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Photo: Jorge Duarte/ Embrapa

“ Sustainable soil management can be adopted by any and all Brazilian producers ”

In January 2020, Brazil’s Ministry of Agriculture presented guidelines for the sustainable development of its agriculture. In addition to “land governance and environmental compliance”, they refer to “innovation and sustainable production” as a guiding theme. The role which strategies and technologies developed by the Brazilian Agricultural Research Corporation (Embrapa) play in this context is described by its President, Celso Moretti.

Mr Moretti, in Brazil, more than 80 million hectares are affected by soil degradation. What are the main reasons?

According to the United Nations Food and Agriculture Organization’s Report published in 2015, soil degradation is affecting at least 33 per cent of the world’s soils. Thanks to its continental dimension and great diversity of environments, Brazil has a considerable variety of soils, climate, relief and vegetation. So it is normal to find areas that are more susceptible to – and affected by – degradation than others, for a wide range of reasons. First, there are the natural conditions, when soils naturally have a greater susceptibility to degradation, which is the case with areas degraded by desertification processes and degraded areas suffering from the formation of sandy patches. Both conditions may be aggravated by inadequate land use and land management. This may be too intensive land use exceeding the agricultural production potential, as well as overgrazing, usually caused by cattle, in particular in places with high susceptibility to water erosion. A further reason is physical soil degradation due to the intense transit of heavy agricultural machinery, intense revolving of soil and soil exposure, leading to soil compaction and reduction of soil carbon stock, reduction of biological activity and loss of soil and nutrients by erosive processes.

What is being done to counter these processes? Und what is Embrapa’s role here?

At policy level, the Brazilian Forest Code of 2012 can be referred to, which governs the protection of native vegetation in areas of permanent preservation and legally prescribed reserves. The aim is to reconcile agricultural production with conservation. In this New Forest Code, the Rural Environmental Register (CAR) and the Environmental Conformity Programme (PRA) were established. The institutionalisation of the Brazilian Soil Survey Program – PronaSolos – in June 2018 is a fur-

ther example. Embrapa offers planning tools, such as Climatic Risk Agricultural Zoning and the PronaSolos Technology Platform. Another recent contribution to public policies was made with the formulation of the National Fertilizer Plan, launched this year by the Federal Government, providing the technological basis of the plan’s design. Our research also allowed the Ministry of Agriculture, Livestock and Food Supply, MAPA, the proposition of the Low Carbon Agriculture Plan (ABC Plan) and its current version, the ABC+ Plan, which, among others, uses practices and techniques that enable the recovery of degraded pastures, planted forests and the treatment of animal waste. It also includes metrics for verifying and proving expansion in the adoption of these mitigation technologies, based on sustainable soil and water management and their efficiency in mitigating greenhouse gas emissions, on the path of decarbonisation and adaptation of Brazilian agriculture to climate change.

Let’s briefly get back to the Soil Survey Program you mentioned – what exactly does it incorporate?

PronaSolos is the largest research programme on Brazilian soil. Initiated in 2015, the programme is to establish a network of research, development and innovation to expand national and competitive capacity in science and technology and to generate and improve knowledge and technologies related to the survey of soils and their use on scales of at least 1:100,000, with the aim of making it compatible with state, municipal and watershed rural planning, in order to ensure Brazil’s sustainable agro-environmental development. The Programme covers the entire national territory and encompasses all soil classes and their variations. The focus is to expand knowledge of Brazilian soils, both in territorial extension and in detailed scales. Regional specificities and those specificities concerning Brazil’s six biomes will also be addressed, as well as the training of new soil scientists.

How is the Program organised?

Today, six Ministries and the Office of Institutional Security of Presidency of the Republic and its subsidiaries form the governance structure. In addition, it has around 40 institutions and public agencies as partners. The project's executing team has researchers and technicians from all over the country, representing the national institutions participating in the project with expertise in soil sciences, geomatics, spatial modelling, land use and management, ecosystem services, geological and environmental resources, database, teaching, rural research and extension, statistics and artificial intelligence. The team also has specialists and reference technicians in pedology, analytical chemistry, spectroscopy, quality management, soil physics and other related disciplines.

This sounds like a multidisciplinary approach. Is it a general characteristic of Embrapa's activities?

Embrapa maintains 34 project portfolios, 93 genetic improvement programmes and international scientific cooperation actions through Labex United States, Embrapa's Virtual Laboratory Abroad, and Europe's agencies. The scope of our research is focused on the multifunctionality of the agricultural landscape. For this purpose, Embrapa built up a network linking several researchers in the different national biomes, creating the Environmental Services Portfolio in 2018. This portfolio integrates Embrapa's research, development and innovation actions with the productive sector and with public policies, aiming to generate and disseminate innovative solutions to enable the sustainability of agricultural and forestry production systems in line with the provision of ecosystem services in Brazilian biomes.

