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Linking Land Policy with Climate Change: A Multi-dimensional Landscape Approach to Territorial Development with a Focus on the Europe and Central Asia (ECA) Region

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Abstract

Globally there is a need to revisit land policy and governance to incorporate concerns about climate change and natural disasters. This is particularly critical for countries where land policy and governance linkages with climate change adaptation (CCA), climate change mitigation (CCM) and disaster risk management (DRM) have not been explicitly incorporated by governments and/or donors into national, sectoral, and regional strategies, policies, research, or programs and projects. The objective of this paper is to address linkages between land policy and governance and CCA/CCM, and DRM.

To address these linkages, an innovative conceptual approach is proposed. This conceptual approach is a multi-dimensional landscape approach that incorporates natural resource governance (NRG) and natural resource tenure (NRT) into territorial planning and development. Landscape approaches explicitly consider the interactions between humans and nature over space, and try to reconcile the competing uses of land and natural resources to achieve social objectives. The proposed approach draws upon evolving practices in sustainable land management (SLM) and land governance, landscape approaches to territorial development, along with advances in information and communication technology (ICT), geographic positioning systems (GPS), geographic information systems (GIS), and spatial data infrastructures (SDI). The approach is consistent with advances in spatially enabled governance, and points to the need for "no-regrets" actions such as improved demarcation of land parcel boundaries using available low-cost mapping technologies, and the use of ICT/GPS/GIS/SDI to improve monitoring and evaluation (M&E), and local planning and development. This paper provides some references to the Europe and Central Asia (ECA) region, but the approach can be applied to regions and countries across the world.

Keywords: land policy, land governance, climate change, landscape approach, sustainable land management, natural resource governance, natural resource tenure, climate change adaptation, climate change mitigation, disaster risk management, spatially enabled governance.

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Abbreviations

CAPRA	Central America Probabalistic Risk Assessment
CCA	Climate Change Adaptation
CCM	Climate Change Mitigation
DRM	Disaster Risk Management
ECA	Europe and Central Asia Region
EWS	Early Warning Systems
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FIG	International Federation of Surveyors
GDP	Gross Domestic Product
GIZ	German Society for International Cooperation
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Reconstruction
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GLTN	Global Land Tool Network
GPS	Global Positioning Systems
ICT	Information and Communications Technology
IFAD	International Fund for Agricultural Development
IDA	International Development Association
IPCC	Intergovernmental Panel on Climate Change
LGAF	Land Governance Assessment Framework
M&E	Monitoring and Evaluation
NRG	Natural Resource Governance
NRT	Natural Resource Tenure
NRM	Natural Resource Management
OECD	Organization for Economic Co-operation and Development
PES	Payment for Ecosystem Services
REDD	Reducing Emissions from Deforestation and Degradation
SDI	Spatial Data Infrastructure
SIDA	Swedish International Development Agency
SLM	Sustainable Land Management
SP	Social Protection
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction: Climate Change Calls for New Conceptual Approaches to Land Policy

Globally there is evidence of increasing climate change and the increased frequency, severity, and geographic spread of extreme weather events and natural disasters (UNISDR, 2011; IPCC, 2012). This has led to increased academic and professional attention to the interface between land policy and climate change adaptation (CCA), climate change mitigation (CCM), and disaster disk management (DRM).[1] This interface has focused primarily on agriculture/food systems, natural resource management (NRM), and rural development contexts. Increasingly there has been attention to interfaces with the urban and peri-urban areas. In spite of increased attention to these interfaces, governments and donors have yet to make significant efforts to explicitly incorporate land policy and governance linkages with CCA, CCM, and DRM into national, sectoral, and local development strategies, policies, programs and projects. To help close this gap, there is a need to revisit approaches to land policy and governance that incorporate concerns about climate change and natural disasters. The objective of this paper is to address the linkages between land policy and governance with CCA, CCM, and DRM, and to propose an integrating holistic framework that improves human resilience to multiple hazards/risks[2] in specific landscapes and territories.

The basic innovation in the conceptual approach we propose is to adopt a multi-dimensional landscape approach that incorporates NRM governance and tenure concerns within the design of land use policy for any given territorial area (e.g., watershed or ecosystem-wide planning framework). We refer to this as a multi-dimensional landscape approach to territorial development. As noted in the World Bank Group Action Plan for Agriculture 2013-2015 (World Bank, 2013) and World Bank (2014) the World Bank Group is increasingly using landscape approaches that integrate the management of land, water, and biological resources, and that take account of human interactions with, and the valuation of, those resources in a way that promotes sustainable and equitable development.

There is no universal definition of "landscape approaches", but the term has gained prominence in the search for solutions to reconcile trade-offs between land (and natural resource) conservation and economic development. Attempting to reconcile agriculture, conservation, and other competing land uses for economic development, Sayer, et. al. (2013, p.2) define landscapes as a geographic/spatial area in which different actors, including humans, "interact according to rules (physical, biological, and social) that determine their relationships." Thus a "landscape is defined in broad conceptual terms rather than simply as a physical space." Landscape approaches highlight the interactions of human and ecological systems toward a specific set of social objectives (Sayer, et. al., 2013).[3] According to the World Bank (2014): agriculture, water, forests, food security, and sustainable development are all connected. It is clear that we need to work across sectors to find integrated solutions at the scale of entire landscapes. A "landscape approach" means taking both a geographical and socio-economic approach to managing the land, water and forest resources that are the basic components natural resource management toward goals of inclusive sustainable development. By taking into account the inter-actions between these core elements of natural capital and the ecosystem services they produce, rather than considering them in isolation from one another, we are better able to maximize productivity, improve livelihoods, and reduce negative environmental impacts. The idea behind a landscape approach is that it is necessary to take the particular geographical/spatial context into account. There is no universal recipe for applying a landscape approach. For example, a different mix of land

[1] See http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf for definitions of CCA, CCM, DRM.

[2] The terms hazards, risks and hazards/risks refer to exogenous events that an impact human well-being. Hazards/risks can be natural and/or related to social-economic-political factors. Vulnerability is related to the exposure to hazards/risks, while resilience and adaptive capacity are related to the ability of systems to reduce the exposure to risks and/or to reduce potential negative impacts of hazards/risks.

[3] Sayer, et. al. (2013) propose 10 principles for applying landscape approaches: continual learning and adaptive management, common concern entry point, multiple stakeholders, negotiated and transparent change logic, clarification of rights and responsibilities, participatory and use friendly monitoring, resilience, strengthened stakeholder capacity, multiple scale, and multi-functionality.

use planning will be required for upper and lower parts of a watershed, and different strategies should be adopted depending on rainfall, topography, land cover, and water availability.

The innovative conceptual approach in this paper addresses both the technological advances in land administration tools and land policy and governance and enhanced understanding of the urgent need to respond to climate change and natural disasters, present and projected. There is a growing body of work which points out the overlaps and synergies for integrated multi-sectoral approaches to dealing with climate change and natural disasters and land use planning in the context of territorial development, and the need to integrate institutional and technological aspects of CCA, CCM, and DRM with improved land policy and governance (Deininger and Enemark, 2010; Enemark, 2010; UNDP, 2010; Siegel, 2011; Arial, Lau and Runsten, 2011; Siegel, Gatsinzi, Kettlewell, 2011; UNISDR 2011; IPCC, 2012; Siegel, Childress, Barham, 2013). The main lesson of this work is that to respond ex-ante to climate change and natural disasters NRM, CCA, CCM and DRM need to be managed at both ecosystem/watershed levels in a territorial context, starting at the individual land parcel. Improved risk management largely comes from improved efficiency and sustainability of land use, improved information about risks, more complete valuation of land resources, and improved land management and governance (Siegel, Gatsinzi, Kettlewell, 2011; Siegel, Childress, Barham, 2013) We can therefore think of linkages between land policy and CCA and CCM as involving an expansion of the traditional toolkit of land policy measures, and a widening of the conceptual domain of land policy and governance to include NRM governance and tenure over landscapes in a territorial context.

