Floram: the Dry Northeast

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1. INTRODUCTION

Any rational effort to design a reforestation plan for the humid regions of Brazil will lose some consistency when the focus is shifted to the Dry Northeast. Its environmental peculiarities, a rigid land ownership pattern and a population accustomed to endure the semiarid environment make it very difficult to propose reforestation actions for the northeastern *sertões.* It is an entirely distinct climatic, hydrological and ecological domain from the rest of Brazil. Profound knowledge of the structure, behavior and functionality of its ecosystems is a must. At the same time, it forces one to look deep into the behavior patterns of its populations and societies scattered throughout remote and rugged *sertões.*

In fact, the seemingly endless *caatingas* are settled by a population of high birth rates, living under unbending land ownership rules, undermined by severe climatic and hydrologic conditions and by the socially catastrophic incidence of years of unrelenting drought. The human settlements in the dry *sertões* have learned to live with the semiarid environment, its seasonal rivers, unfriendly soil, and its archaic and inflexible agrarian structure. The hinterland people, however, cannot survive years of prolonged drought when there is no water for cattle or crops, when rural unemployment brings family hardships and leads to dramatic migration to the major Brazilian urban centers.

More so than anywhere else in the country, a multi-purpose reforestation plan assumes that there is knowledge of the local environment as well as of the rural population's economic and social conditions. The actions involved in any reforestation plan must be understood as a process of gradual and differentiated developments with no economic return in the very near term, but with major opportunities of social returns in the medium and long runs. In fact, no reforestation/afforestation effort in Brazil can be more effective and efficient as a model of social forestry than whatever is directed to the dry *sertões.*

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2. THE DRY NORTHEAST: CLIMATIC, HYDROLOGIC, AND ENVIRONMENTAL PECULIARITIES

Among the major natural domains in the country, the Dry Northeast is surely the most complex environment in regard to afforestation/ reforestation plans, projects or programs. Any discussion about the introduction of fast growing or tree species in different sections of the dry hinterland requires a solid understanding of the region as a whole and at the same time an analysis in light of its wide local and ecosystem diversities. Nevertheless, improving our knowledge base is absolutely vital to face the challenge of developing the proper policies for rehabilitation of rural areas more suitable for economic and social development efforts. A customized afforestation/reforestation policy for the *caatingas* is a chance to address most of the problems faced by the *dry sertões.*

It is essential to define some limiting factors and to list the key local peculiarities for further consideration:

— it is hard for a hot semiarid region, with rainfall levels at less than 800 mm in major centers, to compete with humid tropical areas of more favorable climatic conditions. Therefore, an afforestation or reforestation policy directed to the Dry Northeast should not focus initially on the issue of production forests (for industry or energy purposes). On the other hand, no other region in the country needs a social forestry policy as urgent or diversified as the Northeast. If properly carried out, this will necessarily translate into economic and social improvements in the short and medium terms.

— only those sites with rainfall exceeding 900 mm located in the outlying portion of the Dry Northeast at varying degrees of barrenness would be suitable for forestry experiments similar to those already performed in humid areas. In the rustic, rural dry badlands, the limiting factors are only partly climatic or water-related; for the most part, they are edaphic in nature. Not to mention the marked demographic and agrarian differences between the eastern Northeast hinterland *strictu sensu,* on the one hand, and other inland sub-humid regions (e.g. western and northeastern Bahia, southern Piauí, northern and northeastern Minas). It would not be wise to introduce great masses of forests in the differentiated and highly populated rural areas of the eastern Northeast. This issue must be reviewed, however, from the angle of cultural and economic approaches to and goals of a social forestry policy.

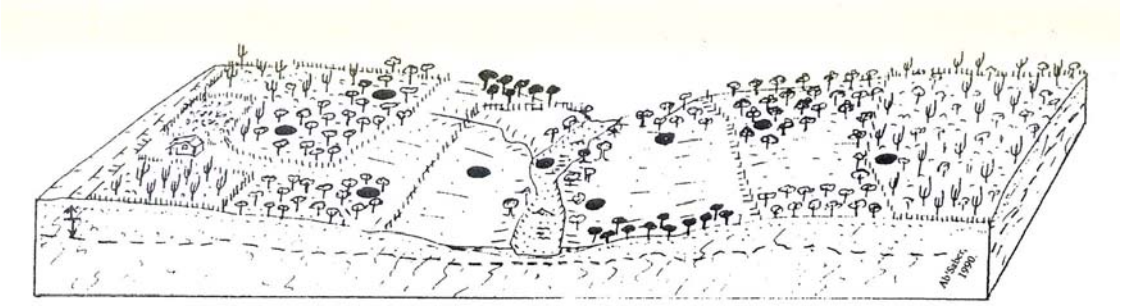
— aside from the new forestry experiments similar to some projects already under way, the empirical expertise available must be retrieved and approached from a perspective

