

# Between Environmental Policy and Scientific Knowledge: How Might Dryland Environments Challenge Ideas Regarding Ecological Dynamics?

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*The desert teaches by taking away*  
Arab Proverb

## Entre la política ambiental y el conocimiento científico: cómo ambientes desérticos y semidesérticos desafían ideas sobre dinámicas ecológicas

**Resumen.** El objetivo principal de este trabajo es analizar cómo las perspectivas acerca de los ambientes semidesérticos y desérticos desafían las ideas tradicionales acerca de las dinámicas ecológicas. Para alcanzar este objetivo, el artículo se divide en tres partes: la primera analiza las características de la ecología de sistemas y la forma en la que dichos ambientes disputan los conceptos tradicionales de capacidad de carga y los postulados de área-biodiversidad y estabilidad. La segunda parte analiza el resurgimiento de la “nueva ecología” y cómo los conceptos de no-equilibrio divergen de aquellos pertenecientes a la corriente más convencional de ecología de sistemas. Finalmente se consideran algunas características de los ambientes semidesérticos y desérticos que evidencian dicha dicotomía conceptual; esta sección busca acentuar los postulados ecológicos adoptados en el diseño e implementación de políticas en torno al manejo, administración y conservación de ambientes semidesérticos y desérticos.

**Palabras clave:** ambientes desérticos y semidesérticos, capacidad de carga, área-biodiversidad, estabilidad, nueva ecología.

## Introduction

In 1987 the United Nations Environmental Programme (UNEP) stated that 27 million hectares of productive land were being lost to deforestation each year; according to that estimate, all productive land on the planet would disappear in 200 years time (Thomas, 1993; Swift, 1994). To reach such a conclusion, an extensive array of academic research took

**Abstract:** The main objective of this essay is to analyze how the rise of perspectives towards dryland environments challenges traditional ideas about ecological dynamics. To reach that goal, the essay is divided in three sections: the first part analyzes the characteristics of ecology systems and the way in which dryland environments challenge the traditional concepts of loading capacity, the area-biodiversity postulate and the biodiversity-stability postulate. The second part will analyse the rise of “new ecology” and how concepts from non-equilibrium ecology diverge from those in the conventional ecology systems. The third part considers some features of dryland environments in which this conceptual shifting has been evident; this part highlights the ecological postulates adopted on policy design and implementation regarding management, administration and support for dryland environments.

**Key words:** dryland environments, carrying capacity, area-biodiversity postulate, stability, new ecology.

place, elaborating in the way in which different ecological systems cope with degradation and global environmental change. The case of dryland environments is central to the study of ecological dynamics; firstly, because the observed trend of desertification has been supported and used as a general discourse for diverse International Funding Institutions (IFIS) and Big Non-Governmental Organizations (BINGOS); and secondly, because dryland environments degradation



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has been considered a global environmental problem as a result of mismanagement and human activities that lead to an irreversible ecological change through desertification (Illius and O'Connor, 1999; Larsen, 2003). 'Overgrazing' as a threat to global sustainability was embedded in the environmental doctrine adopted by different governments decision-makers, development practitioners and institutions to deal with issues of desertification (Sullivan, 2000; Sullivan and Rhode, 2002; Warren, 1995). Discourses about encroaching deserts, desertification, and land degradation as means of socio-political and economical struggles became the basis for policy implementation along the late twentieth century (Semple, 1971; Grainger, 1983; UNEP, 1992).

These statements based on traditional ecological postulates fulfilled the interests of colonial and national governments, international aid donors, specially United Nations (UN) agencies; and some scientists that, adopting the ideas of the conventional systems ecology, and have been justifying their interventions and policies by arguing that land degradation and desertification have broken the fragile ecological equilibrium of dryland environments (Ellis, Coughenour and Swift, 1993; Adger, *et al* 2001; Sullivan, 1996). Recent research about the natural fluctuation in dryland vegetation communities and the management of its resources (Behnke, Scoones, and Kerven 1993; Thomas, 1993; Warren, 1995), added to the rising of "new ecology" postulates; which challenges the traditional ideas about a nature which tends to equilibrium, stability and balance (Botkin, 1990; Zimmerer, 1994).

