe was taken by Embrapa. This strategical investment was central to consolidate the innovation and the protagonism of tropical agriculture research in Brazil.

The no-tillage farming is one clear example of a technology that was early incorporated by farmers and the supporting private sector (new farming equipment and agrochemical developers) as a strategy for production in the tropics creating the “Zero Tillage System. Today, the technology is used in more than 30 million of hectares in Brazil and has resulted in greater economic efficiency coupled with gains in productivity and resilience.

Another important element was the adaptation of soybean to the tropical conditions of Cerrado region, an effort accomplished by Embrapa in partnership with the Agronomy Institute of Campinas (IAC), Agronomy Institute of Parana (IAPAR), a cooperative of producers - Coodetec and Fundação MT. This important scientific advance has become a reference and by the 1980’s it started to positively impact the global availability of this product, adding to the production already obtained in more temperate regions in the South of Brazil, in the USA and in Argentina. In parallel, with the support of microbiologists and breeders, effective breeding programs led to the development of soybean cultivars that could also rely on biological nitrogen fixation (BNF) for its nutrition, reducing costs and the dependency of chemical nitrogen fertilizers.

Today, BNF is the major source of nitrogen for soybean production and has contributed to reduce by 76% the import of this fertilizer with a projected reduction of up to 83% by 2025. Improvements in management of the soil microbiota contribute to improve physical, chemical and biological properties of the soil, resulting in higher productivity, lower environmental impact and greater economy for the producer. New products are being developed to improve BNF by other leguminous crops, and inoculation with free living nitrogen fixing bacteria is being tested in corn, sugar-cane and some other grasses used in pasture land.

As a result of the joint collaboration between government, private and public research institutions, and the private sector, particularly farmers, the productivity of Brazilian agricultural sector has increased steadily since the 1990’s. The productivity of the sector increased from 38 million tons in 1975 to 236 million tons in 2017. At the same time, pressure over new lands for agriculture has decreased by over 65%.

Due to genetic improvement of different crops and the shortening of production cycles, certain areas in the Cerrado region now produce during 365 days/year in rotation systems that maintain soil cover all the time and therefore help build fertility and avoid erosion losses. The introduction of cattle and trees in the rotation has led to the development of integrated cropping systems now being implemented in Brazil.

The Crop-Livestock Integration System (ILP) proved to greatly reduce risks and improve the resilience and adaptation of agricultural systems to adverse impacts of climate change, as well as contributed to increase efficiency and better control of GHG emissions. It has also led to significative increase in the quality of pasture and the fertility of the soil. Those elements increased the potential for farms to handle greater density of animals per hectare that led to an increase from the former average of 0,8 Animal Unit per hectare AU/ha, traditionally observed in Brazil, to figures of 3 or 4 AU/ha with weight gains of over 1,0 kg/A/day and beef productivity of 20 @/ha/year compared to the 1 or 2 @/ha/year traditionally observed in the Cerrado.

Independent studies indicated that integrated systems are been applied in 11,5 million hectares in Brazil. This system is being adopted by 83% of cattle ranchers that use some kind of combination and has naturally contributed to foster synergies between environmental conservation and agriculture, in the landscape reducing pressure for deforestation and while contributing to the regeneration land in ranch areas, conserving soil and increasing watershed and soil conservation.

Integrated systems have been undergoing many interactions resulting in a continuous effort to advance technology coupled with pragmatic political incentives. As a result many different systems have been tested: establishing intercropping between annual crops and pastures under no-tillage (System Santa Fé); introducing leguminous species to the forage (System Santa Brigida); correcting sandy soil profile fertility to restore degraded pasture coupled with soybean (System São Mateus); restoring degrade pasture with a view to increase silage coupled with forage (System Santa Ana); restoring degraded pasture with partial desiccation (System Vacaria); utilizing overseeded of forage species over annual crops (System São Francisco); involving the structuration of pastures with ILP during intercrops (System Boi Safrinha). The full integration between Pasture, Crop and Forest, referred as Crop-Livestock-Forest Interaction "ILPF", in an agrosilvopastoral system, is, over the last couple of years, scaling up in area.

It is important to highlight that civil society has also been a key component towards the implementation of ILPF and other relevant technologies. Farmers and interested private and public organizations have created the "ILPF Network" with the goal to accelerate the adoption of integrative technologies in different regions of the country.

It is important to highlight that Brazil has managed to enforce sound environmental rules integrating forest, water and soil conservation, with the Brazilian Forest Code (Law 12.651/2012). As a consequence, the Brazilian rural reality is today characterized by multifunctional landscapes that overcome possible dichotomies between agricultural production and the conservation of biodiversity.