both agrarian and silvicultural. This would involve the use of perennial or quasi-perennial trees, including shade or firewood trees, fruit-bearing species, and trees producing beans or fruit for fodder. The number of species suitable for reforestation is much greater than was assumed some years ago. Species selection, however, must not be based on the same criteria used by forest developers for the humid intertropical regions of Brazil. The temptation to utilize fast growth species like eucalyptus, pinus or Paraná pine for hinterland hills, however, would be doomed to failure and disappointment. Facts indicate otherwise, as native riverside plants, a wide range of regional or foreign fruit-bearing trees, and species adapted to the pedologic, climatic and water supply conditions of the dry *sertões* would be a better choice.

3. A BASIC APPROACH DEVELOPED FROM PRELIMINARY DATA GATHERED

The human settlements in the dry sertões have learned to live with the semiarid environment, its seasonal rivers, unfriendly soil, and its archaic and inflexible agrarian structure.

During the early studies on Floram Project/Brazil, we pooled together our own field research data and the inventory of environmental, social and economic information available on afforestation/reforestation possibilities for the northeastern dry *sertões*, badlands, and marshes.



Seasonal watershed fluctuations

Possible cash crops for the *caatinga* rural domains
10 to 100 hectare parcels

— every forestry research center in the Dry Northeast should develop multiple projects in small areas at different *caatinga* patterns with several types of tree species, to evaluate performance and yield. If each agronomy and forestry center carried out experiments in hinterland ecosystems near their campuses in 2 to 5-hectare plots, including

diversified planting sites with fast growing and native species (fruit trees or otherwise), we would have an accurate forestry management profile for the Dry Northeast. This would require sufficient funds for the Northeastern Agronomic Schools (at Mossoró, Fortaleza, Natal, Recife, and Campina Grande, for example). Regional research centers already operating in the *caatinga* domain could also be engaged (there are weir research centers, irrigation control stations, experimental farms, and ecological stations). If these facilities were to run experiments in 2-hectare plots, they would provide a profile of the forestry development potential of the Dry Northeast within a 5 to 7 year period. As an added advantage, these would constitute the embryo or starting point of the first gardens, germplasm or seedling banks to supply afforestation/reforestation efforts. They would be hubs to radiate and stimulate forestry practices in the region (environmental and social reforestation).

— while these research and data gathering bases are defined, other centers better prepared in terms of planning and strategic organization should start thinking of a social forestry approach for the dry hinterlands. This requires the development of models for introduction of special forest stands for each rural parcel pattern of the different dry *sertöes.* The ability to plant tree copses suitable to the phytoclimatic conditions of hinterland hills will improve if the area in each parcel is effectively broken down into well differentiated sections. This is especially true of medium size properties from 5 to 100 hectares. For properties extending from an interfluvial hill to the bottom of a seasonal intermittent river, the parcel should be organized into a series of differentiated implantations: interfluvial or high slope woods, species adapted to the semiarid (mesquite, cashew, passion fruit, foraging palm, etc. in alternating planting sections). This should be followed by pens for small livestock (goats and kid goats) or improved sties. Halfway up the slopes, again woods and trails cut toward the valley bottom. Foothills would have sites for medium-depth wells. At the bottom of the valley between the rim of the valley or river bed, shallow water holes for storage during droughts, and riverbed or weir embankment crops on flat plains (cassava, corn, beans).

