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Combating Land Degradation and Desertification: The Land-Use Planning Quandary

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Received: 15 December 2018; Accepted: 28 January 2019; Published: 1 February 2019

Abstract: Land-use planning (LUP), an instrument of land governance, is often employed to protect land and humans against natural and human-induced hazards, strengthen the resilience of land systems, and secure their sustainability. The United Nations Convention to Combat Desertification (UNCCD) underlines the critical role of appropriate local action to address the global threat of land degradation and desertification (LDD) and calls for the use of local and regional LUP to combat LDD and achieve land degradation neutrality. The paper explores the challenges of putting this call into practice. After presenting desertification and the pertinent institutional context, the paper examines whether and how LDD concerns enter the stages of the LUP process and the issues arising at each stage. LDD problem complexity, the prevailing mode of governance, and the planning style endorsed, combined with LDD awareness, knowledge and perception, value priorities, geographic particularities and historical circumstances, underlie the main challenges confronting LUP; namely, adequate representation of LDD at each stage of LUP, conflict resolution between LDD-related and development goals, need for cooperation, collaboration and coordination of numerous and diverse actors, sectors, institutions and policy domains from multiple spatial/organizational levels and uncertainty regarding present and future environmental and socio-economic change. In order to realize the integrative potential of LUP and foster its effectiveness in combating LDD at the local and regional levels, the provision of an enabling, higher-level institutional environment should be prioritized to support phronetic-strategic integrated LUP at lower levels, which future research should explore theoretically, methodologically and empirically.

Keywords: integrated land-use planning; land degradation; desertification; policy; phronetic approach

1. Introduction

Land[1] mediates all interactions between the natural environment, society and the economy [2,3]. Land resources provide ecosystem services but also pose constraints on human activity which, if violated, generate important unwanted environmental and socio-economic consequences. The alarming pace at which land resources are degrading in recent times has been recognized at the international and subglobal levels [4–7]. Sustainable Development Goal (SDG) 15, one of the 17 SDGs decided at the Rio+20 conference in 2012, is specifically geared to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" [8].

[1] "Land means the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system" [1].

The wise governance of land resources in coupled human-environment systems, or land systems[2], is key to strengthening their resilience against natural hazards and numerous other environmental, technological and socio-economic disturbances [10–13]. 'Land systems science' is a term coined to denote the contemporary, interdisciplinary scientific domain concerned with the theories, approaches, analytical tools and instruments related to the analysis and resolution of land-use problems [12,14]. Land-use planning (LUP) is an instrument of land governance that has been used since ancient times to protect land and humans against natural hazards and to address pertinent land use-related issues in order to secure the sustainability of land systems [15–19].

Desertification, an extreme form of natural and human-induced land degradation, and drought, a natural hazard, threaten the smooth functioning of land systems [7]. Desertification differs from other natural hazards, such as fires, floods and earthquakes, because it is a wide-net, higher level, multi-scalar and long-term phenomenon; at the local level, it is mostly experienced as (severe) land degradation. Land degradation and desertification (LDD) is the term commonly used in official (e.g., UN, European Union) and scientific quarters, and which is adopted in this paper. The causes and consequences of LDD concern several interdependent human activities, directly implicate more than one land resources (soil, water and vegetation) and involve diverse economic sectors, social groups and institutions, spanning the local to global spectrum. The incidence of LDD exposes land resources and human populations to multiple threats: loss of land productivity, food insecurity, water shortages and scarcity, economic hardship, social deprivation and health risks [20–25].

The signing of the United Nations Convention to Combat Desertification (UNCCD), one of the three Rio Multilateral Environmental Agreements (or, Conventions)[3], in 1994[4] underlines the global significance of the phenomenon as well as the critical role of appropriate local action. Since 2012, the UNCCD has embraced SDG 15 and, more specifically, Target 15.3 that sets the ambitious goal to achieve land degradation neutrality (LDN) by 2030. Among the several actions for its effective implementation, the UNCCD and other international and sub-global organizations incite the signatory parties to use local and regional land use planning to help combat desertification and mitigate the negative effects of drought in affected areas [26] and, more recently, to address the LDN target[5] [27]. Putting this straightforward call into practice, however, presents considerable challenges, several of which have been noted since the early days of the UNCCD [28].

In complex land systems, a multitude of actors interacting on and across scales continuously place diverse demands on a multitude of interconnected resources to satisfy various, often conflicting, goals, environmental protection being one of them, that differ in priority among groups [13,29]. Conflicts arise over the allocation of land among competing uses which accrue short- and long-term costs and benefits to individuals and groups. If human activities locate in resource-poor (e.g., water), hazard-prone and other high-risk areas, biophysical constraints imply high costs of protection or, if they are ignored, significant environmental and socio-economic costs result. LUP aims to arbitrate and resolve these conflicts and issues to secure the sustainability of local and regional development [30]. In LDD-prone areas, in particular, the LDN goal makes LUP an inevitable instrument in the fight against LDD. This is a demanding undertaking because LUP is called to harmonize the LDN with numerous other goals and it is, furthermore, complicated by the ever-present uncertainty regarding future human needs, goals and priorities, environmental conditions, socio-economic and technological

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2 "Land systems constitute complex, adaptive social-ecological systems (Berkes et al., 1998) shaped by interactions between (i) the different actors and demands that act upon land, (ii) the technologies, institutions, and cultural practices through which societies shape land use, and (iii) feedbacks between land use and environmental dynamics (Millennium Ecosystem Assessment (MA), 2003; Verburg et al., 2015)." [9], (p. 53).

3 The other two are the 'sister' Conventions of the UNCCD, the UNCBD (United Nations Convention for Biodiversity Conservation) and the UNFCCC (United Nations Framework Convention for Climate Change).

4 The UNCCD came into force in December 1996.

5 "Furthermore, through Decision 2/COP.12, the UNCCD endorsed the formulation, revision and implementation of action programmes in view of the 2030 Agenda for Sustainable Development, (United Nations General Assembly, 2015) encouraging the linkage between planning and the implementation of LDN" [27], (p. 76).

change, unpredictable events and their changing constellations. Harmonization points to the need to apply *phronesis* (practical wisdom) [31] in making land-use decisions to safeguard the potential of affected areas to successfully adapt to changing conditions and, thus, secure their resilience and enhance their sustainable development prospects.

This paper delves into this land-use planning quandary aiming to show that LUP is not a straightforward but a complex endeavor, reveal the LUP challenges facing the fight against LDD and suggest avenues to handle them to foster the effectiveness of LUP efforts. The discussion is general applying to most (democratic) socio-political contexts although geographic particularities and historical circumstances determine the actual form the issues and challenges obtain. The second section briefly presents the main features of desertification and the institutional context to combat it. The third section introduces land-use change and land-use planning and explores the issues and challenges arising at each stage of the LUP process in the context of combating LDD at the local and regional levels. The concluding section suggests necessary priority actions to realize the integrative potential of LUP and, thus, improve its effectiveness in combating LDD that indicate future research directions.

2. Desertification and the Institutional Context to Combat Desertification

2.1. Desertification

Desertification has received and, with the escalation of global warming, is receiving significant political support at the international and subglobal levels [4,6,7,22]. However, it remains a politically contentious issue; the existence of more 100 definitions is telling [32]. The UNCCD definition, which is mostly used by now, states that desertification is "land degradation in arid, semiarid and subhumid tropics caused by a combination of climatic factors and human activities" [1]. Land degradation means reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including those arising from human activities and habitation patterns, such as: (a) soil erosion caused by wind and/or water, (b) deterioration of the physical, chemical, biological and economic properties of soils and (c) long-term loss of natural vegetation [1,23].

This definition makes clear that (a) desertification is land degradation in the drylands[6], i.e., in areas with adverse biophysical conditions, (b) it leads to an extreme, often irreversible, state of degradation implying reduction or loss of both biological *and* economic productivity *and* complexity of land, (c) the natural resources concerned are climate, soil, water and vegetation, (d) it involves both natural and human-induced processes operating at multiple spatial and temporal scales, and (e) a variety of human activities and users of land are implicated.