The Brazilian sectoral policy to address climate change in the agricultural sector (Sectoral Plan for Mitigation and Adaptation to Climate Change for the Consolidation of a Low Carbon Economy in Agriculture – ABC Plan), approved in May 2011, is central for the implementation of the Brazilian NDC. The ABC Plan strategy of implementation was a mix of top-down and bottom-up approaches. The plan is structured at the national level, but actions are planned and implemented at the State level, with flexibility to locally define, in harmony with national general parameters, their needs and priorities. At state level, a "State Management Group (GGE)" is responsible for supporting the plan's local implementation as well as to synthetize and give publicity to local priorities in the form of a State ABC Plans. GGEs consisted of representatives from local associations, public entities and the agricultural sector. The performance of this policy is being continuously assessed though a multi institutional platform that aims to provide transparency and assist governance of this policy.

Due to this strategic implementation approach, the ABC Plan has performed very well, promoting the capacity building of technicians and rural producers; technology transfer; research, development and innovation; credit lines; land and environmental regularization, among others. Over seven years of implementation of this public policy, capacity building has reached, by 2017, over 57,000 people, with more than 7,400 trained technicians, producers, project designers, and representatives of the financial and bank sector. More than 100 on-farm Technological Reference Units (URT) and/or Test and Demonstration Units (UTD) were implemented and maintained; and several field days realized, among other accomplishments.

The ABC Plan's official line of credit, the ABC Program, have already surpassed half of Brazilian municipalities (2,808 out of 5,570 municipalities), with a total of US$ 4.63 billion US Dollars in a 32,0000 contracts signed with participation for the implementation of climate resilient technologies, totaling an area of over 8.5 million hectares. These numbers are just a fraction of the investment in climate resilient technologies. Due to the increased perception of the benefits associated to the implementations of those technologies, the private investment has recently increased very significantly and today accounts for an additional surplus of 60% compared to public investments. The performance of this policy is being continuously assessed though a multi-institutional platform that aims to provide transparency and assist governance with this policy.

Over the last few years, the development of new technologies and a continuous effort to research and innovate has led Brazil to be in a better condition to assess the impacts of climate change on agriculture, helping policy makers to enforce measures and incentives that contributed to attract the interest of the private sector. This engagement paved a shift in the perception of climate change itself from a previously perceived negative agenda to a potentially very positive opportunity for the national and international valorization of agricultural products and processes. All those elements have contributed to enhance the value of sustainable agricultural practices and processes including its multiple benefits, such as: enhancement of ecological diversity, above and below soil, attention to the socioeconomic dimension as well as enhanced investments in capacity building and education, valuation of environmental services, watershed conservation, positive influence in the micro-climate, increase in the resilience of farms and adaptation to the adverse effects of climate change as well as a better control of GHG emissions.

Some R&D activities that have been designed to promote the improvement of soil carbon, soil health and soil fertility under grassland and cropland, particularly taking into consideration integrated systems, water management and resilience to climate change are:

- SCAF - Simulation of future agricultural scenarios from regionalized projections of climate change;
- CLIMAPEST - Impact of global climate change on crop health issues;
- PECUS, FLUXUS and SALTUS - Three projects on carbon balance in livestock, crops and forestry systems, respectively, and also integrated systems. For all these systems the projects determine emissions and carbon storage in the production systems; and
- AGROHIDRO - Impact of climate change and agricultural land use on water resources in searching for solutions to the most efficient water use.

Those six nationwide large projects funded by the Ministry of Agriculture, Livestock and Food Supply (MAPA) through Embrapa and with the engagement of many partners, are in different stages of maturity and should influence the development and implementation of new and better tools for farmers as well as the design of public policies, providing support for decision makers to better address the challenges posed by climate change.

In the path of adaptation to climate change, a dedicated Research Center for Climate Change Applied Genomics (UMIP GenClima) was launched in 2017 and will have bioinformatics, molecular biology and breeding laboratories supported by a large-scale phenotyping infrastructure to provide new technologies to the very demanding agricultural sector.

The Nationally Determined Contribution (NDC) submitted by Brazil in 2015 expanded the scope of the original ABC plan, stressing that Brazil considers adaptation to be a fundamental element of the global effort to tackle climate change and its effects. The implementation of policies and measures to adapt to climate change contributes to building resilience of populations, ecosystems, infrastructure and production systems, by reducing vulnerability and through the provision of ecosystem services.

Brazil also stresses in its NDC that the social dimension is at the core of its adaptation strategy, bearing in mind the need to protect vulnerable populations from the negative effects of climate change and enhance resilience. Brazil firmly believes that the implementation of the Koronivia joint work on agriculture will foster scientific and technological development coupled with sound implementation strategies, key to ensure the proper balance between production, resilience and emissions of greenhouse gases (GHG) in the agricultural sector.

Brazil stresses its commitment to continue pursuing a sustainable development pathway for its agricultural sector. With the additional activities framed by the Forest Code related to land use on rural properties the country stands ready to share its experiences and materialize its planned responsibilities.