Examples of practices that Embrapa recommends for soil protection and rehabilitation include minimal cultivation, no-tillage, green and cover fertilisation, reduction of grazing pressure, organic agriculture, suppression of deforestation, management of cultural remains, agroforestry systems and integrated crop-livestock-forestry, among others. All these good agricultural practices tend to generate environmental support and regulatory services, such as increased nutrient cycling and water infiltration in soil and erosion control, as well as increased carbon stock and greenhouse gas reduction.

How does your research knowledge reach the farmers?

We cooperate closely with the Ministry of Agriculture, Livestock and Food Supply as well as other ministries providing technical-scientific knowledge learnt by our researchers and as-

sociated institutions so that farmers and rural entrepreneurs have access to this knowledge. The knowledge imparted to farmers on sustainable land management includes mechanical practices, such as terraced and contour cultivation, draining channels, vicinal roads, bus, dams, underground dams, etc. and vegetative practices, such as strip crops, soil cover, green fertilisation and crop rotation, etc. Good agricultural practices which are disseminated include biological nitrogen fixation and the use of bioinputs which have been developed at Embrapa, slow-release organo-mineral fertilisers, traffic control and mitigation of soil compaction, integrated management of pests, diseases and invasive plants, reforestation of recognised fragile areas such as riparian forest, declivous areas and resurgence areas. The No-Tillage System or NTS that is today applied on 35 million hectares in Brazil brings together mechanical and vegetative practices, meeting three basic principles – no soil disturbance, permanent soil cover through using species dedicated to straw formation and rooting in the soil, and the multiannual rotation of annual crops, forage and forestry. Also noteworthy are the systems derived from the NTS, which are the integrated systems – agroforestry systems and crop-livestock-forestry integration systems, which can be adopted in all types, area sizes and activities, without environmental degradation. This implies the maintenance of both soil health and quality, the water resources involved and biodiversity.

In the context of the National Fertilizer Plan, the Embrapa FertBrasil Caravan is visiting the main agricultural regions of Brazil with researchers and experts to bring to the rural producer technologies and knowledge in order to increase the efficiency of fertiliser use, emphasise the importance of sustainable soil management and improve productivity.

And how are the technologies received by the farmers?

It is essential to regard Brazil as a continental and highly diverse territory, considering the peculiarities of each of its six biomes, not to mention regional characteristics and access to information and technical assistance. These factors alone already reveal part of the challenge that represents ensuring the adoption of sustainable land management methods. No-tillage, integrated crop-livestock-forestry systems, biological nitrogen fixation and planning tools such as the Climatic Risk Agricultural Zoning are some of the deliveries that have resonated. According to the 2021 Social Report, alone the biological nitrogen fixation in soybeans, adopted in more than 38.5 million

hectares, accounted for savings of more than 36 billion Brazilian real for producers. During the period, Embrapa's solutions developed for soil management were adopted in more than 97.6 million hectares.

And are there differences in the approaches elaborated for small-scale and large-scale farms?

Indeed, the best practices for the care and sustainable management of soils are the same, regardless of the size of the property. Embrapa's research and innovation are not different for these two audiences and are accessible to all producers, but purchasing power can be decisive in the adoption of certain higher cost practices, regarding aspects such as technological level and producer investment capacity, etc., as well as in the type of crop and breeding chosen, weather it be crop, forest species or, livestock. Sustainable soil management can be adopted by any and all Brazilian producers. Access to rural credit and knowledge can, however, be a differential in the adoption of these practices.

What do you regard as the greatest asset of science?

The outlook for the future is uncertain regarding hunger in the world, so the role of science in raising productivity becomes even more preponderant. And science enables us to ensure that we no longer need to cut down trees to maintain food production with sustainability. Research regarding the crop livestock-forest integration system that supports the carbon neutral beef concept, research to reduce emissions in the pig and poultry chain that allows differentiating the difficulties of emission control in the production, processing and distributing networks of meat, and land-saving technologies, focused on the search for increased productivity, such as soybean, corn and cotton production systems are pioneering examples of this.

Interview: Silvia Richter

About Embrapa

The Brazilian Agricultural Research Corporation (Embrapa) was established in 1973 by the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA) to develop the technological foundations for a genuinely tropical model of agriculture and animal farming. The corporation currently employs over 8,200 people, of whom more than 2,200 are scientists.