Biophysical and human *driving forces* (indirect drivers), from the local to the global levels, underlie *the proximate causes* (direct drivers) of LDD; i.e., human activities, such as agriculture, animal husbandry, forestry, housing, tourism, transport, extraction and energy production. The associated land-using and potentially resource-degrading practices include intensive cultivation, monocultures, abandonment of traditional practices (e.g., terracing), poor or no maintenance of rural holdings, overgrazing, deforestation, forest fires, water overdrafts, extraction, drainage of wetlands, and large infrastructure works [4,5,22–24,33–36]. Their combined action modifies land resources and produces land use and land cover change which, under adverse biophysical conditions, set in motion processes of LDD.

The biophysical drivers of desertification include climate, geology, soil conditions, hydrology, topography and vegetative cover. Selected important characteristics of these drivers are: low and uneven annual and interannual rainfall distribution, extreme weather events and out-of-phase rainy and vegetative seasons; soil depth, structure and stability, organic content, stoniness of land,

[6] i.e., "areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65" [1].

soil–water balance; slope gradient and slope aspect; surface and ground water availability; and biomass productivity[7] [37]. Slow and fast physical and/or chemical processes are involved in LDD. The former include soil erosion, compaction, salinization, alkalization and nitrification. The latter include drought and extreme weather events [25,37,38].

The diverse and interdependent human (socio-economic, cultural, political and institutional) drivers of LDD play a dual role; they either underlie the incidence of LDD or contribute to its mitigation by changing the valuation, modes of utilization and management of land resources. Important among them are: population structure and dynamics (mobility and migration), poverty and social inequality; changes in technology, modes of production, social values, consumption patterns, life styles, family structure, employment composition, market and/or public policy-induced agricultural product prices, capital availability and competition among economic activities [20,25,32,39].

The institutional drivers of desertification are particularly important. They encompass international economic and environmental regimes (e.g., trade, climate change and biodiversity) as well as supranational policies, such as the European Union (EU) Common Agricultural Policy (CAP), transport policy, the Structural Funds (SFs) and their national level counterparts [40]. Several national policies negatively affect bioclimatically sensitive regions, setting the stage for their degradation. Important national level concerns include the mode of governance, which depends on the prevailing political regime, inappropriate or inexistent environmental and spatial planning legislation, problematic plan and policy implementation, unclear, uncoordinated or inexistent systems of resource rights for critical resources, such as water and soil, administrative compartmentalization and lack of coordination [33]. At the local level, land tenure and ownership constitute critical institutional influences. Rural land rental, combined with absentee ownership, land fragmentation, and vague and incompatible resource regimes often give rise to inappropriate land management and degradation, impeding the proper implementation of formal policies [25,37].

Geographic location, accessibility and the spatial distribution of economic activities, uses of land, population and infrastructure determine the particular nonlinear interactions among biophysical and human drivers and underlie the processes, such as agricultural intensification, urbanization, industrialization, etc., that judge the incidence and magnitude of LDD in a region. The urban–rural dynamics, in particular, greatly affects the long-term prospects of the phenomenon as it consolidates the complex, multi-scale influences and pressures on land resources. Lastly, biophysical and human macro-forces and events operating within a period, e.g., wars, famines, natural disasters, new technologies, price shocks and resource crises have important off-site effects on the incidence of LDD [25].

In contrast to other natural hazards, the biophysical, socio-economic and other impacts of desertification may range from localized and short-term to large-scale and long-term, owing to the diverse biophysical and human drivers that act and interact non-linearly at different speeds (fast and slow processes) on multiple spatial and temporal scales. This is the most important source of uncertainty concerning LDD with important implications for its definition, identification, assessment and choice of proper measures to combat it.

2.2. The Institutional Context to Combat Desertification

The institutional activity pertinent to LDD and drought spans the global to local spectrum. At the international level, the UNCCD is the principal direct institutional regime that provides the broad frame of actions to combat desertification. It comprises five Annexes that correspond to five groupings of world regions and related region-specific desertification problems. Annex IV (Northern Mediterranean) includes 16 signatories, of which 10 are EU member states. The organizational apparatus of the UNCCD comprises the Conference of the Parties (COP), a permanent secretariat and a Committee on Science and Technology (CST). Their mandate includes support for the elaboration,

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[7] Land is considered desertified when biomass productivity drops below a certain threshold value.

implementation and co-ordination of various instruments; co-ordination of the UNCCD with its sister conventions, the United Nations Convention for Biodiversity Conservation (UNCBD) and the 40United Nations Framework Convention on Climate Change (UNFCCC); research and development, technology transfer, acquisition and adaptation; capacity building, education, awareness raising and provision of financial resources and mechanisms to facilitate implementation[8]. The UNCCD Secretariat provides regular monitoring and reporting on the implementation of proposed actions [33,37].

The UNCCD, acknowledging the complexity of desertification and recognizing the vital role of local level responses in sustainable resource management, offers guiding principles for an integrated 'top-down' and 'bottom-up' approach to designing interventions in affected areas and encourages multi-level communication and collaboration [33]. It prescribes general and specific obligations of the signatory parties, underlining the institutional conditions required to facilitate effective implementation. The most important obligation is the preparation of Regional Action Programmes (RAPs) and National Action Programmes (NAP), following a UNCCD-defined template [1]. These programmes should be linked to national sustainable development programmes based on participatory processes with input from the field and the scientific community. The affected countries are urged to strengthen extant and enact new, including spatial and land-use planning, legislation.

Given the implementation problems recorded over time, COP8 [41] approved a 10-year strategy to improve UNCCD implementation and secure adequate financing that prioritizes the integration of desertification concerns into development planning and policies. The most important development since that time is perhaps the agreement of the parties to endorse Target 15.3 of SDG 15 that states "By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world" [3][9]. Land Degradation Neutrality (LDN) was defined as "A state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems" [27], (p. 33).

LDN is considered a hybrid lay-scientific concept that "aims to maintain and increase the amount of healthy and productive land resources, *in line with national development priorities*" (emphasis added) [42], (p. 2). As such, it represents "a flexible target that can be implemented at local, regional or national scales. *It recognizes the sovereignty of nations to manage the trade-offs* and to capitalize on the synergies between biological and economic productivity (emphasis added) [42], (p. 2). It has been hailed as "a paradigm shift in land management policies and practices . . . a unique approach that counterbalances the expected loss of productive land with the recovery of degraded areas. *It squarely places the measures to conserve, sustainably manage and restore land in the context of land use planning*" (emphasis added) [43]. Practically, it could be achieved by: "(a) managing land more sustainably, which would reduce the rate of degradation; and (b) increasing the rate of restoration of degraded land, so that the two trends converge to give a zero net rate of land degradation" [44], (p. 12).

It is widely recognized that the implementation of this ambitious target requires multi-stakeholder engagement, cross-scale and intersectoral planning and strong national-scale coordination that should serve to manage and streamline diverse local, regional and sectoral governance structures[10]. If successful, LDN might reinforce the implementation of the convention and contribute to the achievement of other goals such as climate change mitigation and adaptation, biodiversity conservation, ecosystem restoration, food and water security, disaster risk reduction, and poverty eradication. In other words, it may serve as a vehicle to affect the coordination and integration of the three

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[8] Lacking autonomous financing, the UNCCD, under the guidance of the COP, employs the Global Mechanism as a brokering body to facilitate the effective and efficient channeling of financial resources and mechanisms to affected countries. COP6 designated the Global Environment Facility as a UNCCD financial mechanism. Developing synergies with the Conventions on Biological Diversity (CBD) and Climate Change (UNFCCC) is expected to improve its financing prospects [41].

[9] Available online: https://www.unccd.int/actions/ldn-target-setting-programme; (accessed on 28 September 2018).

[10] See, [45] for a discussion of open challenges.

conventions (UNCCD, UNCBD and UNFCCCC) that variously materialize, in one way or another, in the process of using land.

The European Union has supported the fight against desertification through research funding (Framework Programmes since 1989), specific projects (e.g., INTERREG, LIFE), research at the Joint Research Centre (Ispra, Italy), technical and information support provided by the European Environment Agency, and specific measures included in the CAP (agri-environmental measures) and the Structural Funds [20]. The Thematic Strategy for Soil Protection [46] remains the only direct institutional response to the issue as efforts to institute an EU Soil Framework directive have failed, the main reason being that planning the uses of land is considered a matter of national sovereignty and not of EU competence[11]. Indirectly, provisions included in horizontal and sectoral policies, such as the EIA, SEA, Habitats and Water Framework directives, provide instruments to address LDD at national and subnational levels.