Most of the five or six types of local water storage facilities for residential use — drinking water, cooking water, and water for washing — should be made into a very rustic system of water impoundment and storage inside each parcel. Throughout the *sertões*, three or more of the following traditional storage practices might be employed: 1. supply from rain water built up in huge clay pots (with the aid of spigots or roof chutes); 2. cattle water in shallow fenced amphitheater shaped troughs at certain interfluvial sites; or

alternatively in shallow scour holes at strategic crossroads of "water ways" (surface runoff); 3. Brick lined wells along the rim of plains or rustic wells opened in dry riverbeds; 4. water holes or springs located at the head of valleys or piedmonts of escarpments, shored up with sandstone or limestone; 5. water collected in natural rock holes or in fragmentation pockets of granite outcroppings. In addition to these more primitive and widespread approaches, there are also public weirs at some scattered sites. These are mainly used for downstream irrigation areas of to supply inland towns, but will not suffice to meet the needs of hinterland properties. Numerous small weirs created by road and highway landfills are also available. They were deliberately built to dam up runoff canals from the seasonal hinterland creeks and are quite to the advantage of hinterland parcel owners. Finally, the water flowing from the spillways of large dams can be either useful — depending on reservoir operation schedules — to perpetuate some river sections, or a catastrophe to traditional riverbed crops when too much water is released by request of powerful farmers or politicians (AB'SÁBER, 19). Woods and forests would have to be planted at selected sites or belts to help keep the majority of these different water reservoirs operational.

— the possibility of spaced woods around interfluvial water holes should be studied for each area where this rustic storage type occurs in the dry *sertões.* An identical recommendation is made — to prevent the effects of the severe local evaporation — for areas surrounding small weirs created by road landfills. In regard to mesquite plantations at interfluvial sections of rural properties — for soil rehabilitation and supply of fodder inputs —, the suggestion is that stands be initially confined to prevent livestock raised freely on the range from feeding directly on the beans. Mesquite plantation must be controlled, and during phase one, no more than 5 to 10% of the total parcel area should be used. Simultaneously with tree planting, a modicum of grass roots technology should be developed for animal ration production from a blend of mesquite and flour meals.

— river valleys and their narrow plains do not add up to more than 2% of the total dry *sertões* area. Intermittent seasonal rivers in the heart of the dry lands were bordered — in the primitive landscape — by narrow perennial or semi-perennial gallery forests, now almost extinct or at least severely depleted. These riverside forests are known as "c'raíba" woods, named after the main tree species found in its ecological system. It can be used to replenish and reclaim these narrow wooden galleries along the high banks of local rivers at selected sites in a massive reforestation campaign along high river embankments throughout the Northeast.

— the *caatinga* — in all of its regional patterns — is a steppe-like vegetation of the hot semiarid, tightly adapted to local climatic and pedologic conditions. Although its annual rainfall ranges from 300 to 800 mm, the northeastern semiarid is prey to dramatic fluctuations along the years and to extremely severe and unrelenting evaporation during the dry season, which lasts six to seven months on average. Impacts include: seasonal drought; drainage interruption; generalized deepening of the watershed; flow rates fall in rivers as they feed the watershed instead of being fed by it. There are no deserts in the semiarid Northeast in spite of the wide diversity of *caatinga* patterns in terms of *geofacies* of *ecosystems.* The fact that the dry *sertões* are under direct and powerful sunlight, bringing mean annual temperatures to 25-29^{o}C, did not result in biological desertification. The local physical and biotic environment to strong seasonal fluctuations, with droughts in winter and rain throughout the summer. All local rivers resume their regular flow rates and ultimately reach the ocean during the rainy season. If the watershed did not undergo almost total flow reversal in relation to the overall profile of hinterland hills it would be much easier to design reforestation developments for the dry sertões. The mere fact that northeastern rivers all flow out to the sea ensures remarkable geochemical properties for the local soil mosaic. Thus it is feasible to develop afforestation/ reforestation plans to assist the economy of a rural society poor in water resources but not totally lacking in strategies to find fresh water for crops and cattle alike.

The sections of so-called "salty" soils in the sertões are local ecosystem anomalies. Saline coastal plains where extensive salt works are located, are found solely in the lower valleys of Rio Grande do Norte rivers (Acu, Apodi) or in northeastern Ceará (Jaguaribe).

A totally singular ecosystem represents an exception in the northeastern sertões — the Xique-Xique dune fields in the lower middle Sao Francisco valley (Bahia). It is a true dune field formed under strict desert conditions in the late Quaternary, subsequently perpetuated by bushy and sub-arboreal, psamophylic, evergreen vegetation. It is a very fragile geologic and biotic ecosystem in urgent need of preservation to prevent the generalized regrouping of old local dunes. Lack of cultural and scientific judgment has led to the preservation of *Raso da Catarina* while neglecting the only documented evidence of a Brazilian inland desert perpetuated by special vegetation over the last 10,000 to 12,000 years. New information on the local physical and biotic features demands a drive to protect this unique local environment by instituting a full-fledged preservation unit.