The main objective of this essay is to analyze how rising of perspectives towards dryland environments can challenge traditional ideas about ecological dynamics. By no means does this essay aim at providing new conceptual or methodological frameworks on ecological studies. Its purpose is to highlight the theoretical and conceptual underpinnings that ecology has brought regarding dryland environments' management, and the consequent policy implementation. It is necessary therefore to analyze to what extent research and programmes regarding dryland environments have adopted the postulates of the new ecology of non-equilibrium and how this conceptual shift can lead to a better understanding of terms as desertification and dryland degradation. To reach that goal, the essay is divided in three parts: the first one analyzes the characteristics of systems ecology and the way in which dryland environments challenge traditional concepts of carrying capacity, the area-biodiversity postulate and the biodiversity-stability postulate. The second part will analyse the rise of the "new ecology" and how concepts of non-equilibrium ecology diverge from the ones in conventional systems ecology. The third part considers some

features of dryland environments in which this conceptual shifting has been evident; this part aims at highlighting the perspective of the local population, government and IFIs regarding management, administration and support for dryland environments.

## 1. Systems Ecology: The Conventional Perspective

The main precept of systems ecology is that environments tend toward equilibrium state and temporal and spatial homogeneity characterized by mechanical regularity (Zimmerer, 1994; Sullivan and Rohde, 2002). Systems ecologists hold that for each environment there is a process of niche specialization, in which every organism plays an important and unique ecological role (Zimmerer, 1994; Adler, 2000). This idea helped to create a narrative in which the modification of the role of ecological components in dryland environments lead to desertification, and that this modification is encouraged by human activities particularly overgrazing in communal forms of land tenure (Sullivan and Rohde, 2002; Blaikie, 2006).

The ecological theory that supported these mainstream ideas was based on the 'succession theory' of Clements (1916; in Warren 1995), in which vegetation ecologist argue that each organism reaches a climax that leads to the decline of the specie (*ibid.*). Later, in 1930, following the work of Malthus (1798), the population growth models gave origin to the concepts of intrinsic growth rate and carrying capacity, describing the supposed stable features of ecological dynamics (Behnke, Scoones, and Kerven 1993; Scoones, 1999:482). By 1950, systems theory established the basis of ecosystems ideas that described natural environments as complex networks with stable and defined interchange of energy and nutrients (*ibid.*). Finally, conservation biology, based on the principles of island biogeography (McArthur and Wilson, 1967; in Scoones, 1999) represents another tendency of ecological theory in which equilibrium plays a central role. The debate about the role of applied biology regarding equilibrium in ecological dynamics came to a point whereby the scientific rationality was rarely being tested (Margules, Higgs and Rafe 1982; Zimmerman and Bierregaard 1986). Assumptions about Homogenous habitats (Margules, 1982), unsubstantiated turnover rates and extinction rates (Boecklen and Simmberloff, 1987), bio-geographic corridors (Simberloff and Cox 1987), species reserves (Salwasser, 1986), among others (See Orians, 1986 and Salwasser, 1986) became the buzzwords in mainstream policy documents, and approaches to ecological dynamics.

These ideas and theories furthermore became a guide for the management of diverse environments, and the findings of scientists attached to this epistemological content, gave raise to policies and practices of conservation based on three main postulates: carrying capacity, area-biodiversity postulate and biodiversity-stability postulate.

The postulate of generalizing carrying capacity holds that a given environment exists in equilibrium with a certain population of organisms, and when an environment is overpopulated, consequently degradation and collapse are generated (Zimmerman and Bierregaard, 1986; Zimmerer, 1994). These assumptions are related to an exponential population growth, and assume a temporal and spatial heterogeneity. Dryland environments challenge these ideas by demonstrating that under unpredictable disturbances as a drought, the rate of population growth can be temporally modified (Thomas 1993; Warren, 1995). For instance, based on a study of long-term change in Machakos District, Kenya, it was shown that degradation is not inevitable in African dryland environments (Mortimore and Tiffen, 1994). These kinds of empirical conclusions draw attention to ideas of forest loss, desertification and dryland management as coming from 'snap-shot' and short-term landscape observations, and by broader visions of dryland environments, without taking into account the interface between population distribution and ecosystems (Fairhead and Leach 1996; 2000).

