AFTER THE STORM THE FLOOD COMES

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OF THE CURRENT SITUATION: LANDS DEGRADATION, DESERTIFICATION AND EROSION

According to studies done by the World Resources Institute (a non –governmental organization based in Washington, DC) " more than two thirds of the agricultural lands were degraded due to erosion, pollution and impoverishment of the soils" It should be alerted that the challenge of the new millennium resides in the adequate use of the soil: only with its correct utilization the feeding attendance of the future generations will be guaranteed – a tendency which was pointed out by U.N. since 1949. In reply to that question several recovery initiatives of degraded areas have been implemented and discussed in many countries. This work points out some guidelines towards thematic approached in Brazil planning aiming at sustainability. It is mentioned, as follow, some Brazilian initiatives in order to argue and implement the recovery of degraded areas.

In 1980, it took place in Brazil, the I National Symposium on the Erosion Control, at the Federal University of Parana in Curitiba. The works presented showed the situation of knowledge and the Brazilian experience as to erosion control techniques at the decade of 70's. Another example of agglutination of experiences occurred in November of 1994, in Foz do Iguaçu (PR). It is about the I South American Symposium and II National Symposium on Recovery of Degraded Areas. From these events forms of thought and evaluation of the degradation of lands emerged, alerting to the emergencial situation towards the advanced process of lands degradation in practically the majority of the ecosystems which compose the diverse biomas in Brazil. From then on these events succeeded, other correlated had appeared and as a consequence knowledge and interchange of recovery techniques of degraded areas.

Silva (1996) exemplifies the degradations of some Brazilian ecosystems for the bad use of the soil. For the author the Northeast region of coastal tablelands, notably in extreme south of Bahia constitutes a representative example of the bad use of the land, with a consequent degradation of the ecosystem: the forest went through a process of intensive deforestation, transforming itself in "dirty" pastures and "capoeiras". The fertility which comes from forests burning is utilized for a period of 3-5 years, after which decreases to the

level of unsustainability of the cattle coming from the environmental degradation and the social and economic novice effects. In the same way, in the Brazilian, Amazon, the deforestation is quickly transforming the forest in pastures of low value and of few perspectives of sustainability with the consequent degradation of the soil. In this context the soil is the main resource affected, with destruction of the mineral-organic sheet and erosion.

The term lands degradation is recorded in the geologic-geomorphologic dictionary with the denomination "soil degradation" and is described as "modifications which reach the soil, following the same from a category to other, much washed, when erosion starts to destroy the superficial sheets richer in organic materials. The soil degradation can pass through microclimate changes for destroying the type of vegetation (...)" (GUERRA, 1987, p. 120). In the ecology glossary, the thematic advances a little more with the entrance of two entries that are, "environmental degradation" and "land degradation". The first case is described as a "gradual process of negative alteration of the environment, as an outcome of human activities that can cause unbalance and destruction, partial or total, of the ecosystems". The second term refers to "loss of productivity from various processes as erosion, salinization, inundation, nutrient depletion, deterioration of the soil structure or pollution" (ACIESP, 1997, p. 69).

We also find in literature more specific approaches. Mentioning the agronomy area, for example the definition of "erosion of the agricultural soil" consists in the "hauling the soil particles out with all the nutritive elements", a type of erosion which is more harmful to agriculture, also denominated superficial or laminar erosion. It is about the removal of the ground of the superior layer, being the consuming of the soil uniform from a low depth, but in a continuous form, without presenting the accented vestige of its effects (SCHULTZ, 1983, p. 20).

Another geographic matrix approach refers to the desertification definition. A degraded soil, if measures which eliminate the provocative causes will not be adopted, can turn into desertified, which means, have its fertility exhausted, besides the loss of the capacity of retention of humidity indispensable to the development of the vegetation. In the Glossary of Ecology the term means "development of deserted conditions (water acute deficiency and/or relative to vegetation absence) as a result from human activities or climate changes. In Brazil nodules of desertification occurs in dry Northeast (Altos Pelados, among others), and ground sands in southwest of Rio Grande do Sul (Alegrete)" (ACIESP, 1997, p.73).