— there is but one pattern of live hedges in the Brazilian Northeast, chiefly in the hinterland countryside. They are *"avelós" (Euphorbia heterodoxa)* hedges utilized as live

fences to separate graze lands from food and cash crops. Though the sap flowing from "avelós" branches is poisonous to cattle, the use of this evergreen in hedges is a deep-rooted tradition in subhumid areas along the dry hinterland rim. It would make sense, however, to introduce sweeping changes in this primitive technique to separate pastures from crops in the hinterland. The only requirement would be a selection of one or more types of tree species adaptable to the seasonal climate and a total annual rainfall of 800 to 950 mm. By extending these hedges into multiple rows of trees of the same species widely spaced toward the cattle ranges, the site would be reforested with shade trees for the cattle and proper separation from crop fields. Applying this pattern to just 10% of the total hinterland area would significantly improve the environment throughout the subhumid inland Northeast. Another possibility under consideration is to have fruit trees partially replace the "avelós" hedges, with substantial improvement in the budgets of small and medium properties along the sertões. Fruit trees planted in alternating rows with trees harvested for timber and firewood would work as a form of social forestry. It is about the same chain of developments proposed for small and medium properties of the humid mountainous regions of southeastern Brazil.

More so than any other Brazilian region — in terms of afforestation/ reforestation programs — the hinterland Northeast needs simultaneous projects for biodiversity preservation and protection, designed with a dependable and serious approach. The Dry Northeast in fact hosts a variety of biodiversity stocks, all worthy of consideration in terms of genetic heritage and germplasm banks. They include:

— narrow riparian forests, along the banks of rivers, streams and creeks; the "c'raíba" woods now severely damaged if not entirely destroyed;

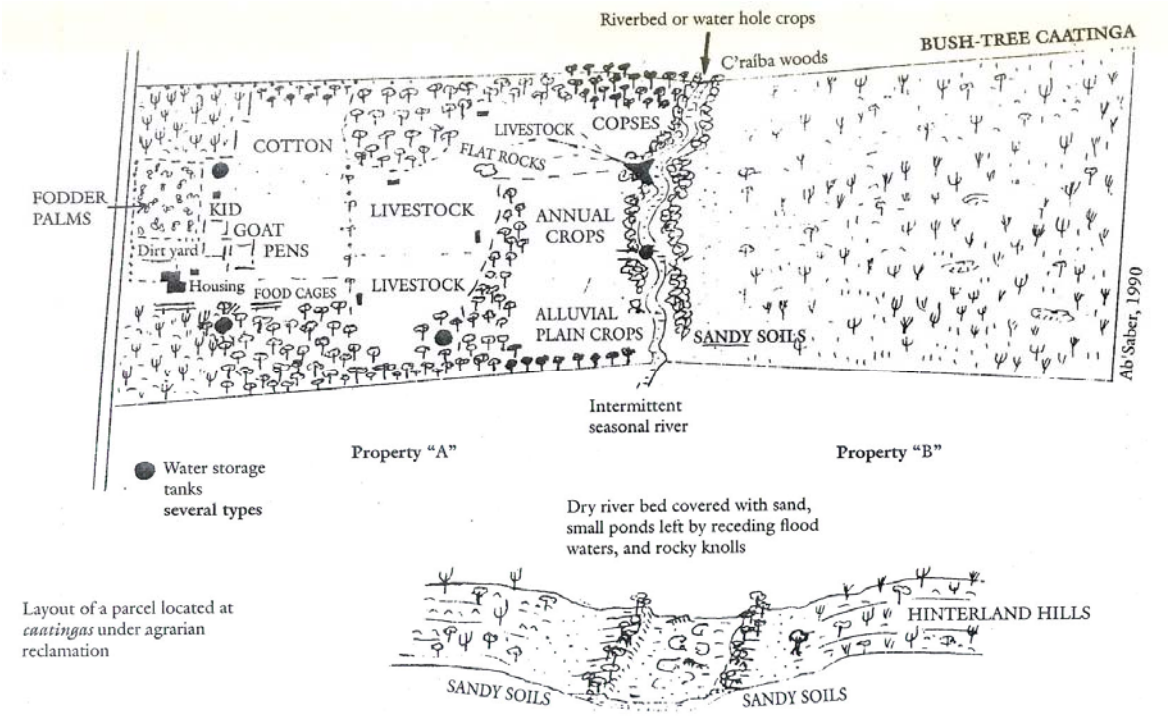
— the different *caatinga* ecosystems forming a broader and more. encompassing backdrop to hinterland areas along slopes and interfluvial areas straddling the endless hills, dry sierras, and escarpments untouched by water;