Furthermore, the spatial distribution of the population in dryland environments is not stable in a single place, the nomadic movement of organisms responds as well to the variation of geographical features (Warren, 1995). This characteristic of dryland environments is directly related to the second postulate: the area-biodiversity relations, in which asserts that "...biodiversity is a direct function of area (island size) and of isolation with respect to similar habitats [...] area becomes the key predictor of biodiversity: the larger the area the better" (Zimmerer, 1994:113). Recent studies have shown that environmental conditions in dryland environments are not regular in time and space; variations in factors such as regional biogeography, environmental heterogeneity, migration capacities among organisms, stational whether conditions, etc. can modify the relationship biodiversity-area (Botkin, 1990; Warren, 1995; Adger, *et al.*, 2001).

The third postulate of systems ecology assumes that the relations of biological diversity and stability are inextricable and determinate (Ellis, Coughenour and Swift, 1993; Margalef, 1968; In: Zimmerer, 1994). This perspective highlights the importance of the role that each organism plays on their

environment, and assumes that the higher the specialization of the organisms, the higher the biological diversity, and as a consequence, greater environmental stability (*ibid.*). Moreover, this reasoning implies that the equilibrium between specialization and biodiversity is an evidence of temporal stability. The influence of this postulate is often related to the implementation of crop varieties and management systems of semi-arid environments that supposed to ensure stability in the long term; however, according to Zimmerer (1994:114): "Niche specialization is not somehow immutable and given; its properties must be demonstrated rather than assumed".

The given assumptions contributed to the perception of ecosystems as rigid and isolated structures, which components tend to equilibrium and internal homogeneity; for many years this concept constrained ecological studies and was characteristic of the plans and programs implemented for their protection (Sullivan, 1996). However, new theoretical approaches are beginning to emphasize non-equilibrium, instability and fluctuations in biophysical environments rather than focus on their components and their protection (*ibid.*).

## 2. The New Ecology: the Non-Equilibrium Concepts

Since the 1980s, there has been an empirical and theoretical shift in the concepts of ecology; the traditional ideas within systems ecology have been challenged by an emerging and interdisciplinary term: "new ecology" (Botkin, 1990; Behnke, Scoones, and Kerven 1993; Zimmerer, 1994; Scoones, 1999). According to Borkin (1990:9) "[...] decisions about managing nature were based on ideas that were clearly contradicted by facts, yet those who continued to advocate those outdated policies were acquainted with the facts; in my own field of ecology, those same ideas dominated, yet the facts that contradicted them were gathered by ecologists". The emergence of the new ecology postulates represented (and still represents) a challenge to not only the scientific rationale previously discussed, but also brought light on policy issues that were based on those aspects of traditional ecological thinking.

For instance, the new ecology proclaims opposition to the idea of stability of ecological systems basing its precepts in three main concepts: multiple stable states, chaotic dynamics and non-equilibrium systems (Scoones, 1999). Thus, these concepts challenge the findings and precepts of systems ecology, and therefore, due to the rising acceptance of new ecology terms, the previous studies and

environmental assessments may be discussed. According to Thomas (1993:318), “[due to the introduction of this new paradigm,] natural fluctuations in dryland vegetation communities caused by inherent environmental instability need to be distinguished from degradation of the soil caused by human activities”, and also suggest that previous assessments of desertification in the world may have overestimated by a factor of three (*ibid.*). The implication of these assumptions could lead to a new understanding of dryland environments and the problems that are facing, such land degradation and desertification.

The new ecology concepts also involve a new notion of time; while systems ecology takes into account cyclical environmental variations, the new ecology takes as reference historical time, making emphasis on irregular periodicity of process that modify the regular features of the ecological dynamics (Christensen, 1989; Swift, 1994). The frequency and spatial magnitude of natural disturbances have been seen as an important part of ecological dynamics more often than before; therefore, terms as land degradation and desertification began to be reassessed. For instance, after an exceptionally high rainfall period in the 1950s, the term ‘desertification’ arose importantly due to the droughts in the 1970s and 1980s, becoming a priority problem for many international aid donors and governments (Adger, *et al*, 2001). More recently, and based on the parameters of the new ecology studies suggests that these periods of variability indicate that dryland environments have dynamic processes tending to the non-equilibrium (Sullivan, 1996). Natural fluctuations as droughts and rainy periods indicate the normal variability of these environments, rather than the exclusive result of human activities (*ibid.*). Empirical evidence about these natural fluctuations and their role on interpreting landscape dynamics and the policies to cope with it are growing in importance and recognition (See Fairhead and Leach, 1990; 2000 and Illius and O’Connor, 1999). The consequences of this shift in ecological dynamics conceptualization have originated a deep reassessment of past estimates of the extent of desertification that assert that between two thirds and three quarters of the dryland environments of the world had been decertified (UNEP, 1992).