According to Lê Houérou (1977) apud Suertegarey (1998, p.15), "(...) the word

desertification is used to describe the degradation of several types of vegetation, including the areas of sub-humid and humid forests that has nothing to do with deserts, be them physical or biological." Therefore it would be an antropic process. The denomination of desert, of the climatic point of view, "would be equivalent to the lack of fresh water in the natural system, which its measure would become through the comparative study between precipitation and evaporation" (CONTI, 1989, p. 190). From the ecological analysis point of view, we find the "decline of the biological activity, mineralization of the ground, aggravation of the superficial erosion and massive invasion of sands due to the activity of man and the withdrawal of nature resourced" (CONTI, 1989, p. 189). The researcher Dirce Suertegarey, clarifies the meaning of the terms desert/desertification. According to the climatic analysis the sandy areas in the northwest of Rio Grande do Sul, present a serial of characteristics that differ from the classic concept of desertic areas. The author appoints that the region present typical vegetation of steppes, rainfall is not low (1 400 mm/a), medium temperature varies from 14ºC in wintertime to 26 ºC in summertime. So it is quite distant from the desertification area parameters (deserts). All the studies in the region, point the existence of areas in the extreme south of Brazil, according to an agreement of the phenomenon for the bias of natural and/or social order (SUERTEGAREY, 1998, p. 16).

In both cases, one of the most landscape visible aspects is the degradation of lands, the accelerated or induced erosion type, described as being "the process of detaching and accelerated arraying of the soil particles, caused by water and/or by wind and undoubtedly, constitutes the main cause of the accelerated depauperation of lands" (BERTONI; Lombardi Neto, 1990, apud Silva; Schulz & Camargo, 2003, p. 26). According to the researcher Antônio José T. Guerra, the soil degradations can have a variety of causes. The author (op. cit.) enumerates "(...) the acidification, the accumulation of heavy metals, the reduction of nutrients in the soil, reduction of organic substance, etc. And he adds that in many cases, erosion is mistaken or is placed as a synonym of soil degradations" (Guerra, 1998, p. 188). The researcher enumerates several causes related to soil degradations and to the intervention of man in nature and affirms that soil erosions cause damages at local level, as also it compromises and affects rivers, bays and reservoirs. All of this propitiates the mass sedimentation and/or pollution, can provoke inundations in urban and agricultural areas due to the deforestation and the use of the land, without considering the fragilities of the natural environments (Guerra, 1998, p. 191).

The result of all this process is that, analyzing from an ecosystemic point of view,

water instead of infiltrating and following a natural way, replenishing the water table and keeping the normal levels of humidity in the ground, it starts to thicken the parcel of superficial draining, acquiring higher speed and power of dragging the soil particles. Who pays the bill? All of us, directly or not, for after the tempest, it is flood that comes.

Another type of approach is related to an integrated approach for the hydro resources related to the use of lands. We can mention the waterproofing and/or soil compacting, increase of superficial draining and increase of erosion (Pires; Santos, 1995, p. 41). We have to think then, of sustainable forms of exploration and use of the natural resources. The clipping which follows, focuses towards assuming the watershed as natural geomorphologic unit of planning integrated in the human activities and alerted as to the importance of the riparian ecosystem in the maintenance of the hydrological processes and the biological diversity of ecosystems, independent of the bioma and environment, if located in rural or urban environment.

(RE) DEFINING THE ROLE OF THE "BEIRADEIRAS" FORESTS[1] AND ITS IMPORTANCE TO THE CONSERVATION OF SOIL-WATER-BIODIVERSITY

Several authors has related riparian forest (or edging) and the species that take place there with the proximity to the water courses, the fluctuation of the water table and still with the surrounding ecosystem (Gibbs & Leitão-Filho, 1978; Bertoni & Martins, 1987; Durigan & Leitão-Filho, 1995; apud Zakia, 1998). The edging vegetation is defined by Kageyama et al. (2001), as that characteristic of edges or adjacent areas to bodies of water be them rivers, lakes, dams, streams or fertile valleys; that presents in its composition typical species resistant or tolerant to the submersion or water excess in the soil and can receive diverse denominations, as: edging forests, gallery forests, trails, bushes of fertile valley, "beiradeira" forest, riparian forest among others.

The authors also stand out that this formation exerts great influence in the maintenance of the biodiversity as it understands an excellent habitat for the terrestrial and aquatic fauna, for the proper structure of the vegetation and the existence of fallen wood and shrubs - that serve of shelter for small mammals, offer nests for many species of birds, make possible high food production for herbivores and stability for the aquatic and terrestrial invertebrate communities. Still it supplies food, covering and thermal protection aquatic fish and other aquatic organisms, besides water and food for the terrestrial fauna (from insects to mammals).

[1] For a better understanding of the expression, consult AB'SABER's text entitled "O Suporte Geoecológico das Florestas Beiradeiras (Ciliares)". In: Matas Ciliares: Conservação e Recuperação.