At the national level, direct desertification policies do not exist besides the NAPs. The co-ordination of their implementation has been assigned to ministries of agriculture or the environment. Most NAPs emphasize measures targeting the proximate causes, such as agriculture, forestry and animal husbandry, and not the driving forces of LDD [20]. Spatial planning activities are supposed to observe the provisions of the NAPs in affected areas. How close this requirement is being followed in practice remains an open question. Indirectly, several pieces of national horizontal environmental and sectoral legislation and policies[12] concerning soil protection, afforestation, fire protection, water resources conservation, nature conservation and other issues may contribute to mitigating the longer term occurrence of LDD. National development frameworks often prescribe the integration of pertinent measures in land use planning strategies [30].

Summarizing, LDD is a process during which extreme, irreversible states of land degradation may emerge at a higher level in the long run. Desertification constitutes an aggregate, macro-feature of the state of the land. It involves complex, non-linear, context-, scale- and path-dependent interactions between natural resources and human activities driven by numerous, multi-scalar, interacting biophysical and human driving forces, among which nature–society institutions (international environmental regimes, policies, customary land management regimes, etc.) play a pivotal role. Considerable controversy still surrounds its definition and causality [25,47,48], making it difficult to disentangle the biophysical from the anthropogenic causes, to accurately assess the land affected and/or at risk, and to predict its consequences and reversibility. Hence, it cannot be stated with certainty whether and when an area will be 'locked' in an irreversibly desertified state.

The complexity of LDD and the associated scientific uncertainty carry over to and combine with a similarly complex world of practice where numerous individual and collective actors as well as formal and informal institutions are implicated on and across multiple spatial and temporal scales in making land use decisions. Land-use planning, functioning within this milieu, is called to assist in coping with a contentious, wicked socio-ecological problem, LDD.

3. Land-Use Planning to Combat Land Degradation and Desertification: Uncovering the Complexities

3.1. Land-Use Change and Land-Use Planning

Land-use patterns and their evolution over time, i.e., land-use change, result from the constant interaction between demand and supply factors from the local to the global level, which are mediated and regulated by human decision making. The demand factors are distinguished into driving forces

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[11] After eight years of deliberations, the proposal for an EU Soil directive was withdrawn in April 2014 because five countries (UK, Germany, Austria, France, the Netherlands) blocked the process.

[12] In EU member states, in particular, the transposition of community regulations and directives to the national legislation has provided a considerable range of measures toward this purpose.

and proximate causes. The driving forces (indirect drivers) underlie the generation of demand for various economic activities and, consequently, the demand for land of particular characteristics. Higher level factors, such as population, affluence, technology, socio-economic organization, culture, international and subglobal institutions, political systems and their change, combine with lower level factors, such as demographic and socio-cultural traits, activity-specific costs, benefits and profits, value systems, formal and customary resource regimes and rights, and resource use practices, to shape the choice, extent and intensity of actual land use [45]. Certain driving forces, such as international agreements, subglobal and national policies, and resource-conserving practices, often act as mitigating forces that moderate the unwanted impacts of land-use change. Finally, the proximate causes (direct drivers) of land-use change include various human activities and their locational requirements, preferences and impacts [45].

The supply factors encompass the biophysical and anthropogenic resources of an area, also referred to as 'capitals'—natural, physical, landesque, technological, human, social, economic, institutional, political [49–51]. The biophysical resources include climate and weather, geology and geomorphology (topography), soils, water, vegetation, fauna and flora. The anthropogenic resources comprise past and present manmade structures (buildings, settlements, archaeological sites, etc.), social infrastructure (schools, hospitals, etc.), physical-technical infrastructure (transport, communication, energy and other networks), human and social capital, institutions, land tenure, land ownership, culture and value systems. The interplay of the features, spatial distribution and dynamics of these factors influences the suitability of land resources for particular activities, their sensitivity to various uses, their accessibility and their activity-specific economic and socio-cultural value that, eventually, determine the relative priority of land for various uses. Land-use conflicts commonly arise as several activities may have similar locational preferences but their co-existence is either impossible or results in unwanted environmental and socio-economic impacts. The actual land-use pattern is determined by past land use trajectories and historic contingencies that favor the domination of one or more uses of land over other competing uses in particular areas and contexts.

Land-use change, either autonomous or planned, takes two forms; *modification* of an existing land use type (e.g., change between crops, change in forest use) or *conversion* from one land use type to another (e.g., from agricultural to urban or industrial land). Land-use planning is the main instrument of planned land-use change. It is the purposeful, anticipatory activity of intervening in an existing, always fluid and dynamic, state of affairs with the aim to modify the land-use pattern in order to achieve certain goals and reduce uncertainty about the future impacts and consequences of human activities [19,52,53]. Given differences in the suitability of land resources for particular activities, the presence of natural constraints on activity location[13] and the competition among activities for the same resources, LUP broadly aims to (a) guide the choice of activities and land uses that can make the best (socio-economically efficient) use of land resources, i.e., cause the least environmental and socio-economic harm, avoid waste and generate the highest present and future environmental and socio-economic benefits, (b) resolve land-use conflicts, thus, alleviating current negative impacts and achieving positive environmental and socio-economic outcomes and (c) distribute equitably the costs and benefits of proposed interventions among the parties involved [3,52,54–57]. Essentially, LUP strives to match the demand for land resources by human activities with their supply to optimize general and place-specific goals and the overarching goal of sustainable local and regional development.

The numerous definitions encountered in the literature over time concur on the quintessence of LUP: (a) it is a process during which the actors involved set goals related to a problem (or, problems), develop alternative courses of action, choose available or devise new means to implement a chosen alternative to achieve the goals, evaluate the outcomes and make necessary modifications during

[13] e.g., geologic faults, seismic activity, unstable slopes, floodplains, habitats of endangered species, desertification-sensitive areas, erosion-prone areas, etc.

implementation; and (b) it is not a one-off operation that produces blueprints but a continuous, iterative, future-oriented decision-making process that comprises certain basic stages, serves certain key functions and is practiced following different styles [58,59].

The LUP process comprises certain basic stages: (a) problem definition and goal setting; (b) problem description and analysis; specification of planning objectives; (c) alternative plan formulation; (d) plan evaluation and choice of the preferred alternative; (e) plan implementation; (f) plan monitoring, evaluation and modification [52,54,60]. Figure 1 schematically presents this process and briefly describes the stages. These stages are not discrete and clearly delineated, they do not necessarily follow a linear succession in practice and they may overlap as some planning activities take place contemporaneously (e.g., problem definition and description, plan formulation and evaluation). Their boundaries are blurred, continuous feedbacks occur from one to another as demand and supply-related environmental and socio-economic conditions change, new actors get involved, new information is gathered, thus, continuously modifying the definition of the planning problem and the subsequent stages.

Land-use planning, like planning in general, is both a technical and a political process [61,62] that serves three functions: an *intelligence function* (data collection and analysis to build the information base concerning the demand and supply side of the planning problem), *advance plan-making* and *action/implementation* [52]. Depending on how LUP and the elements of the process are conceived, and on whether a proactive or a reactive decision making culture prevails, different planning styles (or, modes) are followed in practice. These include the classical (and by now mostly defunct) comprehensive or synoptic planning, incremental, transactive, advocacy, mixed scanning, contingency, adaptive and participatory planning [56,61,63,64]. The last three styles are particularly important in the case of natural hazards in general and LDD in particular.

In contemporary democratic, but increasingly complex societies, desirable features of LUP necessary to enhance its performance and effectiveness are strategic orientation, coordination and integration with development planning, wide participation (bottom up decision making), flexibility and adaptation [58,65,66]. These require well developed social and institutional capital and, above all, political will to devise and implement scientifically sound and socially acceptable solutions to socio-ecological problems that are characterized by considerable uncertainty [56]. In this context, the coordinating role of the advance plan-making function is critical in bridging the technical (intelligence) with the political (action/implementation) functions of LUP, thus, underlining the role of both science and politics in judging the outcomes of the process.