There is considerable convergence in approaches and technologies needed for climate change and disaster modeling, early warning systems (EWS), and resilience to climate change and natural disasters (Murthy and Krishna, 2010; Siegel, 2011). This is especially true with advances in land administration practices that utilize modern information and communication technology (ICT), geographic positioning systems (GPS), geographic information systems (GIS) and spatial data infrastructures (SDI)[4] which can be used for ***spatially enabled governance***[5] and ***landscape-based territorial planning*** approaches that explicitly incorporate CCA, CCM and DRM (Castren and Pillai, 2011; Siegel, 2011). Landscape based territorial planning integrates concerns about land policy and governance, CCA, CCM and DRM in a multi-sectoral and spatially differentiated territorial approach that includes both rural and urban areas, and rural-urban fringes (Siegel, Childress, Barham, 2013; Kissinger, Brasser, Gross, 2013). The proposed updated conceptual approach draws upon evolving advances in sustainable land management (SLM)[6], and landscape approaches, land governance (including new voluntary guidelines for land governance)[7], along with advances in ICT, GPS, GIS, SDI, and the application of spatially enabled governance. This approach considers land resources as part of a dynamic natural-human system which needs to be understood holistically so that land governance and land tenure are viewed as part of the more general domain of natural resource governance (NRG) and natural resource tenure (NRT).

We refer to the proposed innovative conceptual approach as a *multi-dimensional landscape approach* to natural resource governance (NRG) and natural resource tenure (NRT)[8] in the context of territorial development. The proposed conceptual approach is not new per se, but it is innovative in bringing together several similar approaches that have not been explicitly linked into a holistic framework. For example, World Bank (2009) recommends taking a systematic approach to planning and management that is spatially oriented and multi-dimensional. This approach integrates models of natural systems (e.g., hydrological modeling) with models of human planned and managed systems that include M&E and valuation. In fact, site-specific

[4]See http://ijsdir.jrc.ec.europa.eu/index.php/ijsdir/article/viewFile/17/11for definitions of ICT, GPS, GIS, SDI.
[5]Spatially enabled government uses place as the means of organizing information and activities, and depends greatly on good ICT, GPS, GIS, and SDI (see Deininger and Enemark, 2010; Enemark, 2010).
[6]See World Bank (2006) for overview of SLM, and FAO (2011) and the TerrAfrica website http://www.thegef.org/gef/greenline/september-2011/terrafrica-partnership-sustainable-land-and-water-management-sub-saharan-co for applications of SLM.
[7]See http://www.fao.org/nr/tenure/land-tenure-journal/index.php/LTJ which is a special edition of the FAO Land Tenure Journal on voluntary guidelines (VG) for land governance and tenure.
[8]See Annex 1 for definitions of land governance and tenure and NRG and NRT.

M&E administered, analyzed and utilized for territorial planning and development is a crucial aspect of this innovative multi-dimensional landscape approach to territorial development. We propose that a *landscape-based territorial approach* based on watersheds or river basins or micro-basins – with appropriate considerations for administrative boundaries - should be used as a guide to land policy development. Systems approaches have great intuitive appeal, but are often sidelined by institutional realities. The World Bank (2009, p.43) report acknowledges the constraints to implement such integrated approaches because of sectoral silos and administrative (e.g., political) boundaries. The proposed new conceptual approach attempts to overcome those constraints by using concerns about climate change as an entry point and by drawing upon rapidly evolving geo-spatial and ICT technology, and place-based approaches to spatially enabled governance. An updated view of land valuation which incorporates climate risks and opportunities and a fuller set of trade-offs links this approach to both site-specific land economics and climate modeling and risk management over territories.

NRG and NRT are very site-specific and have highly differentiated effects over landscapes, and thereby influence exposure to hazards/risks related to climate change and natural disasters, and the ability to adapt over time, therefore affecting site values and requiring site-specific geo-spatial information and local governance processes. By approaching each landscape in terms of the multi-dimensional aspects of NRG and NRT, it should be possible to identify an appropriate set of land policy tools for addressing climate change and natural disasters in each landscape. In this way, appropriate programs and projects can be designed with appropriate (and to the extent possible, participatory) M&E systems that generate information that can be used in land-use and territorial planning. In practice, such programs and projects range from the regularization of land tenure arrangements, to zoning and land-use restrictions on building in flood-prone areas, to land consolidation schemes, to ecosystem service payments. In most landscapes it will involve a complex and diverse mix of land policies and governance structures which build on the existing systems of NRG and NRT.

The multi-dimensional landscape approach integrates information and policy measures from different communities of practice, including those dealing with land policy and governance, sustainable development, climate change, and disaster management into a unifying, place-based framework. These information sources, analytical processes and decision-making are tied together through geo-spatial information systems and participatory governance processes and hinge on updating valuation of land resources based on a full climate-relevant accounting. Although the proposed innovative conceptual approach is applicable to all countries, for illustrative reasons, this paper focuses attention on applications to the Europe and Central Asia (ECA) Region[9].

The proposed conceptual approach highlights the fact that many priority policies and actions can be characterized as "no-regrets"[10], and assumed to be economically justified in the short and medium term in addition to their economic benefit for future CCA and CCM. These "no-regrets" interventions for land policy and governance and for CCA, CCM and DRM are critical because they can help establish and mainstream the necessary conditions for policies and actions for NRG and NRT and territorial development that are environmentally sustainable, socially equitable, and economically efficient whether or not climate change takes place, and thereby justify immediate action without recourse to cost-benefit calculations based on the uncertain costs of future climate change.

To summarize, this innovative conceptual approach to land policy presents an approach for human settlements interested in adaptation to climate change to make system-level assessments of their land values, risks and opportunities across multiple dimensions, and then modify their land and natural resource tenure

[9]We refer to the ECA Region, as per the World Bank, see: http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/0,,contentMDK:21776903~menuPK:5026204~pagePK:146736~piPK:146830~theSitePK:258599,00.html

[10]'No regrets' means taking climate-related decisions or actions and/or investments that can be justified from economic, social, and environmental perspectives whether or not a specific climate threat materializes in the future, and this is achieved by building resilience to different hazards/risks (Heltberg, Siegel, Jorgensen, 2009; Siegel, 2011).

arrangements and governance frameworks and management tools in a manner to optimize values by minimizing risks and to maximizing opportunities for sustainable and equitable territorial development.

2. Climate Change and Land Policy: Linkages are Multi-Dimensional and Multi-Sectoral

Global climate change is driven by changes in temperatures and rainfall patterns, with widespread impacts on wind patterns, evapo-transpiration rates and water availability and water flows in multiple dimensions: *above and below ground* and *on land surfaces*, and *across land surfaces*, and *above/below land surfaces*. These will affect risks and land values in multiple and novel ways. The main land-related influences of climate change and natural disasters will be experienced by the changing availability of water resources, its effects on agricultural production and food security, and the changing requisites of NRM and maintenance of biodiversity (World Bank, 2006). The effects of climate change, through changes in soil moisture and temperature, evapo-transpiration, and rainfall, and possible increases in heat stress will be most strongly felt in agricultural, forestry and fisheries sectors. These changes will, in turn, lead to droughts and heat waves and forest fires, increased wind storms and stronger hurricanes and cyclones, increased floods and landslides, and other hydro-meteorological risks. In addition, there are other changes in precipitation patterns like snow and hail storms, and melting of glaciers, and changes in ocean, sea and lake levels. These manifestations of climate change will have impacts on and be impacted by changes in human, animal and plant disease and pest vectors, and additional direct and indirect impacts on humans, natural, and ecological systems.