Another term often used to describe some properties of ecosystems under the new ecology perception is resilience. Resilience is the capacity of a system to absorb internal and external perturbations and recover itself; is the ability to maintain a steady ecological state (Pimm, 1991; Behnke, Scoones, and Kerven 1993; Holling, *et al* 1989; in: Adger, 2000). The variability of dryland environments represent an example of the resilience of ecosystems; therefore, studies,

policies and programmes directed to protect and manage dryland environments must recognize its instability and complexity leaving behind the neo-Malthusian discourse and the precepts that consider the environment as an equilibrated and stable system (Adger, *et al*, 2001). Studies in African settings show that dryland environments are able to recover quickly from drought once the rains or land use pressures return to more normal levels (Bie, 1992). “Many development efforts disregard this resilience. Large-scale tree planting projects, animal restocking schemes, development of energy sources alternative to firewood/charcoal, or the construction of road networks to facilitate delivery of relief supplies, may therefore be founded on erroneous assumptions” (*ibid.*: 5). Furthermore, the resilience of dryland environments has demonstrated a central role in understanding global environmental change. Recent studies have shown that policies regarding the struggle of human settlements in dryland environments have not taken into account the resilience of these systems, leading to inaccurate empirical evidence (Ramsey, West and Norton, 2008). This problem has created policies with questionable outcomes and secondary consequences related to natural resource management and poverty reduction (*ibid.*).

Despite the arising of the concepts mentioned above, the majority of international donors, funding institution, governments and NGOs, continue using the concepts and precepts of the old paradigm; as a consequence, the policies and programmes are often based in overestimated information (Ellis, Coughenour and Swift, 1993; Thomas, 1993; Warren, 1995). The results of this erroneous information repeatedly follow the interests of these decision makers, while pastoralists, small holders and subsistence farmers do not receive benefits from those actions (Adger, *et al* 2001).

### 3. Shifting the Paradigm: the Relevance of Drylands

The assumptions of new ecology that highlight natural variability in ecological dynamics, also take into account the human presence as a modifying agent of the environment (Adger, 2000). The relationship between social and ecological resilience, moreover, have deep impacts on the conservation or degradation of any natural environment (*ibid.*). Furthermore, the new paradigm implies that protection and management strategies must be carefully adapted to the permanent disequilibrium characteristics of dryland environments (Bie, 1992; Behnke, Scoones, and Kerven 1993; Warren, 1995). Nevertheless, the implementation of these strategies based on the old paradigm of systems ecology have found support in three main bodies:



...a) ecologists who believed in Clement's (1916) model of succession and ecological stability; b) economists who believed in Hardin's (1968) concepts of the 'tragedy of the commons'; and c) authoritarian administrations which saw pastoralist as backward and destructive" (Adger, 2000; Sullivan and Rohde, 2002).

Consequently, there are two main concerns about dryland environments that challenge ideas about their management and protection: the productivity of dryland environments and the official fight against desertification.

#### 4. The Productivity of Drylands Environments

Dryland environments cover 41% of the terrestrial surface and support more than 36% of the world's population (Ramsey, West and Norton, 2008). The pressure on dryland environments productivity is enormous, taking into account the growing population stress and the perceived threat of land degradation and desertification. Some definitions of desertification are based on a reduction in productivity; or as United Nations Conference on Desertification (UNCOD) stated in 1992: "desertification is a reduction or destruction of the biological potential" (UNCCD, 1994). These definitions influence the way in which dryland degradation was acknowledged. Therefore, dryland environments have been seen as infertile lands with low potential to meet the basic requirements of the population that inhabits them (UNEP, 1992). Nonetheless, studies about pastoralists in Africa and Latin America reveal that communities also interact within such environments, contributing to the general resilience of them (Bie, 1992; Scoones, 1994; Warren, 1995). The production strategies that some communities apply to cope with the variable conditions of dryland environments, confront the wide spread ideas based on the tragedy of the commons in which human activities induce degradation.