On the technical front, present-day LUP employs a variety of approaches, such as the landscape, the ecosystem and the multifunctional land-use approach [67–70], quantitative and qualitative analytical methods and techniques originating in the natural and the social sciences, such as land suitability analysis, environmental impact and risk analysis, needs assessment, survey research, environmental and social impact analysis, scenario analysis, integrated environmental-economic modeling, socio-ecological systems analysis [64,71–73], and planning support systems as well as traditional and contemporary data collection techniques (e.g., Earth observation systems, censuses, surveys).

On the political front, LUP combines a broad variety of technical/technological, physical, economic, financial, social, institutional and educational means and instruments, originating in environmental and socio-economic policy sectors and in various spatial/organizational levels, to produce and support the implementation of land use plans. Formal (institutionalized) and informal negotiation, mediation, bargaining and conflict resolution mechanisms and procedures are utilized toward this purpose [74,75].

The effectiveness of land-use planning depends critically on the availability of all types of resources (or, capitals) in the right combinations, in the right place and at the right time to successfully implement the land-use plan and meet the LUP goals and objectives. These requirements are rarely met in practice due to several reasons as discussed in the context of combating LDD below.

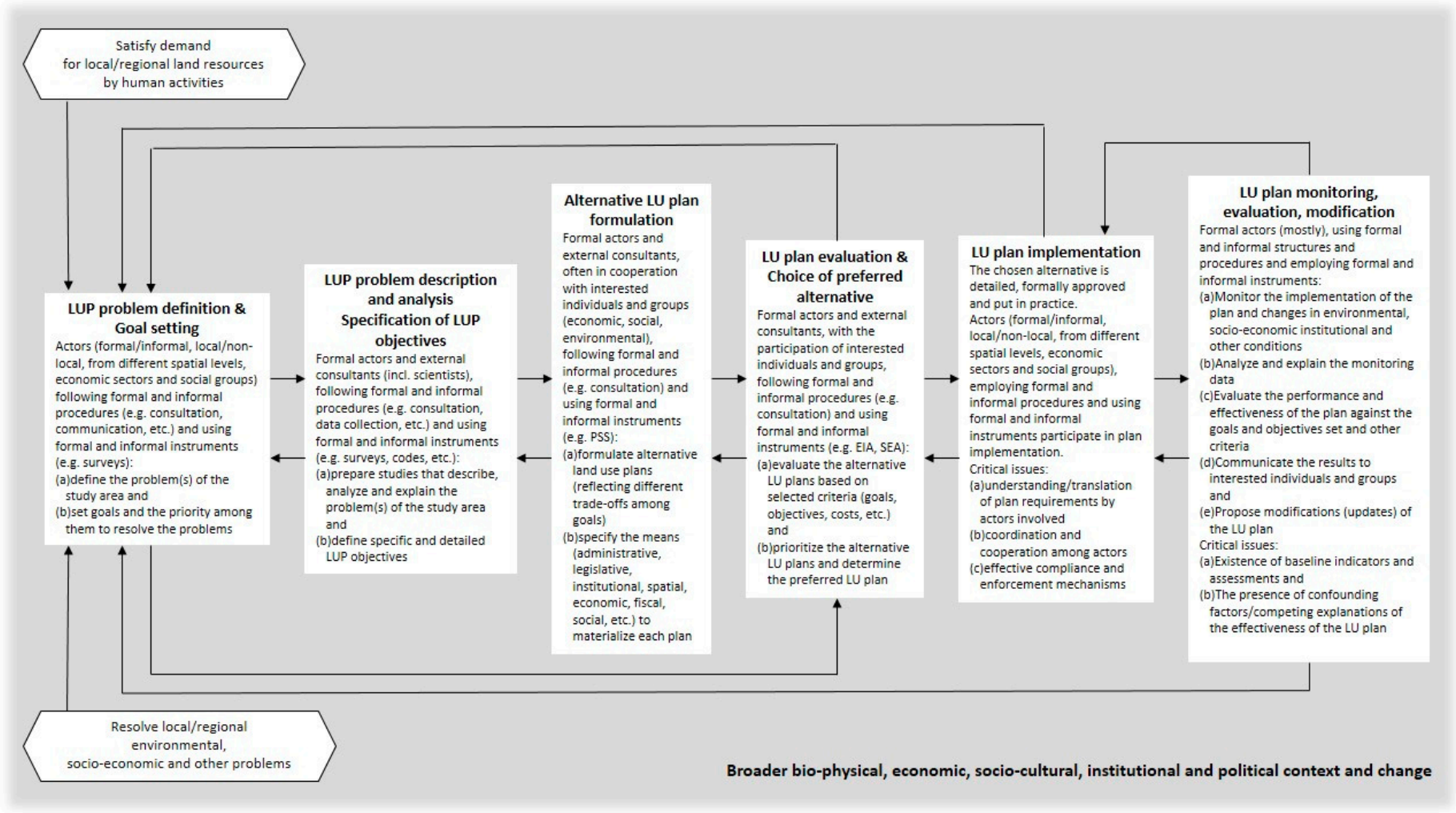

Figure 1. Schematic presentation of the land-use planning (LUP) process and description of the stages.

3.2. Land-Use Planning to Combat Land Degradation and Desertification

In affected areas, the general land-use planning problem is to determine those uses of land that will protect their land resources against LDD and will secure their socio-economic vitality (economic welfare, quality of life and social equity)—i.e., promote their sustainable development. The LDD-specific goal is to stop, reverse or moderate the degradation of land resources by properly selecting, siting and monitoring human activities. The land degradation neutrality (LDN) target gives more concrete, although not necessarily precise, direction: (a) reduce the rate of degradation by managing land more sustainably; and (b) increase the rate of restoration of degraded land, so that the two eventually produce zero net land degradation.

In order to assess the prospects of land-use planning successfully meeting the overarching goal of combating LDD and mitigating the impacts of drought at the local and the regional level, this section undertakes a reality check of the ideal LUP process; more specifically, it inquires whether and how LDD concerns enter, or may enter, the stages of the process. For each stage, the interplay of demand and supply factors is examined with regard to the actors involved, the organizational apparatus (decision structures and procedures) available and the instruments used. The use of stages is made for the purposes of analysis only because, as mentioned before, they intermingle and do not follow a given order in practice.

3.3. Problem Definition and Goal Setting

This stage concerns the question of *who* defines *what* problem and sets the LUP goals for the study area. It is the most critical stage of the LUP process and influences all subsequent stages. It takes place both formally and informally depending on the institutional status of planning and the administrative organization and culture that range from formal/centralized to informal/decentralized. A variety of mixed real world situations are encompassed in between. It is both demand- and supply-driven as the need for LUP in an area may arise from external or internal demand for its resources by economic activities and/or from the need to resolve environmental, socio-economic and other problems.

Various kinds of actors are implicated in LUP problem definition and goal setting. Some of them represent the demand and some other the supply side of the problem. Who and how can legitimately participate is determined by state laws and the associated procedures and instruments (e.g., consultation, committee membership).

Formal public actors (individuals and agencies) from various spatial/organizational levels represent spatial planning, regional and rural development, economic (agriculture, forestry, industry, extraction, tourism, energy production) and environmental sectors (water, soil, forests, nature protection, etc.). The latter potentially stand for LDD concerns. Planning consultants are also formally involved as states usually commission the preparation of LUP studies to specialized firms.

Other individual and collective actors may participate, as in decentralized systems following inclusionary, participatory processes, or they variously seek to influence formal actors and shift the LUP problem definition and the goals set to their advantage. These include economic interests placing demands on land [59], related intermediaries (e.g., construction and real estate sectors), social and environmental groups (e.g., NGOs, civic groups, etc.). In recent times, actors are increasingly non-locals (e.g., multinational firms, the EU, the World Bank) as in the case of tourism and second home development, infrastructure projects, energy production, industrial agriculture and forestry, etc. LDD concerns may be represented depending on the mandate and interests of these actors. Scientists may participate formally or they indirectly influence problem definition by disseminating scientific evidence concerning the magnitude and severity of LDD (studies, maps, indicators, etc.) among other problems.