The most critical linkage is between land and water. Linkages between traditional domains of land administration and water and other domains need to be strengthened to enable resilient development in places. OECD (2011, p.12) notes: "Notwithstanding a growing recognition of the importance of the relationship between land and water resources there are few, if any, formal links between land tenure regimes and water rights regimes. An understanding of the relationship between water rights regimes (and their inherent planning processes) and land use planning and permitting regimes is necessary to move toward *integrated land and water management*. In developing countries and economies in transition, their land and water legislation often is lacking and/or lacks appropriate implementation/enforcement. A lack of security regarding land and water use rights (and regulations) will inevitably impact negatively on the worth and security of land and water access and the livelihoods of those attempting productive engagement with land and water. Changing water access for agricultural areas, flood risks and trade-offs in water uses (e.g., between energy and agriculture, or between urban water supply and irrigation) will impact land values in new and uncertain ways.

Systems modeling and spatially-enabled information systems are key tools for managing territories in the face of climate and natural disaster risks. The traditional concept of the bundle of rights to land and land policy has been evolving as the multi-dimensionality of the values inherent in land has been historically expanded. The consideration of land-water-air and subsurface relationships as a complex package of values requires system-level tools and data. Climate change risks make the need to do this more acute, and raise the level of benefit from early actions. For example, for any given piece of land, there are interactions and often rules and *r*egulations on land use, with respect to vertical above-ground surface level land-water-air relationships from parcel to atmosphere and vice versa. Similarly, there are below-ground surface level water-air relationships that pass from parcel to sub-surface and vice versa. In addition, for each piece of land there are horizontal in-flows and out-flows of water and pollutants. When linking land policy with climate change and natural disasters, it is incumbent to explicitly consider the multi-dimensionality of land governance and tenure rights and duties and land-use decisions. In addition, there is a need to consider - as part of the ***vertical and horizontal landscapes*** - activities such as oil and gas extraction, and mining of different types of minerals; and considerations of rights and restrictions on emissions of GHGs and other pollutants into the atmosphere. Concepts of site value need to be expanded to consider the comprehensive value of ecosystem services (i.e., benefits) and costs from the site. There is also a need to internalize the benefits and costs in land values. Fortunately, the technical and technological tools for collecting and using

information about all of these domains have been evolving rapidly and now can be used much more comprehensively by society.

Increasing climate and natural disaster risks call for an approach to policy-making for land and natural resource management for territories which are able to account for CCA, CCM, and DRM policy and investment priorities in order to address the hazards/risks in real-time and in multi-dimensional landscape contexts in a manner that is transparent and can be monitored and valued. Externalities from climate change extreme weather events conditioning flood risk and water availability over landscapes will be intensified with varying effects over landscapes and territories Impacts over landscapes and territories may be felt hundreds or thousands of miles away from the source. Transboundary and global natural resource governance issues connect the globes places through trade, public goods like water and air quality, migration, energy and raw materials. Global food production and food security will depend on climate-smart land use and efficiency in the land-water nexus. Production shortfalls in some global regions will need to be offset by increases in other regions. The spatially uneven distribution of agro-ecological changes resulting from climate change – with and/or without CCA and CCM and overall resilience and innovation the way landscapes are conceptualized and managed in territories within the global commons. This innovation recognizes the need to protect individual and group property rights and access to land, water, and natural resources, while also strengthening governance institutions that mediate NRM decisions over landscapes and territories.

The well-being of people and places depends on these systems functioning well to improve well-being and face climate change and natural disaster risk. The opportunities and risks facing people are unequally distributed across global space and continue to change. The complex relationships between changing climate and vulnerability and impacts of climate change also affect other socio-economic trends, including: changing demographics and life expectancy (including the phenomena of an aging population in many countries, especially because of out-migration from rural areas), rural-urban migration, urbanization, increased global wealth and evolving trade and consumption patterns (especially the increasing demand for livestock products and feed grains), biofuels, etc. These dynamics lead to changing perceptions of land and natural resource values and what is considered "good land" and "good locations" for varying uses, and ultimately the comparative advantage of locations across the landscape. All of these shifts have major implications to human relationships and access to water and land, which are basic to sustaining natural and social systems. Institutions for NRG and NRT including property rights need to be prepared to address these dynamics and uncertainties.

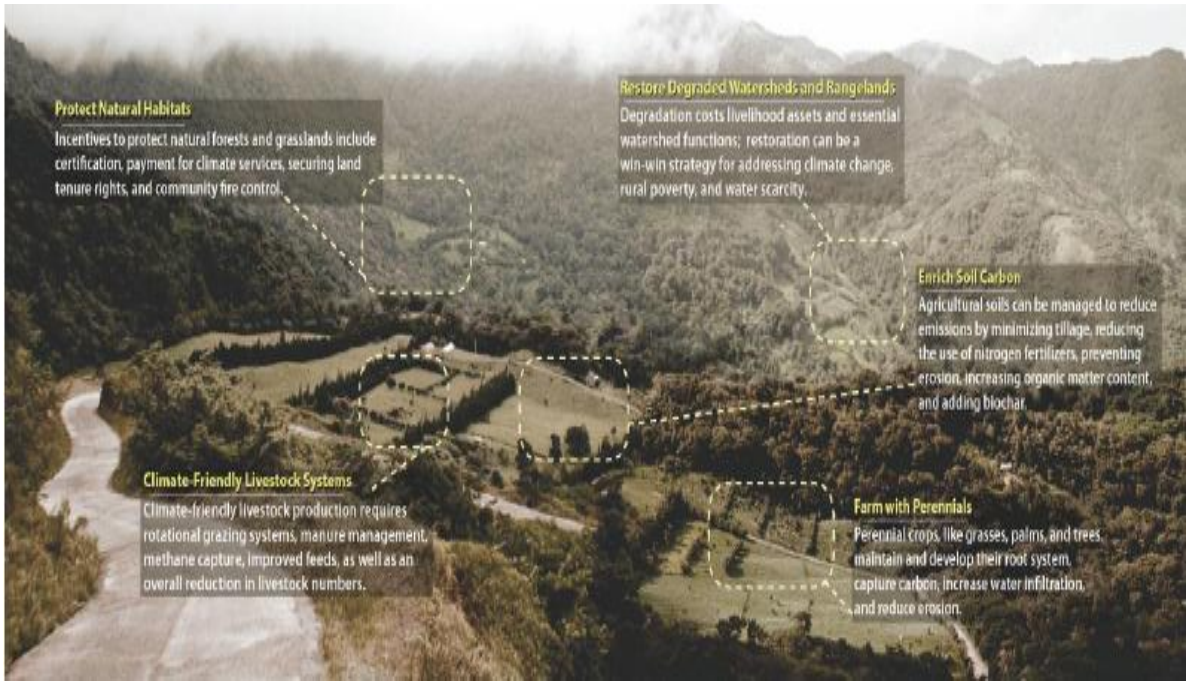
3. From Land to Landscape Approaches.

Landscape approaches emphasize the site-specific interface of human, natural, and ecosytems over space. Landscape approaches address site-specific strategic planning with an expanded and integrated view of land and NRM governance represents an organizing framework to address the complexity of multi-dimensionality. A multi-dimensional landscape approach that views land and water management, along with agriculture and forestry and urban human settlement as a systems that requires an integrated NRM approach within each specific landscape and territory with its unique regimes of NRG and NRT. This framework encompasses a wide range of stakeholders involved in formulating and enforcing NRG and NRT that incorporates CCA, CCM, and DRM.