— the tropical woods of humid sierras and various "islands" of damp environment generically known as "brejos." These behave as tropical spots or islets because of a combination and interaction of local heat, humidity, and water resources, soils, and drainage;

— high altitude bands or zones of babassu stands located in the low "half-hills" (Barurité) or halfway up the slope of a few humid escarpments (Ibiapaba — north section). They involve a certain number of tree species interspersed with babassu palms in great

numbers, at 250 to 450 m in altitude, before making way for the forests of high overhangs or humid mountain crests;

— subcoastal groves of carnauba wax palm scattered on flat and generally sandy plains of the steppe kind, dotted with palms adapted to the rugged semiarid conditions. Unlike the babassu, which spreads up the slopes and strips of humid hills, the carnauba can only live or survive in coastal plains, its roots sunk into alluvial soil drained by subsurface waters. It is a better adapted ecosystem, therefore, and at the same time dependent on special heat, light, dryness, and surface water tables. It is found in coastal plains, in sections of the Dry Northeast where the hinterlands abut on the ocean: northern Rio Grande do Norte and northeastern Ceará.



Layout of a parcel located at *caatingas* under agrarian reclamation

A few ecosystems represent exceptions, real enclaves in the *caatinga* domain: interfluvial cerrados on structural platforms, at the tableland formations of Ribeira do Pombal (northeastern Bahia); low sierras of the "inselberg" type with cliff walls covered by bromeliads and cacti, often showing exceptional cover densities (the "inselbergs" of the Jaguaribe-Jaguaribara region east of Ceará); rocky knolls in low lands, again with a cover of bromeliads and cacti, appear in a variety of Dry Northeast areas; and the "bald hills" of highly scoured laminar soils, spots of sub-rocky outcrops spread over large areas, cacti scattered or in clumps, some rare dwarf trees, and different types of bromeliads.

Out of all the *caatinga* ecosystems, the most rugged ones in terms of erosion and routine anthropic actions (overgrazing, slash-and-burn crops) are the shrub or combination shrub-tree *caatingas.*

Tree-bearing *caatingas* and the dry woods of the *sertões* have been more extensively deforested and have no natural rehabilitation strength. This applies to all types of woods growing in a broken pattern in or around the semiarid: c'raíba woods, "marsh" woods, and liana woods. The only medium-strength forests are the *babaçu* stands. When under anthropic attack, the *babaçu* eliminates other surrounding trees and grows in numbers. When *babaçu* stands are burned in some parts of the dry hinterland ecological areas, heat from the soil causes the fallen and semi-buried small beans to sprout. They germinate wildly and give birth to what the locals call *pindobais,* an old Indian name for the young babassu. This renewed sprouting, however, is stronger and more widespread on coastal plains like Baixada Maranhense. It happens more seldom at *babaçu* forest strips at "mid-slope" in the Dry Northeast. The steepness of slopes seems to be a limiting factor to the recovery of babassu sprouts following a burn.

Drafting of the preliminary guidelines for Floram Project/Dry Northeast focused on three key concerns: 1. To promote environmental and social reforestation involving less than 15% of the hinterland over a 30-50 year span; 2. Through a better detailed understanding of the local physical and ecological features, to ensure that biodiversity in the dry *sertões* would be preserved to the greatest possible extent, including all sets of ecosystems that form part of its natural make-up; 3. To protect subareas containing local combinations of unique or critical physiographic and physiological features: humid sierras, "marshes," undamaged riverside woods, groups of "inselbergs" (Milagres, Quixadá, northwestern Ceará, Patos), "inselbergs" containing a large number of rock formations (Jaguaribe-Jaguaribara), the ruins of Pará rock plateaus (Sete Cidades de Piracuruca and others).