Informal actors always co-exist with formal actors, act autonomously and in parallel with them, placing demands on land resources, making and carrying out their 'plans' outside the official apparatus in affected areas. They often create *de facto* land uses (e.g., informal agriculture, housing) and produce environmental, LDD-related problems (e.g., deforestation, fires, overgrazing, water

overdrafting), that formal LUP is called to handle. Informal residential and tourism development in coastal LDD-sensitive areas in the Mediterranean and elsewhere and illegal deforestation in the Amazon are cases in point.

The effective legislation mandates the competences of and linkages among formal actors. The diverse linkages developing between formal and informal actors as well as among informal actors take two basic forms; coordination/cooperation or conflict. The perception and knowledge of the problems of the area, the vision regarding its future, the congruence of aspirations and the common interests among actors as well as the presence of externalities of the respective activities judge whether cooperation or conflict will result. In the case of conflicts, both formal and informal, customary conflict resolution procedures and prevailing power balances determine the outcome. Obviously, communication, common understanding and coordination among actors are necessary to produce a coherent LUP problem definition that encompasses LDD concerns. However, scientific uncertainty regarding LDD and its causes, together with lack of hard local and regional evidence, leaves ample room for multiple interpretations and adaptation to local circumstances.

The spatial, sectoral and administrative diversity and plurality of formal and informal actors, possessing differing mandates and knowledge of LDD, the compartmentalization of administrative structures even for the same resource (e.g., land, water, etc.) and turf politics [37] often result in vague and incoherent definitions that show up in goal setting. Formal LUP goal setting follows either in a top-down process, in the case of centralized systems and hierarchical modes of governance, or some form of participatory process in more decentralized systems. General national goals, often incorporating international obligations (e.g., climate change), include sustainable development, economic development, resource protection and conservation, as well as specific goals such as agricultural specialization, tourism development and energy production. Strategic goals concerning the protection of critical resources (water, soil, air, etc.), food and energy security, and others may be also specified. LDD-specific goals are included in the case of duly constituted NAPs. Agreement over general goals is usually easy to achieve especially if all actors share a common development vision for the area. Conflicts arise later when the more detailed planning objectives formulated reveal the critical trade-offs.

The priorities set among goals reveal the influence of dominant actors. The decisions regarding the uses of land are made on the basis of economic considerations mainly (demand side), often by nonlocal interests, and rarely on the basis of environmental considerations (supply side) except for symbolic purposes and extreme cases of environmental degradation, including LDD. Therefore, the protection of land resources is one of several socio-economic and environmental goals of LUP in affected areas, which depend on the specifics of each individual case but are, most likely, intricately related to LDD. The perception and knowledge of LDD which the formal and informal actors hold, that depend on scale, sector and social group, and the prevailing proactive or reactive decision culture critically determine the sense of urgency and the priority it is given compared to other problems. The possibilities range from total ignorance (theoretically possible but practically rather unlikely) to complete knowledge and concern for its impacts. At the local level, LDD is perceived as land degradation, not as desertification, and it is of direct concern to agricultural interests and environmental groups. LDD-related goals may be congruent and synergistic with certain goals, such as environmental protection, resource conservation and food security, or incompatible and antagonistic with some others, such as large-scale industrial, energy and tourism development. When goals conflict, the need for trade-offs among them and for specific LUP objectives that support consensus land use patterns arises.

LUP problem definition and goal-setting do not remain constant. They are often revised and modified especially when LUP processes are protracted. Economic, socio-cultural, environmental, administrative and political changes occurring at all levels modify environmental conditions (positively or negatively), introduce new actors, legislation and planning modes (e.g., participation), bring about changes in demand for land from new activities and different lifestyles, provide new knowledge and necessitate changes in priorities among goals. These changes create considerable uncertainty

and necessitate emphasis on strategic goals, continuous top down-bottom up communication and coordination and broad actor representation and participation as well as integration, flexibility and openness as early in the LUP process as possible. However desirable these features may be, which characterize decentralized systems and are absent from hierarchical planning systems, they underline the complexity and explain the difficulties to come up with clear, coherent and consistent LUP problem definitions and goals in affected areas that prioritize combating LDD.

3.3.1. Problem Description and Analysis; Specification of Planning Objectives

Following the LUP problem definition, this stage aims, on the one hand, to set up the indispensable basis of plan making, i.e., the comprehensive and reliable description of the biophysical and human structure, dynamics and problems of the area, including LDD, and, on the other, to specify the LUP objectives.

Formal actors and external consultants are the most important actors at this stage although the role of other actors interested in the resources of the area should not be downplayed. The effective legislation may prescribe the relationships among these actors, such as formal requirements for plan development and the instruments (consultations between formal actors, consultants and the public) that have to be used. However, the most important relationships are informal, occurring during problem description, analysis and formulation of LUP objectives. New actors enter the process, such as data and information providers, new users of land and new formal actors, different from those involved in problem definition, responsible for formulating the specific LUP objectives.

Consultants take the problem definition and goals set as given but may propose modifications based on the description and analysis of the information and data collected for the affected area as well as on pertinent scientific theories, including those related to LDD. In this way, they may proactively introduce new concerns, activities and actors as well as underline the uncertainty surrounding the causes and effects of LDD and other problems of the area, thus, paving the road for feedbacks and problem redefinition and goal reformulation.

From the viewpoint of properly describing and analyzing LDD, the most important issues concern (a) the theoretical framing of the evolution and problems of the area; (b) the availability of reliable assessment techniques; and (c) the availability of suitable data. Scientific theories developed at higher spatial levels, including those contained in the NAPs, cannot satisfactorily address the causality of land use change and LDD at the local and regional level because they ignore the numerous, tangible and intangible, place-specific and contextual factors and their changes. Study area-specific theoretical frameworks are necessary to guide the situated description and analysis of the affected area for the purposes of LUP especially with respect to combating LDD [25,27,48,76].

Numerous LDD assessment methodologies, indicators and indices have been developed in the last decades to describe the extent and severity of LDD as well as to support LDD abatement decisions at the global, national and local/regional level [77–89]. The Environmental Sensitivity Assessment (ESA) methodology [79], in particular, concerns the assessment of desertification risk on the basis of selected indicators of climate, soil, vegetation and land management at lower levels (landscape/watershed, regional, national). It is continuously being used widely up to the present [90–96] and it has been refined through the application of Remote Sensing and GIS techniques [97–100].

From the viewpoint of their utility for LUP purposes at the local/regional level, the assumptions and limitations of these assessment methodologies and indicators should be kept in mind. Most of them use variables (or, indicators) for which published, regularly collected data are readily available. Issues related to the data used arise as discussed below. The operationalization of several factors (e.g., policy, land management) is based on expert judgment (for obvious reasons). Their suitability and transferability to lower levels of analysis and particular resources (point and

nonpoint)[14], the assessment and mapping of LDD-related issues, such as the rate of degradation and the rate of restoration of degraded land, carrying capacity and many more remain open issues that should be treated judiciously [25,28,48,101].

The theoretical and methodological issues briefly discussed above raise important issues with respect to the suitability of existing data bases for the spatial scale and unit of analysis[15] and the time period for a LUP problem at hand. Existing data may concern units of analysis (e.g., mapping units, land units) that do not correspond to the actual decision making units in the study area [102] and may not be available for long time periods for all variables (environmental, economic, social, etc.) of interest. Aggregate land-use types (used in current data bases) may conceal more detailed uses of land at the level of the study area as human activities are multi-purpose and nonhomogeneous and more than one activities may occupy the same tract of land (the case of multifunctional landscapes) or co-exist vertically (the case of high-rise urban areas)[16]. Spatio-temporally consistent environmental, socio-economic and other data may be also lacking [102]. Lack of suitable data do not favor valid assessments and mapping of baseline values of pertinent LDD indicators (see, e.g., [38,87]), impact assessment of past interventions (e.g., policy measures) and of land-use change as well as projections of future demand (population, income, tourism, etc.) and supply of local resources (i.e., carrying capacity, potential, sensitivity and thresholds of critical biophysical and other factors). In sum, for LUP purposes the assessment methodologies and indicators should be used with caution as helpful but indicative and not the only guides to describe and assess, but not explain, the incidence and severity of LDD, to set LUP LDD-specific objectives, to operationalize the LDN target and to make land use decisions.