Moving traditional domains of land administration from two-dimensional concept of land to a multi-dimensional view of landscapes and territories that incorporates CCA, CCM and DRM creates opportunities for multi-sectoral strategies that can increase resilience to climate and natural disaster risks. Moving from sector - oriented planning to location/territory specific strategizing and planning using landscape-based territorial development approaches presents opportunities for social inclusion, transparency and innovation. This requires good governance and equitable land tenure arrangements.

Landscape approaches focus on the relationships in the human-natural ecosystems of particular places and thus expand the traditional domain of land policy to incorporate the full range of land uses and land-use trade-offs. Using landscape approaches allows planners to address natural systems, including linkages between land and water use, and biological systems within the confines of human-generated political or administrative boundaries. Well-being, "territorial health" and good governance are objectives in landscape approaches to territorial development. Shames, et. al., (2011) have highlighted how landscape-based approaches can be utilized to address the interface between climate change and land use policies. They demonstrate how resilient rural communities draw on a full range of land-based resources to maintain long term sustainability. Food security and sustainable rural livelihoods based on either agriculture or forests have to adapt in ways which conserve ecosystems services while providing livelihoods. Generating the full set of values for resources and allocating them in a way which equitably resolves conflicts among a wide range of stakeholders and is an important characteristic for resilience-enhancing CCA, CCM and DRM activities, which will increasingly need to consider ways in which agricultural production and food security needs can be met simultaneously in the face of increasing climate and natural disaster risks. Despite the positive synergies between agriculture and forests, they compete for space, and agriculture is the world's leading driver of deforestation**.** The complicated interactions between agriculture, forests and climate over landscapes mean that efforts to manage any of these in isolation to achieve inter - related objectives of food security, livelihood development and climate change mitigation will be difficult. Project and program designers and policy makers will need to incorporate the perspectives of all stakeholders and the status of all relevant rights regimes into plans. The incorporation of payments for environmental services and full natural accounting for all of the elements in the landscape will help to manage the difficult trade-offs. A landscape approach provides a framework to develop such synergies, by encouraging a spatial understanding of land uses and their interactions as well a process for coordination that reflects the institutional diversity of forest-agriculture mosaics and their associated ecosystem services and other natural values.

To visualize some underlying aspects of a landscape and human activity within a specific ecosystem, Figure 1: Depiction of some of the CCA, CCM and DRM services associated with different land parcels in a landscape and their inter-relationships. (source: Shames, et. al., 2011)



Shames, et.al. (2011) conclude that: "sectoral policies and programs across agriculture, forestry and climate institutions need to be harmonized, along with other relevant sectors including environment and rural development. In most countries, the development of cross-sectoral policies will require a rethinking of the spatial division of labor within ministries. To shift towards cross-sectoral collaboration, people working in sectorally-focused institutions at the national level will need training on integrated planning and program monitoring and evaluation. At the sub-national level there is a need to increase flexibility for district and state ministerial offices so that they can participate in, and respond to, requests from landscape initiatives." In practice this means a shift from sectoral planning to place-based planning with multi-sectoral technical inputs. Institutional innovation using improved ICT/GPS/GIS/SDI is now expanding and integrating traditional sectoral practices in public administration, planning,and spatially enables governance (Enemark, 2010; Castren and Pillai, 2011).

4. From Land Governance to Natural Resource Governance and Tenure

The proposed conceptual approach seeks to embed land policy for climate change into the broader policy-planning framework of multi-dimensional landscape approaches that incorporate NRG and NRT in a territorial context. This approach responds to a need that has been widely identified. For example, in a special edition of the FAO's *Land Tenure Journal* dedicated to climate change and land tenure, the editors Arial, Lau, and Runsten (2011, p.15) claim that: "Land and natural resources should be addressed at the outset of CCA and CCM schemes and be part of the design of policies, laws and activities. To keep up with the impacts of climate change, innovative solutions, flexibility of institutions and adaptability of livelihoods are required. [And there is a need to consider] the wider context of cities and urban development, to other natural resources such as water and fisheries, and to global, regional and local governance of tenure." To accomplish these goals the authors point to the urgent need to map, demarcate, and register land and natural resource use rights and responsibilities using innovative, low cost methods that are currently being applied in land administration projects around the world (Siegel, Childress, Barham, 2013). Embedding land policy in a multi-dimensional landscape approach to NRG and NRT in a territorial context is an important building block to help identify the appropriate mix of policy tools and investments in an era of climate change and increasing natural disaster. Thus there is a need to broaden the spatial perspective of land policy analyses from land policy to NRM to multi-dimensional landscape approach which considers NRG and NRT in each specific territorial context, and associated land values.

Some land governance systems provide incentives for land use practices that are less damaging to the environment than others, and every society has a complex mix of these NRG and NRT relationships. The specific mix of NRG and NRT is site-specific for given landscapes, and they have evolved differently in different parts of the world. In most cases, the sectoral and "top-down" nature of land institutions and policies, the relative lack of widespread citizen participation in NRM and planning decisions, and the dispersed nature of spatial information and strategic spatial planning means that achieving efficient, equitable and environmentally non-damaging the management of land and natural resources in an optimal manner over landscapes and territories is extremely difficult.

The ECA region in particular region faces twin challenges of climate change and natural disasters and the urgent need to reform their land and NRM sectors. Recent reports on CCA and DRM in ECA countries (GFDRR, 2008; UNISDR, 2008; Pollner, Kryspin, Nieuwejaar, 2008; World Bank, 2009) focus on actions are needed to improve resilience, highlighting the need to proceed as quickly as possible with "no-regrets" strategies, including increased linkages with DRM, notably risk reduction activities, innovative insurance and finance instruments, and improved EWS (including improved hydro-meteorological services). There are many institutional reforms that are "no-regrets" strategies, including improvement in NRG and NRT. In addition, there is a need to increase the awareness of citizens (and non-citizen residents), and governments at all levels about the importance of climate and climate change in the present and for the future, essentially including climate in the current-period valuation of land and resources. There is a need for ECA countries to adopt "no-regrets" approaches that seek to promote efficient and equitable sustainable

development by reducing the vulnerability associated with climate risks, and thereby increase human resilience.

World Bank (2009) recognizes the need to reform land policy in ECA countries to improve resilience. Strengthening property rights and markets should help to increase the flexibility of farmers, reduce fragmentation, increase access to finance, and encourage investment (World Bank, 2009, p.74). These types of reforms are indeed necessary conditions for dealing with climate change in ECA, but they need to be nested within a broader, more holistic approach which fully incorporates the landscape-based territorial approach in a multi-sectoral planning framework which accounts for disaster risk, impacts of land use on water and soil, and other relationships. This type of framework would stress evolving governance tools like expanded roles for local councils and associations with new technologies which permit a greater degree of local, participatory governance while simultaneously permitting a wider and more informed scope of strategic planning and establishment of appropriate M&E systems for places and sectors.

5. Relevance of the Conceptual Framework for Climate Change in the Europe and Central Asia (ECA) Region.

Agriculture and natural resource production continue to be critical for rural poverty reduction, employment, economic growth and food security in the ECA region. Despite a perception that ECA is an urbanized region, roughly one-third to one-half of people still reside in rural areas, with the figure approaching two-thirds in Central Asia. Agricultural production, processing, and related services remain an important source of income in many ECA countries, approaching 30% of GDP in Central Asia. However, the agricultural sector in ECA countries is highly climate sensitive and potential adverse changes in temperature, precipitation and the frequency of extreme weather events (for example, droughts, heat waves, floods, forest fires) as a result of climate change are likely to increase the vulnerability of poor rural communities. This will place a major strain on institutions, food supply, rural growth, and influence decisions on migration from rural areas. This risk is further exacerbated by the relatively low productivity associated with a lack of capacity to adapt to the present climate in many ECA countries, resulting in an adaptation deficit.