The Dry Northeast requires detailed knowledge at different levels for any plan to succeed in solving its problems. There must be information on land and climate issues, on the problems of the physical and ecological world that have a direct bearing on people and society. The daily routine of the hinterland man is governed by the rhythm and fluctuations of the climate, water supply and the environment. This rural society pays a heavy toll involving simultaneously nature, the local economy, and the national economy. Though things go reasonably well under normal seasonal conditions — half the year dry, half the year rainy or somewhat rainy — there is no way to bear the years of severe drought,

unemployment and hunger. The large country families seem to soften the solitude of life in the sertões. But they are also the root of serious survival problems during prolonged droughts or domestic crises. Migration to faraway job markets has a strong appeal, uprooting family members and threatening to leave behind just thin groups of very young or very old people. They have no socioeconomic way out in the short or medium terms: the younger, stronger and bolder emigrate; the children, the elderly and the defeated stay.

Against this dramatic backdrop of periodical droughts, however, several new considerations will be helpful in designing a set of proposals specifically oriented to meet the local climatic and hydrologic fluctuations. As the century comes to a close, the following sets of factors seem promising:

— a relatively dense and modern road system interconnecting most of the hinterland settlements easily with the major coastal, eastern, and southeastern Brazil;

— power supply throughout the hinterland from Paulo Afonso and Boa Esperança hydro power plants, to be boosted considerably as soon as new plants are completed on the middle Tocantins. There is also the possibility of using wind power for agriculture, and the likely development of solar energy thanks to the high rate of sunlight in the hinterland;

— increase in the number of food crop farms at "marshes" *"brejos"* and on land irrigated by the inland reservoirs (the system of government operated weirs);

— a growth in urban activities in medium-size northeastern cities will increase the local job market and planned public services. This will in turn serve as a disseminator of social development hubs to surrounding sertões;

— a possible technical-scientific recycling of the massive government machine toward more suitable social and economic development planning for the Dry Northeast. This is achievable through a retrieval of knowledge and expertise already accumulated and a new moral and cultural mind frame. The effort to revamp old and new bureaucratic machines must involve primarily the Departamento Nacional de Obras Contra as Secas, (DNOCS) Superintendência do Desenvolvimento do Nordeste (SUDENE) and Companhia Hidroelétrica do São Francisco (CHESF) in closer cooperation with regional universities. Technobureaucrats must be more flexible and far-sighted while Academia has to be less pretentious and more actively involved.

There are several avenues open to assist the Semiarid Northeast. As far as social forestry is concerned, the approach must combine procedures and strategies for reintroduction and introduction of species, along with preservation, conservation, and water use techniques at parcel level. To accomplish this at low cost, governments should

start forming massive germplasm banks around key hinterland cities. At the same time, field pilot studies must be carried out to expedite plans and dovetail reforestation efforts with the introduction of simple water impoundment models or systems in preparation for the dry seasons. As shade woods grow — whatever species are selected for them -, the poorer farmers would receive water conservation and distribution equipment plus the basic instructions as to likely sites and use to improve their farming yields. Each diffusion center can take on the distribution of water tanks in large numbers — the model would have to be defined — plus supplies to build brick walled water holes next to river beds, chutes or drip piping, and simple ration mixing equipment. Afforestation and reforestation can only be done before the rainy season. Meanwhile, water storage and distribution facilities in each parcel can be build with the available manpower at any time during the dry season or in major droughts.

The habit of draining weirs massively during the dry season to benefit major land owners downstream must be definitely stemmed. It causes severe losses to peasants who farm riverbed crops. Instead of this antisocial behavior, it would be better to benefit hinterland properties located on hills by draining water from weirs to supply new systems of small reservoirs built right on their parcels. In time, hinterland land owners would learn to store water during the rainy season to prepare for the dry season shortage. In the medium or long run, perhaps the local peasants will even have greater job opportunities. But this requires a great deal more in terms of ideas, resources and plans than just a mere environmental forestry program.

It is recommended that implementation of the dissemination centers proposed by Floram Project/Dry Northeast be done in conjunction with every local technical and scientific community, who are aware of the need for multi-purpose forestry. This would necessarily involve the universities of Pernambuco, Rio Grande do Norte, Ceará, Paraíba, Alagoas, Sergipe, Piauí, and Bahia as well as institutions traditionally engaged in public works and planning in the so-called Drought Polygon. The main emphasis is no DNOCS, CHESF, SUDENE, Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Coordenadoria de Pesquisas de Recursos Naturais (CPRN), and all public reservoir managing agencies. The use of government-run reservoirs to benefit the entire rural society in the northeastern semiarid must be maximized.