Nowadays there is a growing evidence that shows that the imminent collapse of the traditional pastoral sector in dryland environments predicted by the old paradigm, can be reverted (UNEP, 2005); the effective survival strategies that this evidence reveals (including nomads' activities, the careful choice of herd species, intimate knowledge of the environment and many others) has now challenge the older points of view (Thomas, 1993; Zimmerer, 1994; Warren, 1995). The new perspectives about the production of dryland environments and the beneficial effects of the communal good management support that within the dryland context the concept of equilibrium and niche specialization is inapplicable. Moreover, "Communities owe their resilience to their ability to exploit the very opportunities that system instability offers" (Thomas, 1993:323).

#### 5. Drylands environments and the 'fight' against desertification

With the main purpose of estimating the extent of land degradation, in 1978 emerge the Global Assessment of Soil Degradation (UNEP, 2003). Based on traditional ecology postulates, the information obtained represented the basis of national policies against desertification and the parameters to apply new management systems to dryland environments. The reformulation of the theoretical approaches regarding dryland environments, originated a new mainstream that include natural variations and chaotic fluctuations; thus, dryland environments changed from barren wastelands, to vital ecosystems capable to support human activities (Adger, *et al*, 2001; Thomas, 1993; UNEP, 2005).

The community-based management in dryland environments also challenges the old paradigm that the human activities are the main cause of degradation by overgrazing and overstocking. Traditional practices may provide lessons about how to live in these environments without destroying them (Bie, 1992; Blaikie, 2006); and represent a lesson for the international donors, funding institutions and governments that have been "... imposing interventions aimed at restoring equilibrium onto a non-equilibrium system" (Sullivan, 1996:4).

#### Conclusions

The rise of new theories and ideas regarding ecological dynamics presents radical changes in the conception of ecosystems and their problems. Dryland environments may play an important part of the new efforts for understanding environmental change as well as the role of humans in protecting and managing natural resources. Therefore, the discussion about how dryland environments engage with the new ecology postulates shows that environmental policies and paradigms are intimately interlinked (Warren, 1995). However, many of the assertions highlighted in the new ecology are partially determined and thus, other points of view related to the old paradigm remain feasible (Ellis, Coughenour and Swift, 1993; Swift, 1994; Zimmerer, 1994; Scoones, 1999). In any case, it is necessary to develop a better understanding of how dryland environments work to avoid misleading projections about the future of these environments, and especially to improve the use of resources available in these arid systems (Ellis, Coughenour and Swift, 1993; Swift, 1994; Pimm, 1991; In: Sullivan, 1996).

Environmental scientists currently recognize the importance of natural processes that characterize dryland

environments; the relevance of this shift is that ecological thinking is adopting new processes in its effort to understand the complex environmental dynamics (Warren, 1995). Therefore, this new conceptualization of ecological dynamics might lead to: a) the development of theoretical frameworks that demythologize dryland environments as 'extreme' environments (Sullivan, 1996), and b) the implementation of policies and programmes that bring real benefits to these ecosystems and the population that habits them, respecting their natural fluctuations and variability (Zimmerer, 1994). The narratives provided by empirical cases in which desertification and dryland environments degradation seem evident challenge not only the very scientific roots of policies and issues of environmental change, but also highlight the role of social, political and financial institutions on building up a global vision of environmental degradation. The evidence provided by this essay conveys the various reasons by which ecological thinking has evolved along the time, creating global discourses that influence scientists and donor agencies.

However, the shift in ecological paradigms and the changes brought by it are subjugated to political interactions. That is the main importance of the change in ecological thinking, and the central position taken by this academic effort. Just as Botkin (1990:16) affirms: "The potential for us to make progress with environmental issues is limited by the basic assumptions that we make about nature, the unspoken, often unrecognized perspective from which we view our environment. [...] In order to gain a new view, we must break free from old assumptions and old myths about nature and ourselves, while building on the scientific and technical advances of the past". Hence, nature has provided the very means by which it is possible to challenge our own understanding of the world; consequently, the adaptation and improvement of the different political approaches in which not only dryland environments but also the rest of ecological endowments are inserted need to be contested, adapted and adopted in political and social spheres in order to achieve more efficient and equitable management and conservation processes.

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