In the ECA region climate is already changing and there are more severe weather events (GFDRR, 2008; UNISDR, 2008; Pollner, Kryspin, and Nieuwejaar, 2008; World Bank, 2009). It is predicted, for example, that ECA will be confronted with more droughts and floods because of changing rainfall patterns (e.g., rainfall is expected to be more intense and variable, even if average annual totals remain somewhat similar). Droughts and floods are expected to become a more serious threat in most countries, although there are major differences in agro-ecological conditions within and between nations and sub-national areas, and expected changes in climate. Higher latitudes could benefit from improved conditions for agriculture, such as the Baltics, parts of Kazakhstan and Ukraine, and most of Russia (except for the North Caucasus). Actually, most ECA countries will face a mix of potential losses and gains based on climatic factors (without considering vulnerability), thus there will be major differences across the landscapes of rural areas and also for rural-urban fringes and urban areas (especially coastal areas). Sutton, Block and Srivastra (2009) present details on the agricultural sector and climate change in the ECA region.[11]

ECA countries tend to be highly vulnerable because of high exposure and sensitivity, and low adaptive capacity which are exacerbated by fragmented landholding structures and widespread management failures of common resources (e.g., forests and rangelands). Furthermore, in ECA, economic growth has often occurred at the expense of the environment; thereby further increasing vulnerability (World Bank, 2009). Thus, there is a need for ECA countries to focus more attention and resources to enhancing resilience in order to lower the potential negative impacts of climate change. The big challenge for ECA countries is to address the wide

[11] Also see the World Bank website: Agriculture and Climate Change: Europe and Central Asia (ECA) http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/0,,contentMDK:22626153~pagePK:146736~piPK:146830~theSitePK:258599,00.html

range of demographic-social-economic- political- environmental trends that have led to increasing vulnerability to negative climatic changes and extreme weather events (and increased disaster risk). The relatively high vulnerability in the ECA region is a combination of demographic-social-economic-political-environmental factors related to the socialist era and attempts toward reform and transformation, and the Soviet legacy of environmental mismanagement. Cynical attitudes toward collective action and government, disdain for free markets, and chronic environmental mismanagement and poorly planned, constructed and maintained infrastructure and housing are residuals from the socialist era and the transition years that increase vulnerability (and disaster risk) to even minimal or no climate change (World Bank, 2009). ECA countries are thus, in general, poorly equipped to deal with natural hazards, per se, and to protect their populations from the impacts of changing climate and increased extreme weather events. Furthermore, the challenges of the post-socialist transition have focused attention on immediate goals like increasing agricultural productivity, which mean that CCA and CCM efforts need to be designed to be compatible with short-term local development goals. "No regrets" approaches that quickly improve land administration and disaster management and agricultural productivity are needed in ECA because most landholders focus on short-term goals and risks, and have short-term decision-making and planning horizons.

While much of the thinking about CCA and CCM in ECA has focused on the energy sector (which also has global impacts), the landscapes of the region merit much greater focus. The region's landscapes are principal food producers for local and global populations, generate ecosystem services like fresh water, and carbon sinks, and are the geophysical frameworks for prevention and/or reduction of natural disasters. For these reasons, far-reaching policy analysis, planning and innovative actions to address landscape effects of climate change represent a timely and prudent response to the associated risks. This means that the traditional institutions of land policy have a new and crucial responsibility to innovate and address these challenges of land policy and climate change. But ECA as a region, in general, has done little (or less than is needed) to prepare for these risks and changes. The global response to climate change has been slow to integrate land policy and landscapes systematically into climate change strategies. This is now beginning to change, at least at the level of technical approaches to climate change and disaster modeling, early warning and rapid response systems (Siegel, 2011; Siegel, Gatsinzi, Kettlewell, 2011). By adapting the conceptual framework for thinking about land and resource governance together in landscapes as a strategy for addressing climate change, it is to be hoped that progress can be faster and more systemic and generating more immediate private benefits as well as the desired climate spillovers.

The ability or inability of the ECA region to deal with climate change, especially through its agricultural and forestry sectors, has important global consequences. This is because of the potential positive (and potential negative) contributions of the ECA region to global food security, CCA and CCM. There are large tracts of land surface in ECA that are under-utilized for agricultural production and for managed forestry. Many global studies about future food production assume ECA countries can, and will, help offset the forecasted decline in world food production resulting from decreasing yields in lower latitudes and arid and semi-arid areas. In particular, Kazakhstan, Russia, and Ukraine are often mentioned as the countries with the world's greatest unrealized food production potential, in addition to huge potential for expanded and improved forestry (and untapped mineral and oil wealth).

It is difficult to generalize existing agricultural land and resource tenure systems in ECA Region. Although there are many similarities, there are also significant differences in terms of formal and informal rules and regulations, and enforcement of rules and regulations. However, present land policies and overall natural resource management in these three countries (and other ECA countries) are not conducive to achieve the potential in an efficient, equitable and environmentally responsible manner (OECD, 2011). On the other hand, there has been increased recognition of the need for reforms of land use and land governance in ECA countries, as a follow-up of the first generation of land administration programs and projects. These land administration programs and projects, which were supported financially and technically by international institutions such as the World Bank, USAID, EU, FAO, GIZ, SIDA were a necessary first step toward improving land and natural resource governance and tenure in the post-socialist era. The question now is: *how to move ahead toward a broader framework of land and natural resource governance and tenure that*

explicitly recognizes evolving concerns for changing climate patterns, including an increase in extreme weather events?

The World Bank's report on CCA in ECA (World Bank, 2009) focuses on actions are needed to improve resilience, highlighting the need to proceed as quickly as possible with "no-regrets" strategies, including increased linkages with DRM, notably risk reduction activities and improved early warning systems (including improved hydro-meteorological services). There are many institutional reforms that are "no-regrets" strategies, including improvement in land governance and NRG and NRT. In addition, there is a need increase awareness of citizens (and non-citizen residents) and governments at all levels about the importance of climate and climate change in the present and for the future. That is, there is a need for ECA countries to adopt "no-regrets" climate risk management approaches that seek to promote efficient and equitable sustainable development by reducing the vulnerability associated with climate risks, and thereby increase resilience.[12]