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As a first emergency action, it would be desirable to channel funds to start a few seedling or germplasm banks — through a gradual and well-designed plan — in several key cities (around major urban centers) strategically located for easy access to remote

hinterland areas. The list of key cities is long. Five would be selected from the following as priority targets initially: Mossoró, Quixadá, Campina Grande, Sobral, Itabaiana, Santana do Ipanema, Paulo Afonso, Crato/Juazeiro, Petrolina/Juazeiro (Bahia), Patos, Feira de Santana, Terezina, Picos, or Pau de Ferros/ Caicó). These diffusion centers would subsequently extend to remote hinterland localities after germplasm or seedling banks are in place. This second comprehensive effort would involve sites as far apart as northeastern Ceará and northeastern Minas Gerais, the serthes of Cariris Velhos and Cariris Novos, the backlands of Irauçaba or Inhamuns, Poções (Bahia) or Campos Sales on the western rim of Araripe, the São Francisco sertões, and southern and southeastern Piauí. Is this a Utopian dream? Or is it an appeal to the sensitivity of policy-makers and to administrative continuity, usually prey to the leaders of our powerful ruling class? It is certainly a historical exercise in how to properly apply science to the social and economic rescue of a society routinely at grips with drought.

4. GUIDELINES FOR THE NORTHEASTERN "MARSHY" FORESTS

It is about time to pool our knowledge and merge proposals for the small formerly forested areas scattered throughout the dry sertões of the Brazilian Northeast. Nothing directed toward preserving the remnants of Atlantic forests or the ecodevelopment approaches addressed to the Amazon jungle is directly translatable to the remains of "marshes" or "brejos," "shoals" or "baixios" or subhumid "riversides" of the Dry Northeast. Everything hinges on how much we know about the past agricultural history of these "brejos," their current agricultural practices, demographic data, and yield ratios. Consideration must also be given to food demand among hinterland populations and the large urban centers of the northeastern coastline (Recife, João Pessoa, Fortaleza, Maceió, and many others).

The name "brejos" is given to islands of waterlogged sites amid the dry hinterland. Its origin is complex. One of the keys to understanding the term is found at Baturité Range (Ceará): a traveler moving uphill from the dry hinterland of the prevailing rolling lowlands would find atop a humid and forest-covered hill some alveolar shaped plains soon to become known by the old Portuguese term "brejo"— literally marsh. These shallow depressions high on the hills were a physiologic and ecological component unknown in the dry hinterland, normally covered by *caatinga* bushes and under intermittent seasonal drainage. The small uphill *brejos* were an integral part of the mountain top forests. In fact,

the perpetual drainage systems of these humid hills had originated the marshy plains (floodplains or *brejos).* In their totality, they were true islands of humidity where tropical vegetation prevailed. Tropical forests and some "floodplains" complete with macrophytes were ecosystems of different extents found atop some "humid mountain ranges." At other locations and for different reasons, the word "brejo" was used to designate parts of the landscape with perennial drainage or rivulets in environments capable of sustaining a forest cover. The fact is that the term "brejo" was ultimately applied to any geoecological area where local humidity helps form and perpetuate native forests. At humid hills cooled by condensing moisture or where slopes trap moisture coming from the east or southeast, these meager but perennial drainages, oxysols, and vast crest or slope forests are tropical enclaves that the dry sertões seem to have lost. Over the extensive Brazilian semiarid domain, these "brejos" behave as true refuges of a local tropical nature once designed to spread into wider areas or strips.

The fact that some "brejo" forests have species typical of the northeastern Atlantic and peri-Amazonian forests — as evidenced by the phyto-sociology studies performed by the esteemed late botanist Dárdamo de Andrade Lima (1982) — seems to suggest a Quaternary or Tertiary-Quaternary continuity link between the eastern Amazon jungle and the Atlantic forests of the eastern Northeast. For a variety of climatic and hydrologic reasons, there are indeed humid subareas where forests bloom in the dry hinterland. They come in a variety of geo-hydro-ecologic patterns: mountain, hilltop or crest marshes (Baturité, Triunfo, Garanhuns, Serra Negra); humid slope "brejos" (eastern rim of Borborema, western rim of Baturité Range); piedmont or foothill marshes with several water springs (foothill of Araripe around Crato, and Missão Velha; Pedro II in Piauí); limestone foothills (Apodi Valley — Mossoró); "brejos" at piedmont showing old alluvial fans (northwestern Ceará); and finally, marshy "shoals" or "baixios" at alveolar-shaped foothills (southeastern Ceará).