In the beginning of the decade of 60's, based on hidrographs studies of experimental watersheds of mountainous regions Hewlett and Hibbert (1967) apud Lima (1998), established the "affluent variable area" (AVA) concept. The development of this concept is due to the fact that in those coated watersheds of good forest covering, the emanation is not produced throughout all the surface of the watersheds. In contrast, the emanation in these conditions is under the influence of an area of dynamic origin, as it suffers expansions and contractions (therefore the name "affluence variable area"), which usually represents only one small fraction of the total area of the watersheds (Lima & Zakia, 2000).

Gregory et al (1992) mentioned by Lima (1995), stress that the riparian zone is intimately related to the water flow, but its geomorphologic limits are not easily restrained, due to differences of climate, geology and soils. In thesis, the lateral limits would extend until the reach of the inundation plain. Another criteria of delimitation of the extension of the riparian zone would be from the ecological point of view, as genic flow corridor function along the landscape, as well as, aiming at the minimum dimensions that guarantee its sustainability. Nevertheless the physical processes that continuously molds the streambeds of the water flows, which go since short intervals of recurrence of annual overflows, until more intense phenomena of decennials and secular floods that impose, the need of considering a secular standard of variation of the riparian zone.

Lima & Zakia (2000) explain that due to this high frequency of alterations that occur in the riparian zone, the vegetation that occupies this zone normally (edging forest) must, in general, present a high variation in structural terms, composition and spatial distribution. This variation must occur along the water flow, reflecting variations of sites as result of the dynamics of the fluvial morphology processes forming characteristic stretches of deposition of sediments and/or characteristic stretches of fluvial erosion. Laterally, the conditions of soil saturation diminish according as it gets farther from the channel, which also can influence the composition of the species. These authors mention as a hydrologic function of the riparian zone, the following main processes: the generation of the direct draining in watersheds; the increase of the water storage capacity in the watershed along the riparian zone, contributing for the increase of the outflow in the dry season of the year; the maintenance of the water quality which emanates from the watershed exerting efficient action in the filtering of sediments; the cycling of nutrients and the direct interaction with the aquatic ecosystem.

Kageyama et al. (2001), observed that in the unnumbered functions attributed to that formation, there is the possibility of habitat, shelter and food for the fauna, acting as

ecological corridors; the maintenance of the microclimate and water quality and contention of the erosive processes. Due to these characteristics and to its contribution, the edging vegetation is considered as a key-element in the landscape. According to Ab'Sáber (2000), the structure and functionality of the riparian ecosystems present similitude between areas, but the floristic composition present innumerable and subtle variations, for its taxonomic composition, according to the domain, region and even the altitude where are found, still not enclosed by botanic studies in Brazil as whole. Still, according to the author, the genesis study of the rivers marginal dikes involves the understanding itself of the interactive processes that give origin to the edging forest ecosystems. In fact, the marginal dikes generated at the rivers" high edge, constitute a geo-ecological support which is essential for the development of the edging forests. Based in field survey, Pedrosa and Pontes (1997) verified that existent native vegetation in the urban perimeters deserve care and attention from the public administrations and the community. As general, this is concentrated along the water flows and close to the upper waters, generally in organic soils and under drained and in floodplain.

Some geographic landscapes which compose the urban mosaic of the Brazilian cities constitute in fundamental elements for the maintenance of a certain representative environmental diversity of the biomas to which they belong. From these reminiscent green areas, certain environments materialize in its physiognomy and inter-relations to complexity and heteroecism of the riparian ecosystems.

MAIN SOCIAL–ENVIRRONMENTAL TRANSFORMATIONS AND ITS CONSEQUENCE FOR THE RIPARIAN ECOSYSTEMS

Some of the main factors which contribute for the non-stabilization of the rural and urban riparian ecosystems are related to planning, inadequate use and disordered occupation of the geographic space. In order to exemplify some of the causes and consequences originated from this process of occupation in riparian environments inside the urban area and the city expansion, follows some transformations portrayed by Pedrosa (2001): removal of the vegetation covering in all environments, as in the river-heads, slopes, banks of the water flows and fluvial intersections, drainage of overflowed areas and hydro saturated areas in flood plains, canalization of pluvial and fluvial drainage, so that in some stretches are subsurface; hollowing, cuts and embankment in irregular lands, promoting alterations that influence in the draining for other directions, concentrations and increase of land declivity, in some cases causing the inversion of topography and geomorphology, appearing, with this, flooding areas and the heaping up the springs with sediments; waterproofing of the ground, that hinders

pluvial occurrences, or hinders the re-appearance of aquifers in other environments; alteration of the atmospheric environment, by removing the vegetal covering of the surface of the ground with alteration of the albedo, by launching of particulate material, aerosols and gases, mostly greenhouses: carbon dioxide and monoxide; contamination of the ground and waters of surface and underground for chemical products, solid derivatives of the oil and residues, mainly for the sanitary sewer, vectors of endemic diseases and epidemics, and, for the volume of the domestic garbage, that is composed of different products with differentiated chemical composition and have various periods for the bio-decomposition.