Numerous other factors complicate the description and analysis of affected areas such as the incidence of unexpected changes and the long time horizons that introduce uncertainty in predicting future land-use change, lack of appropriate environmental and socio-economic monitoring, and so on. Most importantly perhaps, lack of time, human and financial resources, data and expertise may preclude the use of suitable analytical techniques in area-specific analyses in LUP studies. These issues deem necessary detailed data collection and monitoring as well as analytical studies that are indispensable for formulating reliable study area-specific planning objectives in support of LUP to combat LDD, among other goals. Recent trends towards participatory data collection and analysis approaches [103,104] may partially ease the resolution of these issues.

3.3.2. Alternative Plan Formulation

Alternative land-use plans may be formulated to suggest different courses of action to match the present and future demand for land resources with the present and future supply of these resources to achieve the goals and the area-specific planning objectives set, a task critically hinging on problem description and analysis. In affected areas, the most critical question is which land use configuration can satisfy the goal of combatting LDD and the LDN target (or else, how the LDN target is integrated in LU plans) while meeting all other planning goals and objectives.

Plan formulation aiming at environmental protection and resource conservation should be proactive, guided, on the one hand, by strategic choices regarding critical land resources and, on the other, by the prevention, the precautionary and other principles [65,105]. The plans thus produced are more likely to safeguard the constant functioning of natural systems and the provision of ecosystem

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[14] Such as erosion models, agro-ecological zoning, statistical models, impact assessment and future projection models (climate, population, demand, supply, etc.).

[15] As [3], (p. 117) has noted: " ... proper analysis and meaningful resolution of environmental problems can take place only within natural spatial units, such as watersheds (Manning, 1988). However, practical considerations (data availability and ease of implementation mainly) dictate the use of administrative units most of the time, the result being fragmented, partial, and often ineffective solutions to these problems. Efforts to combine the two types of entities into geopolitical units, such as the 'environomic units' being developed in Canada (Gelinas, 1988), should be encouraged, as well as the formation of inter-jurisdictional bodies ... "

[16] The problem is more acute for small study areas that may suffer from severe LDD.

services that constitute the enabling condition of sustainable development [106]. In this context, an important consideration is the property status of land and other resources, such as water; i.e., whether they are private, state or common property [107,108] that significantly influences land-use allocation decisions[17] [109,110]. It is noted, however, that land resources, irrespective of property status, are common pool resources[18] that should be preserved for the benefit of all present and future users [111]. Given the fundamental role of soil and water resources in the LDD context and not only that, it follows that their protection should constitute a strategic LUP goal. While water resources enjoy a more or less satisfactory legislative protection and status in plan formulation, this not the case with soil resources. Land-use plans often prescribe uses of land that give rise to several soil threats—erosion, decline in organic matter, sealing, contamination, compaction, decline in biodiversity, salinization, landslides [46]—that increase the risk of LDD especially in sensitive affected areas.

Alternative plan formulation is usually carried out by planning consultants (including scientists) in cooperation and consultation with formal actors but also with diverse other interested actors, some of them entering at this stage of making critical land use allocation decisions. Guidance regarding how land-use plans should meet LDD-specific objectives such as improving the rate and extent of land restoration and reducing the rate and extent of land degradation is missing. The UNCCD sets broad goals and lacks operational guidelines and satisfactory indicators to measure progress at lower levels [32]. The NAPs usually focus on land uses related to the proximate causes of LDD—agriculture, animal husbandry, forests and, to a lesser extent, on tourism, extraction, transport, energy (e.g., renewable energy sources) and large infrastructure works (transport and energy networks, airports, etc.). They propose general activity-specific measures to minimize LDD because pertinent policy measures and instruments, such as environmental regulations, sustainable land management (SLM) practices, subsidies, etc., may be already in place and usually agree with dominant sectoral preferences. This is the case of the EU CAP agri-environmental and cross-compliance measures [33].

The focus on known proximate causes of LDD agrees with the common LUP practice where the uses of land in an area are determined by the present or future demand for land by economic activities. Activity-specific obligations are formally specified in order to avoid resource degradation and other predictable externalities. This practice of coupling demand with supply overlooks two important issues. First, the status of land resources is affected by numerous and diverse indirect drivers that modify, in one way or another, the demand for and thus, the pressures on land resources. These include outmigration, land abandonment, socio-economic restructuring, changes in urban-rural dynamics, changes in life styles (e.g., trends towards eco-living, eco-tourism, etc.), land and other taxation, and so on. This implies that, second, changes in these drivers may preclude the realization of chosen land-use combinations or, if realized, drastically modify their anticipated impacts, leading to either deterioration or effective protection of land resources. Therefore, LUP instruments, such as zoning (of hazard-prone and sensitive landscape areas), natural and cultural reserves, multifunctional land use schemes, should be coupled with economic, fiscal and other instruments, e.g., land and general taxation, incentive schemes, voluntary measures, to attain the LDN and related objectives [68,110].

This broadened perspective necessarily leads to the quest for integrated land-use planning that has been voiced since the early discussions of the issue [43,48] and more recently in discussing the materialization of the LDN goal [27,38]. The need for integrated and situated land-use plan formulation becomes evident at this stage of plan formulation as the effectiveness of any land-use plan depends on the spatial coordination of several activities, policy instruments, etc. at the level of the study area and across levels to promote individual and collective goals.

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[17] Private interests exert pressures on the LUP process and significantly affect the choices made.

[18] Common Pool Resources (CPRs) are characterized by (a) non-excludability—they are indivisible and, thus, nobody can be ethically or practically be excluded from using them and (b) subtractability—they are finite and, thus use by one user reduces the amount of resource available to others [107,108].

The alternative land-use plans reflect, to different degrees, the trade-offs among different goals and objectives and, consequently, among the associated economic activities. This is a highly-charged political stage that, combined with uncertainty and land inertia, renders integrated land-use planning a challenging endeavor. Participatory decision making and planning is proposed, and occasionally practiced, in an effort to strike balances and arrive at land-use plans with higher chances of implementation [18,19,27,56,112]. Cross-compliance measures, that require the satisfaction of environmental goals as a condition for financial assistance, are practical, although partial, integrative instruments that may be used to integrate LDD concerns into LUP.

3.3.3. Plan Evaluation and Choice of Preferred Alternative

This stage, theoretically at least, concerns the evaluation of the alternative land-use plans on the basis of criteria flowing from the goals and objectives set in order to arrive at the preferred alternative that will be implemented. The priorities among criteria, which usually favor economic over environmental considerations, determine the final evaluation outcome. In practice, two alternatives are commonly considered: the existing land use pattern and a preferred land use pattern that meets the approval of interested actors. In this case, the evaluation essentially dissolves into a formal approval process of the preferred (and only) plan. Notice, however, that several alternatives may have been considered before the preferred one was chosen.

The actors involved in this stage are more or less the same with those participating at the previous stage. Formal evaluation instruments, such as the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA), are commonly used, offering the opportunity to laypersons and other individuals who have not participated in the previous stages to express their opinion regarding the proposed plan or plans (in the rare case that there are more than one) through public consultation. These procedures, although they are proactive in nature, face several theoretical, methodological (analytical) and practical (data) challenges and their results are fraught with uncertainty [113]. Consequently, their potential to resolve essential questions regarding differences among alternative land use plans, in terms of goal achievement and distributive impacts, is limited. One issue of particular relevance in the LUP context is the requirement built into the EIA and SEA to evaluate alternatives for the same problem. Studies have shown that this requirement is rarely met [114]; alternatives are eliminated using qualitative reasoning mostly in support of the preferred alternative.

LDD concerns do or may enter this stage if LDD-related (or LDN-related) criteria are included in these formal procedures; they are often raised in the context of public consultations if they have not been integrated in the proposed plan(s). Their meaningful and effective application at the local and the regional levels is conditioned by the availability of data and baseline environmental and economic[19] assessments and the suitability of assessment techniques mentioned before.

3.3.4. Plan Implementation

Plan implementation remains the most critical stage of the LUP process because it constitutes the real test of whether the chosen land-use plan can materialize under actual, dynamic and fluid conditions. When land-use plans are put to practice a host of issues inevitably surface. These include omissions during previous stages (actors, local characteristics, LDD assessments, etc.), past planning and other legacies, pressures from interest groups, perception and understanding of the planning problems and prescriptions by the actors involved, conflicts between proposed/new and customary practices, endogenous and plan-induced change (externalities) and unexpected events and contingencies (natural and technological

[19] Economic assessments, and the respective methodologies, of the costs of LDD and the costs of various abatement options do exist but they are still not widely used in local and regional LUP practice [115–117]; (see, also, the ELD site at: http://www.eld-initiative.org/).

disasters, political and socio-economic events) in the study area and the rest of the world [118,119]. The end result is that the implemented land-use plan deviates from the chosen, legislated plan, implying that its actual environmental and socio-economic impacts will also differ from those originally assessed.