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Since these constitute islands of tropical nature and fertile soils ranging from a handful to hundreds of hectares in size and scattered throughout the dry *sertões* — spanning dozens to hundreds of square kilometers -, these *brejos* represent for the Dry Northeast the same as oases in a desert. They are true breadbaskets of the Northeast, where they supply local street markets. They also play a historical social role linked to small farmers trained in the tillage of these old forest soils prevailing at hilltops and along some slopes of residual massifs enclaved in the hinterland. They are tropical wildlife refuges changed by the hand of man. But they are equally differentiated remnants of the proud

culture of human settlements living at privileged locations in the Brazilian hinterland. They deserve better treatment from the state and federal agricultural agencies.

The *brejos* are currently under the impact of new cropping trends. Some have a farming pattern inherited from the distant past. They produce sugar cane in limited areas to supply *rapadura* (a hard candy) mills and hard liquor stills. Others show decadent coffee plantations under tree shade (Baturité) or even unshaded coffee crops (Garanhuns range rim). Yet others grow cassava, corn or beans. They harvest traditional fruit trees like mango, orange, papaya, and watermelon. They import beef cattle but routinely breed hogs. Some have gone into cash produce crops to supply the bigger coastal cities (Baturité). But the main problem encountered by the forest marshes lately has to do with the massive encroachment of banana stands. They started along a few central portions of the Baturité Range not suitable for traditional crops, at mid-altitude where babassu palm used to be grown. Banana plantations have gradually spread through several wooded marshes and hills located at different distances from the big cities along the coast. At Itatira Range in mid-southwestern Ceará, banana growing has extended from previously forested crests down to the bottom of local valleys. Now only a mock strip of the old dilapidated forests remain in barely 1% of the total area, as verified by our colleague from Ceará, Maria Angélica Figueiredo (1981). Around Machado and on many slopes of Natuba Range along the Pernambuco-Paraíba border (east of Borborema), mountain banana stands have invaded deep into areas that were under forest covers just a few years ago, as another local researcher and colleague, José Grabois (1988), has shown. The landscape originating from banana growing along slopes and hilltops is amazing and a matter for great concern. Growers have introduced banana tree in all classes of subareas, along slope grades ranging from 20 to 45% as well as on mid-slope terraces and crests of the eastern rim of Mantiqueira Range. The fact that the marshy mountain soils were suitable for banana growing introduced a complicator in terms of use of the forested hills of Pernambuco's Atlantic coast. Farmers found in banana crops —according to Grabois — a means to escape the hard, primitive, unprofitable, and most of all not permanent, offered by the large sugar cane plantations. They changed over the self employed and year-round farming, and thus became free from the enslaving seasonality of regular crops.

An overview of the current farming practices at northeastern *brejos* clearly shows that they each have a different profile, with a greater or lesser number of traditional components side by side with more or less innovation. If the policy makers and development agencies were farsighted, each humid range or marshlands of different origins

and economic-social and farming background should have received special treatment in terms of monitoring and management. The *brejos* are special miniparcels and small properties. Some of them have a longstanding farming past. These have contributed to extensive deforestation of the native forest cover, although often to experiment with shaded, low-yield crops in small patches. Others, however, have been affected by aggressive deforestation to enlarge current banana groves. It is a form of single crop farming of multiple and nefarious consequences. Banana growing must be prevented from becoming "universal" at the hinterland marshes. The forests along steep slopes and headwaters must be preserved, while production of traditional local food staples is stimulated. Roughly speaking, 20 to 30% of the area around remaining forests in humid hills should be set aside for food crops. Where banana growing is intensive and extensive (Itatira, Natuba, Machado), farmers must be redirected to strip planting along the slopes following natural contours. This would stop or slow down soil erosion and spare the forest still remaining at slopes above the 25 to 30% grade level. At the moment, to protect slopes from more severe erosion, land owners line the ground of their plantations with the wide leaves removed from banana trees themselves. This is a primitive but valid solution that might be improved by the mere reorganization of banana groves along the rugged slopes of humid mountains. In areas heavily under banana growing, preserving at least 30% of woods or copses in each parcel should be mandatory. Between 30 and 35% of the forests of all ecological areas of each unit identifiable as a tropical "island," as well as water sources, should be preserved within the scope of the dry sertões. Whatever the case may be, the humid mountain ranges of the Northeast cannot be treated the same way as proposed for coastal ranges like Serra do Mar. It is strictly a matter of judgment, of common sense, of a humanistic and cultural approach.

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