In European countries Binder (2002), stands out that the opening of new roads, sewer treatment stations and urbanization had reduced the larger streambed of the rivers and had diminished the areas of flood retention. The reduction of the river course length and the uniformization of the outflow section increase the speed of the chain and, consequently, the erosion and the mass sedimentation to the ebb tide, demanding works of countenance to keep the riverbed rectified. At times of extreme flood, material damages are frequent and, sometimes human loss. The rupture of the natural interaction between river and lowland causes the impoverishment of ecosystems with loss of biotic diversity Moreover, the increase of the outflow capacity reduces the frequency of overflow of minor and medium floods, and however they remain or intensify great floods. The relation between rivers subject to flood lowlands is interrupted, contributing to the disappearance of places for the spawning of fishes, for example. It has also to be added the implantation of division of lands in inadequate places and the unbridled real estate speculation.

In relation to the social cost of the desertification, Santana (2003) clarifies that "(...) the society, the individual, the agriculturist, work, today, 25% more than has 20 years ago and, can only obtain 63% of that obtained previously (loss to an annual tax of 2,8%). It is as if the half-barren totality produced and lost 4,8 million tons/ year, or in values, 360 million dollars /year; for the bioregion of the Araripe, the loss is of 11,4 million dollars/year. (...) It is good to remember that a significant part of these losses happens through the most rotten part of the population (half-barren and rural) and represents the R$ 80,00 equivalent per capita or something around that to R$ 400,00 (reais) for family/year". The cost of floods and inundations is high: the losses are bigger for they involve human lives.

In the case of the canalized water flows, its natural features are significantly modified. The canalization of the stream bed, the detour of its natural course and the lateral pavement, cause a process of draining of the hydromorphic grounds which support the remaining

fragments of edging vegetation, called by Ab'Saber as "geo-ecologic support of the 'beiradeiras forests' ", and generate a consequent alteration of the energy flow between the diverse components of this riparian ecosystem causing loss of the biological diversity and of adapted arborous components to the water retaining capacity conditions of the ground, availability of nutrients and higher content of humidity. Other consequences can also be mentioned as; loss of the natural capacity of purification of waters, the increase of the water speed due to rectification of its course, naturally sinuous, and the link rupture between the aquatic and terrestrial ecosystem.

RIPARIAN ECOSYSTEM X ENVIRONMENTAL LAW

According to Kageyama et al. (2001), the closest legal representation of the riparian ecosystem is expressed in the Forest Code (Código Florestal), currently in phase of revision, in the form of Permanent Preservation Areas (PPA): "Area protected in the terms of arts. 2.º and 3.º of this Law, covered or not by native vegetation, with environmental function to preserve the hydro resources, the landscape, the geologic stability, the genic flow of fauna and flora, protection of the ground and assure well-being of human populations".

Based on the Law 4.771/65, modified by the law 7.803/89 the situations and dimensions in which the edging areas can be found are: along the water flows, around springs and around lakes and reservoirs, protecting the following aspects: for water flows with up to 10 meters width, the dimension of the edging area must be of 30 meters in each edge, so that the width water flow is measured from its highest point, in other words, in that elevation that the water flow reaches every year. The exceptional floods do not have to be considered; water flows from 10 to 15 meters width must have 50 meters of edging area in each edge and the width of the water flow is measured from its highest point, in other words, in that elevation that the water flow reaches every year. Exceptional floods do not have to be considered; for water flows from 50 to 200 meters width, the dimension of the edging area must have 100 meters in each edge and the width of the water flow is measured from its highest point, in other words, in that elevation that the water flow reaches every year. Exceptional floods do not have to be considered; for water flows with more than 600 meters width, the dimension of the edging area must have 500 meters in each edge and the width of the water flow is also measured from its highest point, in other words, in that elevation that the water flow reaches every year. Exceptional floods do not have to be considered; in springs (intermittent or perennial), the dimension of the edging area is of 50 meters radius, whatever is the topographical situation.

Any way, according to Kageyama et al. (2001), it is important to point out that these

areas, covered or not with native vegetation are protected by law and in case one desires to make any intervention in this area, including the planting of trees, the competent environmental agency must be consulted. It must still have, the assent of the federal or municipal environmental agency for suppression of vegetation in this edging forest area protected by law.