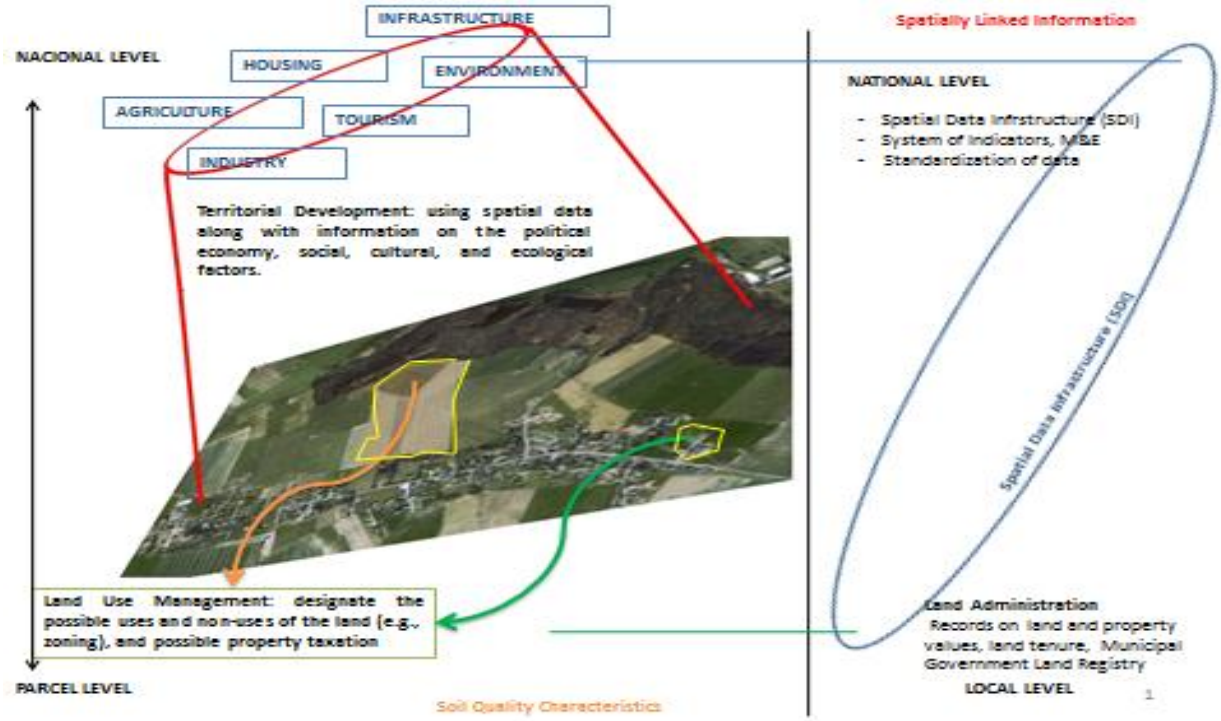
Land policy and governance are thus embedded in a multi-dimensional landscape approach to NRG and NRT. Each land parcel contributes to the overall productive, ecological and social profile of the landscape. The aggregation of each parcel's physical characteristics (including its above-ground and below-ground attributes), and the rights and obligations pertaining to the parcel for its use and disposition, build up the complete mosaic of the landscape and thus the local landscape's climate risk profile, its role in local and global ecological, social and productive services, and its role in the global carbon budget. Traditional measures of a land parcel's value, such as price, will become more complex as the multiple dimensions of a parcel's role in a landscape are valorized by global markets which will increasingly factor in climate risks and ecological services associated with each parcel. Traditional bundles of rights and obligations will also likely become more multi-dimensional to account for these risks and services. Land information technology, in turn, will need to also become more multi-dimensional to map the spatial and legal correspondences of these rights and obligations.

6. Reconsidering and Expanding Land Policy Tools for Climate Change Scenarios

Modern land administration systems and geo-spatial information technologies allow land management and NRM to be more easily monitored in real time which should become a basis for landscape management and governance improvements. The public goods which land supplies also create wider constituencies for their maintenance, including international ones. These institutions and their information systems form a strong basis for the addition of other layers of information and for creating new systems of monitoring and analysis based upon them. This involves the linkage of parcel-level land information systems with land cover and soil data, hydrological data and modeling, and both site-embedded and remote sensing of weather and other dynamics. At broad levels, the introduction of SDI (the rules and regulations governing the exchange of spatial data) represents a fundamental building block to make spatial data from different domains interoperable to perform these landscape management functions and evaluate the physical and economic tradeoffs among different uses and sets of rights/obligations. Figure 2 below illustrates some of the integration of different domains of geo-spatial information based on SDI in a landscape management scenario.

[12] Climate risk management involves proactive 'no regrets' strategies aimed at maximizing positive and minimizing negative outcomes for communities and societies in climate-sensitive areas such as agriculture, food security, water resources, and health (Hellmouth, et. al., 2007).

Figure 2: Spatially Linked Information from the Land Parcel (source: Siegel, 2012)



Faced with the climate change challenge, the land and natural resource policy tool boxes will need to be expanded and integrated further with each other to provide a full menu for the implementation of multi-dimensional landscape approaches. Fortunately the ability to use technology to do this is quickly improving (Castren and Pillai, 2011). At the International Surveyors' Federation (FIG) Commission 7 Symposium on Cadastre 2.0 in 2011[13], it was noted that future land cadastres will need to be three-dimensional and monitor dynamics based on historic data. These cadastres will need to be multi-functional and multi-jurisdictional, and will carry out the integration of land administration and management in social networks linked to governance structures. Multi-dimensional land and resource information will become an essential element of the knowledge society.[14]

7. Evolving Role for Land Administration and Land Institutions for Spatially - Enabled Governance

The new conceptual approach represents a continuation of a historical trend in land policy and governance to increasing expansion of the bundle of rights and interests in land, and increasing concerns under the domain of land policy. The historical evolution of land administration systems towards greater complexity, and focus on issues of sustainable development and the inter-relationship with land management has been documented, for example as shown in Figure 3, below.

[13] See http://www.fig.net/news/news_2011/austria_sept_2011.htm report on the FIG International Symposium on Cadastre 2.0, Innsbruck, Austria, September 25-October 1, 2011.

[14]Based on comments by Giorgio Pauletto at the FIG International Symposium on Cadastre 2.0, Innsbruck, Austria, September 25-October 1, 2011. http://www.fig.net/news/news_2011/austria_sept_2011.htm

Figure 3: Historical Evolution of Land Administration Systems (source: Gur, et. al., 2003)

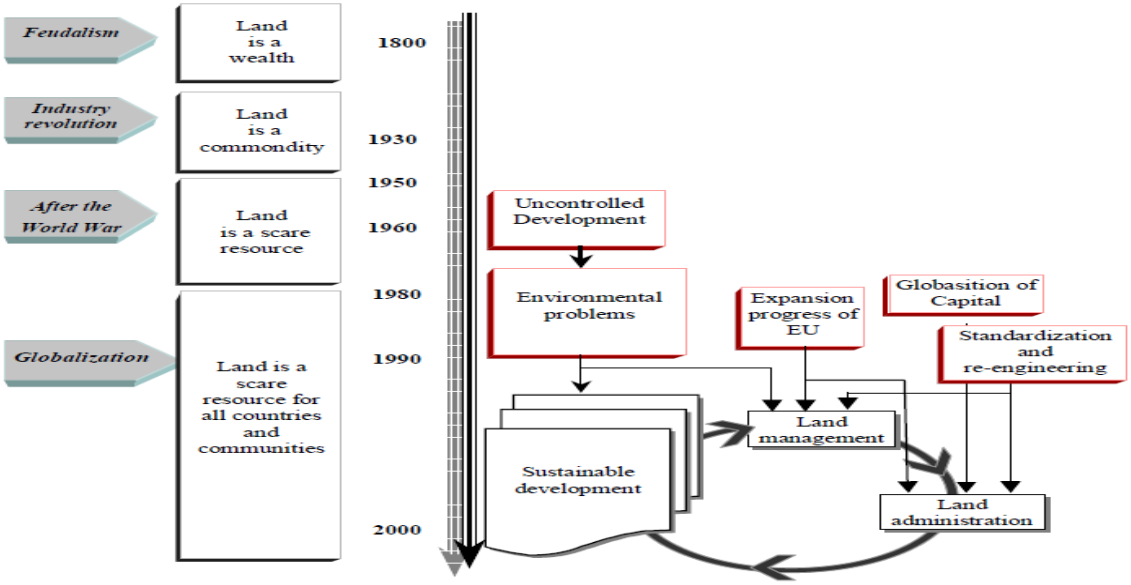


Figure 1: The evolution of perception of land
(Enhanced from WILLIAMSON 1999; ENEMARK 2001)