Plan implementation implicates a wide variety of formal and informal actors from various sectors, jurisdictions and spatial/organizational levels who variously contribute to the materialization of the proposed uses of land. Examples are formal local and regional administrators of various ranks, the courts, land owners/renters, farmers and their associations, real estate and building groups, banks, professionals (individuals and groups), the media, local and supralocal environmental and civic groups, residents, and so on [66]. This variety of actors engenders differences in decision culture (reactive vs. proactive), knowledge and perception of planning problems (including LDD), multiple local understandings and interpretations of planning goals, objectives and requirements of the land-use plan, different priorities among goals and interests, competences, reactions to change and local pressures, and power imbalances when conflicts arise. During implementation, the LUP problem is essentially redefined several times; issues that were not originally considered are included (e.g., safety and soil protection issues following severe floods, landslides or earthquakes). LDD may, thus, obtain significance if interest groups raise concerns during implementation that may lead to suspension or change if the approved land-use plan has potentially negative effects on soil and water resources.

The implementation of land-use plans requires cooperation and coordination among actors from various policy domains, such as agricultural, development, spatial, economic, social and environmental, the existence of formal procedures which guide their interactions as well as informal procedures based on mutual trust; i.e., on social capital. In the case of LDD, a strong commitment to the cause of combating LDD is indispensable for proper implementation of resource (soil, water, biodiversity) conservation requirements and pertinent plan provisions.

The most critical issue in plan implementation is compliance with the plan's requirements and the existence, application and effectiveness of formal and informal enforcement mechanisms (fines, penalties, etc.). Because of the inherent uncertainty of plans and the changes occurring during plan implementation, conflicts will always arise that necessitate the presence of effective conflict-resolution mechanisms. Compliance, enforcement and related mechanisms depend on local culture, tradition, familiarity with planning and on the broader mode of governance. Participatory land-use planning approaches aim at securing compliance by involving all actors early in the process. These are increasingly applied in coping with environmental problems, such as LDD, as a way to avoid non-implementation or significant deviations that will ultimately nullify the original plan. Their success is not guaranteed, however, because on the one hand socio-cultural, institutional and several practical factors condition participation and, on the other, power balances modify the outcomes that may not always favor combating LDD (e.g., development of water-intensive activities in water-deficient and degraded areas).

The less-than-satisfactory implementation record of several land-use plans reveals that the above requirements are difficult to meet in practice, the end result being implementation delays and uncertain outcomes. LDD may worsen, under unfavorable biophysical conditions and strong development pressures or, it may be reversed when pressures are reduced for other reasons (e.g., lack of development interest in the area, local resistance to development plans, etc.).

3.3.5. Plan Monitoring, Evaluation, Modification

Monitoring the implementation of land use plans aims at identifying and evaluating the issues arising and taking corrective action. Monitoring may be prescribed in the legislation and employed using suitable monitoring mechanisms (e.g., water metering, indicators, etc.) or it takes place voluntarily (see, e.g., [84]) or spontaneously when problems arise and necessitate resolution.

Monitoring is not a singular but a multiple operation involving old and new actors who, most likely, may not have complete knowledge of the land use plan and operate within narrow sectoral domains with specific mandates. Assuming that the required apparatus is in place, feeding

back monitoring results (e.g., population change, land use change, soil conditions, water consumption, production levels, etc.) to formal and other actors requires proper transmission channels for the variety of actors and settings involved. Even with proper feedback, the monitoring results represent new information that is variously processed, translated and evaluated under conditions different from those prevailing when the initial land-use problem was posed and defined, planning goals were set, the land-use plan was formulated and implementation commenced [27].

Assessing and evaluating the monitoring results requires the existence of reliable local/regional level baseline indicators and assessment models, previous assessments, etc., a condition that is rarely met in practice. Evaluating the changes in the rate of LDD and of land restoration, in particular, is limited by the incomplete local/regional level assessments. Explaining the evaluation results, i.e., answering the question "what has caused the change", requires consideration of numerous endogenous and exogenous factors that may have contributed to change, in addition to the interventions associated with the land use plan. A single indicator is often difficult to describe and assess the latter because interventions are composite and complex actions. Attributing the changes in the rate of LDD and of land restoration to the land-use plan is, thus, a task that cannot yield dependable results to support plan modifications necessary to achieve the LDN and other LDD-related goals. Careful analysis of the monitoring results is needed accounting for the co-presence of several factors and concurrent changes that take place at all levels [27].

Land-use plan revisions may be prescribed in the legislation and they are usually undertaken every 10–15 years. They involve a comprehensive revision of the conditions of the study area since the official approval of the initial plan and propose required changes that reflect the changed conditions and the new demands for local and regional resources that arise with the passage of time. Whether plan revisions are prompted by or take into account LDD-related monitoring results, for shorter time intervals, is an open question that only thorough knowledge of the study area can answer.

4. Facing the Land-Use Planning Quandary

The reality check carried out in the preceding section suggests that the effectiveness of LUP as an instrument of land governance in combating LDD at the local and regional level depends on whether and how LDD concerns enter, or may enter, the stages of the LUP process. LDD problem complexity and severity, the state of scientific knowledge, market forces driving demand for land, the prevailing mode of governance (cf. [27]), the planning style followed, combined with local awareness, knowledge and perception of LDD, value systems and planning goal priorities, power balances, geographic particularities and historical circumstances are important catalyzing influences in this respect [33]. The complex nature of LDD implies that no single state agency can deal with it exclusively, as happens with simpler and less complex hazards[20]. Multiple, diverse, formal and informal, individual and collective actors are involved and numerous, disparate, formal and informal institutions from multiple organizational levels are implicated, interacting non-linearly on and across spatial and temporal scales [33,120]. All these forces generate a fluid and uncertain context within which LUP confronts important challenges. This concluding section first summarizes the main challenges and outlines necessary priority actions to realize the integrative potential of LUP and, thus, improve its effectiveness in combating LDD. Figure 2 schematically summarizes the rationale of the preceding analysis, the challenges identified and priority actions proposed.

[20] Even in this case, of, e.g., earthquakes, the responsibility for dealing with the issue may be divided among several competent state agencies.