Referring to the Law of Environmental Crimes (Law 9605/98) that establishes punishments, as regards to the edging areas, there are three types of lawsuits and penalties foreseen: administrative (fine), the civilian (repairing of the damage) and the criminal one (deprivation of rights, also of freedom, in other words, arrest). Another important factor for the authors (op. cit.) is that these three different processes start with tax assessment notice made by the competent agency and are independent, in other words, if a rural proprietor will be fined for intervening in the edging area, without having asked for license, he will certainly pay a fine. But the fact to have paid this fine does not mean that the other lawsuits will be interrupted. Similarly to the exemplified case above these processes must also be applied to the urban environment, according to the laws to be contemplated in the Managing Plans of Urban Development or similar legal devices.

The problematic situation resides in the treatment given to these edging forests (riparian ecosystem) in urban environments, borders of urban expansion and rural areas. Ally to this is to the question of ` subjectivity of the localization and identification *in situ* of the riparian zone and the corresponding size of the area to be preserved, which also leads to (re)think the legal minimum limits of delimitation of the EPA (Environmental Protection Area). Another factor, not less relevant, consists of the distant relation between the scientific agreement of what is considered to be riparian ecosystem (concept), and its viability and diffusion in the environmental technique surrounding and society in general. In order to reach positive results from these approached questions, the social practices has to be multiplied and has to be methodical by the commitment with the defense of quality of life and with the magnifying of the right to information (Santos, 1999).

A RE-NATURALIZATION AS AN ALTERNATIVE TO RESTORE THE ECOSYSTEMS; FROM FLOOD TO TRANQUILITY

The conception to re-naturalize rivers guided by specific plans of maintenance of the water flows, without putting in risk the urban zones and routes of transportation, and without causing disadvantages for the population and the proprietors of the neighboring areas, appeared in Europe, during the first half of last century.

In the majority of the Central Europe countries most of the rivers and streams were rectified with the aim of protecting urban zones, routes of transportation and agricultural lands against the floods that occurred regularly. The adopted technology was to transform the rivers in beds with regular profile, many times with coated edges and aimed at, mainly, to gain new lands for agriculture, new areas for urbanization and to minimize the local effects of the floods. According to Binder (2002), the works carried through with base in this conception had caused negative impacts, especially to the biota of the rivers and the lowlands, destabilizing completely the components of these riparian ecosystems. The consequences had been evaluated as being neglected in the planning. Regarding this process, in the majority of the European countries, the author also reports that the awareness of the interactions between the antropic activities and the environment allows, today, that new strategies directed to the re-naturalization of rivers and streams are considered valorizing the natural conditions of the hydro flows and natural lowlands, in order to regenerate the closest possible to the natural biota, through restoration and regular management programs, hindering any uses that make impracticable such function. However, the re-naturalization of rivers does not have to be understood as the return to an original landscape not influenced by man, but it corresponds to the sustainable development of rivers and landscape in order to propitiate the maintenance of the health of the riparian ecosystem in compliance with the necessities and contemporary knowledge.

In Germany, the plans of maintenance of the water flows are elaborated in order to take care of the particularities of each case, but in a intersectorial form, articulated to other territorial plans and regional programs, that is to say, according to the municipal plans of urbanization, the regional plans of landscaping, as well as with programs of protection of the biota and species in danger of extinction, and also with the agricultural managing plan. For Binder (2002), the re-naturalization of the current water by "the process of self development" (**"to leave" instead of "making"**) demands the understanding of the surrounding dynamics of the basin and experienced technical staff, who has to have the capacity to observe, with patience, the development of the river and the capacity to interfere when it is necessary **"with more savoir-faire e less concrete"**.

The perspectives pointed by the ONU, based in studies carried through for its technician and researchers, indicate that the main problems of this century to be faced by the world-wide population, in regards to subsistence, will be the expansion of desertified areas and lack of water. The desertified areas are a consequence of degraded lands, resultant of the deficiency

in controlling the erosion of the soils. The exposition of the mentioned aspects explicit the lack of scientific knowledge and the necessity of perfecting the environmental legislation in force concerning the riparian ecosystems characteristic of each Brazilian bioma, the barrier between them and the knowledge of the technician specialists or sectors of the society who consider as solution for the water flows, boring projects of canalization and waterproofing. We have to (re)think which type of environment we want to live in a short, medium and long term; and from then on, to set in motion the necessary mechanisms to reach such an end.

In reality, there is much to learn with nature around us, before it is too late to preserve the integrity of the ecosystems which compose the biomas, the maintenance of its services and processes and assure quality of life to the populations.

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