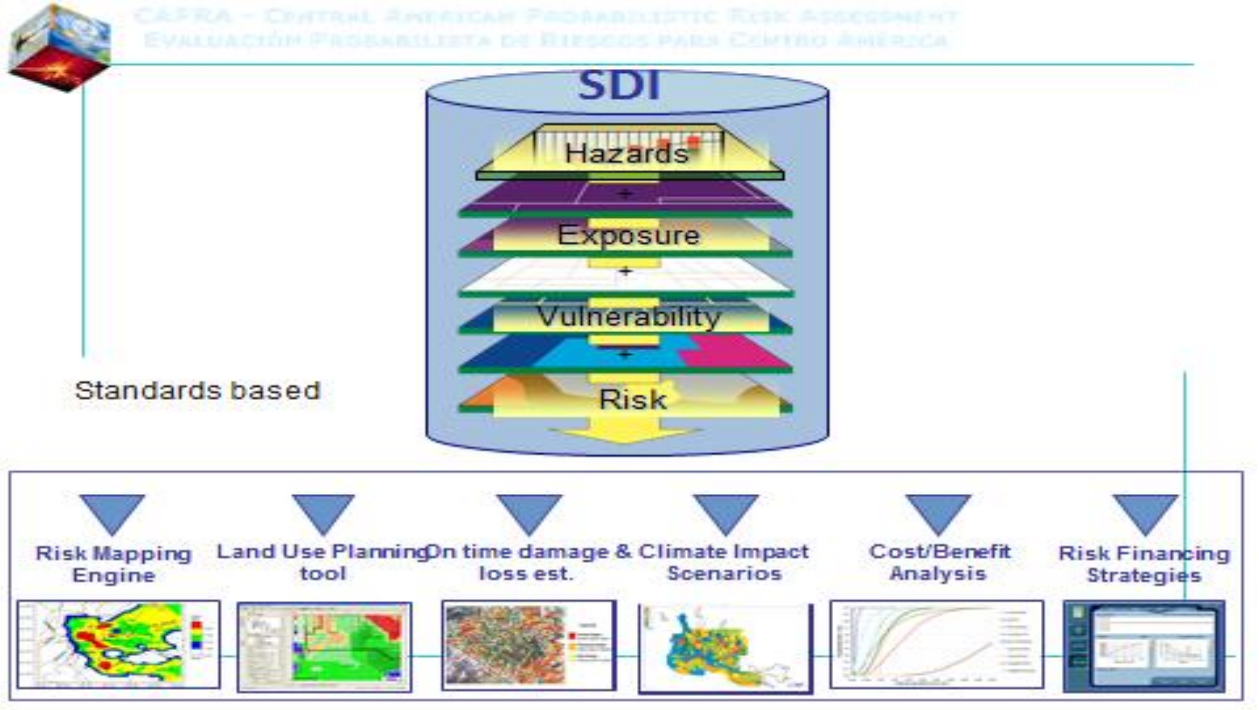
Especially in light of the challenges of climate change, population growth and urbanization, land policy and governance institutions will need to innovate to meet the challenges of land as a scarce resource with multiple functions and interests. Because of concerns about climate change, NRM-based institutions must face the challenges of global interconnectivity of resource systems, spatial externalities, and to account for and respond to interests which may be spatially distant from the local landholder. Any one point in space has impacts over neighboring and distant spatial/social frameworks. Policies and actions for CCA and CCM try to change the dynamic of NRM practices in order to lower the vulnerability to climate change - over vertical and horizontal landscapes, integrating land tenure, land use, water management, sub-surface resource management and management of the built environment. This calls for a much greater degree of harmonization of national, sectoral and spatial policies than has ever been attempted in the past, and requires a new degree of strategic integration and information support than has yet been implemented. Ultimately we believe this will call for a paradigm shift in NRM governance in which local resources and global objectives and interests are closely articulated through a more complex regulatory, monitoring and payment system than now exists, managed through a new generation of technological tools. This calls for greater strategic planning at regional levels, and greater citizen involvement in NRG and NRT at local and individual (land parcel) levels.

7. Using the Multi-dimensional Landscape Approach for Integrated Risk Management

Spatially-enabled government uses places as the units of organizing information and activities. As UNDP (2010) and Siegel (2011) point out, spatial data can now be more successfully merged with economic, social and environmental data, and information on hazards/risks and vulnerability to create probabilistic risk management tools. Siegel (2011) points out how the innovative technologies for land administration such as GIS and satellite based remote sensing can be combined with similar types of spatially indexed data from DRM and CCA practitioners, notably from early warning systems (EWS) and hazard/risk modeling, to carry out community-based and territorial approaches that are based on *spatially enabled governance*.

The Central America Probabilistic Risk Assessment (CAPRA)[15] is an attempt to bring different layers of information together in Central America. Risk is modelled as a function of hazards, and the exposure and vulnerability of assets to hazards. See figure 4 for an example of the types of information that are needed, and the types of GIS information that can be generated to assist decision-makers and policy-makers when they are collected and disseminated as part of a SDI. Land-use planning tools for risk management require site-specific data on hazards, and the exposure and vulnerability to hazards, and risk management capacity (UNDP, 2010).

Figure 4: Schematic Presentation of Probabalistic Risk Assessment Model (cited in UNDP, 2010)



Increasing concerns about multiple hazards that are directly and indirectly linked to climate change and natural disasters provide an opportunity for increased integration of land policy with CCA, CCM and DRM. Simultaneously the availability of ICT, GPS, GIS and SDI have opened new possibilities for cooperative multi-sectoral efforts. These efforts can aim at improved EWS and rapid response systems, ongoing M&E efforts that improve forecasting of hazard events, improve the understanding of underlying sources of vulnerability and adaptive capacity constraints, and better anticipate impacts on risk outcomes (Siegel, 2011).

The growing awareness of the land practitioners about the ability to incorporate geo-referenced data about hazards/risks, vulnerabilities and capacities usiSchng modern ICT, GPS, GIS and SDI technologies has created new ways to help decision-makers and policy-makers at community, local, national and international levels. Good land governance, in turn, is the key to achieving poverty-reducing sustainable growth and to effective CCA, CCM and DRM. Spatially enabled government, using ICT/GIS/SDI to integrate DRM/CCA/SP using territorial planning approaches offers potential to improve the resilience of people and places and strive toward sustainable growth (Siegel, 2011; Siegel, Gatsinzi, Kettlewell, 2011). Many local governments around the world are increasingly using ICT/GPS/GIS/SDI as key components of their information management systems (Castren and Pillai, 2011). Development agencies have a major role to play in technology transfer that includes both hardware and software, especially institution and capacity

[15] See http://ecapra.org/about

building. There is experience in these types of efforts from past projects in support of decentralization and land administration.

Although the complexity in the land-climate relationship is daunting, it can be managed with a mix of supra-national and national guidance, enhanced local involvement in land governance, integrated, cross-sectoral policy-making and improved technological tools. Moving to the multi-dimensional landscape approach and its expanded concepts of rights and interests is a long-term, complex process which will require new institutional arrangements, new types of analysis and research, new policy, regulations and programming by Governments and supra-national bodies, new types of investments in land management and administration, and new concepts of rights and interests. Progress on this process is in its early stages.

8. Connecting the Conceptual Framework for Land Policy to the Global Discussion and Land-Climate Linkages and Tools: Toward Low-Cost Land Demarcation

There is evolving attention in the development community to the critical importance of the linkages between climate change and land policy and for achieving efficient and equitable options for CCA and CCM which reflect many elements of the multi-dimensional landscape approach. Although it is only beginning to become apparent, several key steps are becoming clearer in the global specialist discussion, each of which reflects pieces of the multi-dimensional landscape approach. These steps include the following: (a) growing awareness of the interconnectivity of land and climate change issues; (b) calls for spatially-enabled governance; (c) emphasis on achieving comprehensive determination of land and property rights and interests, (d) expansion of public participation in land policy and planning; and (e) the creation of more transparent and flexible mechanisms for an expanded menu of land transactions including new forms of transactions involving PES/REDD and instruments for more complex, multi-sectoral valuation, taxation and monitoring of land resources.