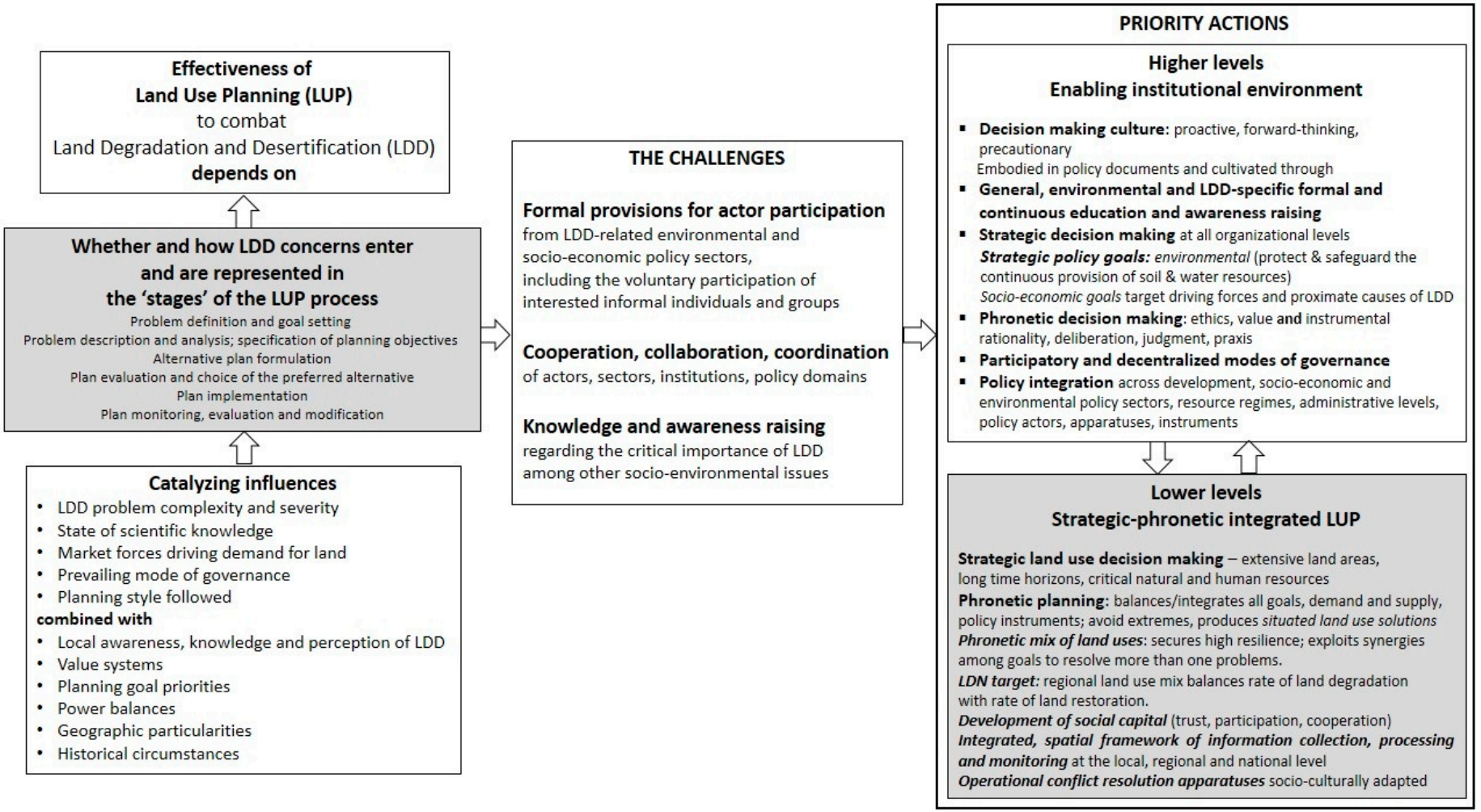

Figure 2. Enhancing the effectiveness of LUP to combat land degradation and desertification (LDD): challenges and priority actions.

The representation of LDD concerns at each stage of the LUP process depends on the existence of pertinent formal provisions for actor participation from LDD-related environmental and socio-economic policy sectors, including the voluntary participation of interested informal individuals and groups. Strong conflicts between LDD-related and socio-economic development goals are common, however, and create an adversarial context. The need thus arises for cooperation, collaboration and coordination of the numerous actors, sectors, institutions and policy domains involved to effectively resolve LUP conflicts and manage present and future environmental and socio-economic change. Hierarchical or mixed (hierarchical and market) governance systems, reactive planning styles (e.g., disjointed incrementalism), a myopic decision culture lacking a preparedness mentality, and the usual administrative and organizational compartmentalization, impede the satisfactory manipulation of these challenges as several real-world situations attest [30]. The attention and priority given to LDD in the LUP context depends on knowledge and awareness of its importance among other issues especially when strong development pressures and pro-development value systems dominate. Greater attention and concern is encountered in areas experiencing extreme LDD and lacking immediate development options and pressures. Moreover, climate change seems to have reinforced interest in effective sustainable land management to safeguard precious soil and water resources.

In order to improve the chances of LUP effectively coping with these challenges, certain priority actions are necessary at both higher and lower levels (cf. [27,118]). At higher levels, an enabling institutional environment should be provided[21] to support lower level actions. Featuring high among its crucial features is a proactive, forward-thinking and precautionary decision culture embodied in pertinent policy documents and cultivated through suitable general, environmental and LDD-specific formal and continuous education and awareness raising. Instituting strategic decision making, which is inherently long-term, should concern all spatial/organizational levels and be supported by suitable instruments. Strategic policy goals should encompass environmental, namely, protecting and safeguarding the continuous provision of soil and water resources, in addition to socio-economic goals. Socio-economic goals should target the driving forces of LDD[22] and not only the proximate causes as is current practice.

Phronesis (or, practical wisdom)[23], the most important of the principal virtues according to Aristotle, should be the guiding principle cutting across LUP decision making. The phronetic approach, first introduced by Flyvbjerg [122], underlines the situatedness of knowledge, decisions and action and emphasizes ethics, value rationality to balance instrumental rationality, deliberation, interpretation, judgment, participation, power relations and praxis. The possession and application of *phronesis* ensures the ethical employment of science (*episteme*), i.e., of universal rules, and technology (*techne*) in choosing the means in concrete, specific cases and adapting action to context [123].

Where hierarchical modes of governance and centralized planning traditions dominate, a gradual shift towards more participatory modes of governance and decentralized planning might be encouraged (and institutionalized) to benefit from greater participation of interested parties and flexibility in making decisions. However, care should be taken to ensure that participation is working for the common good and in the long run, it is based on a common understanding of LDD, and effective communication among the parties is involved as well as on cooperation around mutually agreed and shared goals and objectives. Lastly, the integrative potential of LUP can be realized only in the context of policy integration at higher spatial/organizational levels. This translates into the need for integration across development, socio-economic and environmental policy sectors, resource regimes, administrative levels, policy actors, apparatuses and instruments [39].

This enabling institutional environment is indispensable for framing and supporting the application of the widely commended and cited integrated LUP and lends it particular features

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[21] As [1] has underlined already.
[22] That may be common to other socio-ecological problems.
[23] "(knowing) how to exercise judgment in particular cases" (MacIntyre, 1985: 154 cited in [121], (p. 381)).

that are necessary to achieve the integration of LDD concerns within the LUP process and address the LDN target. First, integrated LUP should develop around strategic land-use decision making, which concerns extensive land areas, long time horizons and critical natural and human resources (cf. [123]), and, thus, it is particularly relevant to LDD and to policy integration.

Second, integrated LUP should adopt the phronetic approach that is suitable when dealing with highly contentious, uncertain and 'wicked' LUP problems [31] that demand flexibility and adaptation to changing conditions, thus, requiring preparedness to cope with the impacts of LDD, LUP interventions and unanticipated events. The phronetic choice of land uses avoids prioritizing certain (usually narrow) goals only, often associated with monocultures and bound to cause serious adverse impacts; instead, it favors those that balance all goals, do not compromise the strategic ones, and support a mix of uses that secures high local and regional resilience. To achieve the LDN target specifically, the regional mix of land uses should balance the rate of land degradation with the rate of land restoration. Moreover, because the direct and indirect LDD drivers usually underlie other socio-ecological problems, phronetic land-use solutions may exploit synergies among the respective goals (e.g., food security, biodiversity conservation) to resolve more than one problems, including combating other natural hazards.

Third, integrated LUP should foster participation, communication and cooperation, i.e., the development of social capital [27], as the most important precondition for generating situated, ecologically sound and socially responsive integrated land-use solutions with high implementation potential. This echoes with certain NAPs[24] that prescribe detailed analyses of affected areas and case-by-case decision making.

Strategic-phronetic integrated LUP, as it might be called, targets both the demand (driving forces and proximate causes) and the supply side (resource conservation and protection) of LDD. It echoes the adaptive co-management approach [125] and combines a variety of policy instruments to support the development and implementation of situated land use solutions. These include SLM, spatial management instruments (impact zoning, transfer or purchase of development rights, land reserves, land banking, etc.), and fiscal and economic instruments, such as subsidies, tax breaks and resource use fees. Its effective implementation hinges on the existence of an integrated, spatial framework of information collection, processing and monitoring[25] at the local and regional levels [31] and of operational, socio-culturally adapted conflict resolution apparatuses. Lastly, it is essential that issues arising during implementation should be fed back to higher level institutions to introduce necessary changes in the enabling institutional environment and the decision-making apparatuses and instruments to facilitate adaptation to changing conditions and needs that local level action has revealed. Future research is required to explore the theoretical, methodological and empirical issues that should be addressed in order to provide operational guidance for its implementation to combat LDD in the context of other local and regional socio-ecological matters.

Funding: This research received no external funding.

Conflicts of Interest: The author declare no conflict of interest.

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