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SUSTAINABLE FOREST AND AGRICULTURAL PRODUCTION

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Get to know the functioning of the ecosystem is the first step; its operation follows the principles of thermodynamics.

Nature has been sustained for about 3.5 billion years, since the emergence of the first simple cells and there are 475 million years ago with the appearance of the first land plants through solar energy, biodiversity and chemical cycling (in Agronomy is known as nutrient cycling). It is the movement of chemicals on the environment, particularly soil and water, is made by the body, and back to the environment are necessary for life. Without this chemical cycling hardly would there be air, water, soil, food or even life.

This article gives priority to energy function in the ecosystem as the basis for an interface between the agricultural and ecological research in the search for agricultural and forestry production systems sustainable and greater productivity. In this context, the thermodynamics is important role.

Thermodynamics is one of the key areas of physics that deals with the processes and thermal transformations (Nussenzveig, 2002). Although this has started its existence from the investigation of the heat, the proof that this is a form of energy that the laws of thermodynamics could be expanded to other branches of science. In particular the first law of thermodynamics, which is nothing more than the law of conservation of energy, says: "considering the heat energy always remains" (Nussenzveig, 2002). This law implies that there is in nature an entity called and that this energy cannot be created nor destroyed, only transformed. The importance of energy lies in the fact that she is behind of all dynamic processes existing in nature, no power, or rather, without a gradient of energy it reduces static systems immutable.

In 1935 the British plant ecologist Arthur G. Tansley (1871-1955) to study this relationship saw the bodies along with the physical factors that surround as ecological systems, and named this ecosystem structure, as fundamental unit of ecological organization. Currently the ecosystem is studied as a community of different species interact with each other and with the environment does not live from matter and energy. Such organisms, living in the same place, have similar tolerances to physical factors of the environment but also interact with each other, and with a system of power relationships are what define it as **food web**.

The chemist Alfred J. Lotka (1880-1949) was the first scholar to consider community populations as systems power transformers, the size of a system and the rates of transformation of energy and materials within it obeys the law of conservation of energy that governs all energy transformations. However, their ideas on ecosystems, published in 1925, were not very well understood, until a young aquatic ecologist Raymond L. Linderman (1915-1942), the University of Minnesota (USA), brought the concept of the ecosystem as a system transformer. Work published in 1942, after his death caused by a rare form of hepatitis.

Following this idea, the most fundamental energy transformation in ecological systems is the conversion of light energy into chemical energy by photosynthesis. Light energy assimilated by photosynthesis (gross primary production), plants use between 15% and 70% to keep, depending on the environment and the way of growth. Those scraping along in the tropics have higher rates of respiration in relation to photosynthesis than those from colder environments. Breath energy, used for maintenance, is finally lost as heat and becomes unavailable to consumers (Ricklefs, 2011).

Additional energy transformations take place as the herbivores of energy converge carbon compounds in plants and other autotrophs-body assimilates the energy sunlight, either, of inorganic compounds – energy that they can use for their own metabolism, activity, growth and reproduction. Similarly, the carnivores use the energy of carbon compounds contained in their prey. Only 5% to 20% of the energy assimilated passes between the trophic levels (Ricklefs, 2011).

The **primary production** provides energy to the ecosystem through the sunlight that underlies all the eco-systemic functions. Without primary production, practically nothing of what we could call of life exists. The total energy assimilated by the photosynthesis represents the gross primary production. Plants use this energy for their maintenance. Another part is used in metabolic needs through breathing. This is lost getting unavailable to consumers. Therefore the biomass of plants contains much less energy than the total assimilated energy. In this way, the accumulated energy in biomass plants, and available to consumers, is called **net primary production**. It is used in the growth and reproduction of plants.

The primary production varies among ecosystems depending on latitude. For its part, the favorable combination of solar intensity, high temperatures, abundant rainfall and many nutrients in most humid tropics result in higher productivity of the land. However, when precipitation exceeds about 3,000 mm a year, net production decreases (Schuur, 2003). To know this condition is very important for agronomic research in humid tropics and particularly for Brazil, in the Amazon.

Studies made by a precipitation gradient in Hawaii have demonstrated that, in areas of high rainfall, the decomposition of organic matter is reduced in flooded soils. Thus, nitrogen and other nutrients are regenerated only slowly organic waste in the soil; This reduced rate of nutrient regeneration in turn depleciona the production of plants (Schuur et al., 2001), that is, reducing any substance or chemical, physical or biological process of importance to crop production.

Availability on different nutrients has to match the requirements of plants to ensure their maximum efficiency. The agronomists and ecologists estimate the efficiency of nutrient use (EUN) of plants as the reason for the production of dry matter for assimilation of a given nutrient element. As evidence we have that the tropical trees of course retain phosphorus to a greater extent than the temperate perhaps due to the relative scarcity of tropical soils highly weathered element-a result of the fragmentation of the rocks that give rise to the soil from physical and chemical agents.

Agronomic research generates technologies aimed at increasing agricultural and forestry production. Currently the technologies should establish sustainable productive systems. In this case, this research works as well as environmental science and as such must seek the interdisciplinary with the ecology, thermodynamics and other branches of science. However the sustainability of early concern was not of this scientific branch.

In Brazil, the agronomic research emerged in Sao Paulo with the Agronomic Station of Campinas, founded in 1887, by the Emperor D. Pedro II and having, as its main objective to support the cultivation of coffee in terms of increased production. In 1892 passed to the administration of the Government of the State of São Paulo in Brazil. In the Amazon, the agronomic research began with the Instituto Agronômico do Norte (IAN), in 1940, created by President Getúlio Vargas, based in Belém (PA), whose primary purpose was researching the *Hevea* strategic raw materials to the West on the basis of Southeast Asian rubber block, due to the Second World War. The dissociation with the ecological research back still consequences to this day.

Fortunately the concern with environmental preservation and the resulting scale of ecological research has directed the agronomic research increasingly make an interface with ecological research. In the appearance here raised, that is, the better use of photosynthesis must extend this interface with the research of thermodynamics.

Thus, it is no longer possible to think in sustainable agricultural production and increasing productivity without the scientific and technological basis of this production are not in line with the knowledge generated from the above mentioned research in a multidisciplinary environment.

This new format of research for agricultural and forestry production in Brazil should be implemented for seven Brazilian biomes – Atlantic Forest, Cerrado, Caatinga, Amazon, Pantanal, South Fields, and Castal-Marine. The understanding of their respective runs, from this interdisciplinary interface will help greatly to agricultural research in providing the agriculture and forestry sector of technologies that increase productivity and sustainability of production systems.

Brazil is a tropical country. It is important that can get bigger and better advantage of photosynthesis for their agricultural and forestry production systems, both in the aspect of gross primary production as in net primary production of energy, namely, generate knowledge and technologies that target sustainability in the sense that nature demonstrates there are 3.5 billion years old.

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