Climate change is creating pressure to re-think the entire approach to territorial and resource planning from top to bottom. As Quan and Dyer (2008, p11) note that: "Climate change raises questions for land policies as a whole and not only for questions of tenure security, but also wider issues of land access and redistribution, urban settlement, the governance of land resources, reform and development of land institutions, management of common property resources, land use regulation and environmental protection, land conflict and the potential demands for settlement generated by mass displacement resulting from the growth of natural calamities, and potentially, civil conflict, to which climate change is contributing." To address these complex issues Quan and Dyer (2008, p1): "The paper finds that climate change reinforces the urgency of scaling up the delivery of secure land tenure over land and natural resources, using *low cost, decentralized systems of documentation and building where possible on functional informal systems*. Adaptation also requires increasing emphasis on land use regulation, the governance of land resources, and the delivery of land in safe and secure sites for informal urban settlements, and both temporary and in some cases permanent resettlement for populations that have to move."

Climate change is also likely to trigger new dynamics in land/resource values, migration of people and social change which land policy will need to manage. USAID (2011) highlights key implications of the linkages between climate change, property rights and natural resource governance:

1) Dramatic changes in land and natural resource-based asset values
2) Displacement and migration of people
3) Further marginalization of the disenfranchised
4) Transformation from land to natural resource management
5) Challenges in the distribution of carbon credits.

Climate change will have major impacts on the relative value of land and productive natural resources throughout the world. The resulting struggles over natural resources (via markets and non-market processes

including various types of conflicts) will modify governance and tenure regimes and create new winners and losers, often to the disadvantage of poor and vulnerable groups (USAID, 2011).

USAID (2011, p.3) notes that: "The central policy challenge for many countries is thus to maintain flexibility in existing customary and statutory tenure systems, but also, on a case-by-case basis, foster rapid adjustment of property rights regimes to new environmental and social conditions." This entails clarifying not only existing tenure of multiple users of the land, but it also entails helping stakeholders negotiate new rules of resource access and use in the face of climate-induced perturbations. "It is highlighted that there is an urgent need to clarify and strengthen property rights regimes and that: "Extensive public participation will be required for these changes to occur in a transparent and equitable manner and for the resulting institutions to be effective and perceived as legitimate. Climate change will challenge institutions responsible for the governance of natural resources, at all levels, to establish inclusive processes to negotiate claims, regulate disputes, and establish new tenure systems in a manner respectful of the rights of women, indigenous people, and marginalized people USAID (2011, p.7)."

Concerns about land and resources for rural-urban migrants under climate stress are another emerging theme in this discourse. UN-Habitat (2010, p.9) points out this linkage: "Rural development and urban development are closely linked through migration, flow of resources, economic empowerment, commodities and services. The problem of expanding slums cannot therefore be seen as exclusively an urban problem as they are largely filled by immigrants from rural areas. Slums may be compared to a leaking boat: new migrants flow in as earlier slum dwellers are rehabilitated or moved elsewhere. The problem can only be tackled at a broader scale requiring both rural and urban development." UN-Habitat (2010) identifies several key priorities: improved records and registration of land use rights in the context of improved land administration, increased regulation of land markets to enhance sustainable land use, improved land use planning, improved enforcement of land use rights and regulations. In this context, UN-Habitat (2010, p.9) notes that: "Important tools for enhancement of land rights of the poor include: low-cost land registration and certification, low-cost land use planning and mapping, introduction of laws that facilitate better functioning land rental markets and sustainable management of rented land." The UN-Habitat (2010) also advocates integrating participatory public works programs as safety nets and as means to invest in environmental conservation, and for financing (innovative low-cost) land surveying and title registration (as in Ethiopia). Siegel (2011) and Siegel, Gatsinzi, Kettlewell (2011) point out how spatially enabled governance can help integrate DRM, CCA and social protection (SP) using spatially referenced data bases and improved ICT, GPS, GIS, and SDI.

Quan and Dyer (2008), UN-Habitat (2010), and USAID (2011) recommend, as a priority to move ahead with efficient, equitable and environmentally beneficial CCA and CCM programs and projects, there is a pressing need to carry out inventories of formal and informal land use rights and regulations using innovative low-cost technologies. It should be noted that this is only a necessary condition, and not a sufficient one. Moving from an inventory of natural resources and existing NRG and NRT to an equitable, efficient and environmentally beneficial NRM regime is a complex multi-dimensional and multi-sectoral participatory process.

Given the complex and conflicting land use practices, claims to land and natural resources above and below the land surface, land tenure regimes and land use regulations over horizontal and vertical landscapes in any given territory, it is important to have a widened and inter-linked inventory of these data. As pointed out by Mitchell and Zevenbergen (2011), land users with informal tenure that is not recorded using a statutory process are at risk of exploitation from more powerful political elites and commercial interests. In particular, land users with socially legitimate but informal tenure that is not recorded using a statutory process are at risk of exploitation from the powerful elite. A detailed understanding of *de facto* property rights is important in protecting the rights of legitimate beneficiaries of climate change mitigation projects, and this is recognized in international declarations. Land administration systems have the potential to assist in formally recognizing and recording both *de jure* and *de facto* rights to land and

resources.[16] A detailed understanding of *de facto* property rights is important in protecting the rights of the poor and vulnerable groups (e.g., women, minorities). Innovative approaches to land administration systems based on technologies such as GIS and remote sensing have the potential to assist in formally recognizing and recording both de jure and de facto rights to land and resources (Castren and Pillai, 2011). Spatial information such as aerial photographs or satellite imagery complemented by ground reference data or land-use or land cover information in digital or paper form or from ground based surveys, is recommended to support this process. Additional information such as land use or land cover information from permits and plans, or information from local registers such as a cadastre or other land registers, may also be useful. The continued development of remote sensing technology will increase its application to these projects, and the continued development of end-user oriented interactive technology for using and updating this information will increase its impact.

Mitchell and Zevenbergen (2011) cite Childress (2010) about the role that the demarcation, delineation and depiction over landscapes, with all potential actual property rights and responsibilities, is needed in order to promote and evaluate different land use management schemes for CCM (notably REDD), monitor them, and to insure that they are efficient and equitable. In practice this will require the development of a comprehensive inventory of the land tenure of each land parcel, and the de-facto and de-jure use rights and regulations. Land administration systems provide a framework for depicting all potential property rights. However, the experience of formal (conventional) land titling in many developing countries has been unsatisfactory, often impacting the poor and vulnerable. There are a range of reasons for this including poor government capacity, poor governance, and inappropriate technical solutions. In order to meet the needs of carbon reporting, improved land administration systems for recording rights to resources will need to be developed, where property rights are informal and complex (e.g. where land is held in communal ownership).

Recent advances in land administration systems provide the potential to comprehensively record interests in a low-cost manner (with most of the examples in Sub-Saharan Africa). The process broadly involves adjudication, demarcation, recording of rights, and registration or certification using a combination of maps generated from aerial photography, satellite imagery and remote sensing to develop cadastral maps supported by field verification (Castren and Pillai, 2011). Mitchell and Zevenbergen (2011, p. 76): "Mapping based on aerial photography or satellite imagery, and land tenure or resource inventories at family or individual level, might be the solution elsewhere. The geospatial technologies needed both for carbon monitoring and for land administration might bring opportunities for cost sharing, although this requires further study."

Land consolidation is another policy tool which is empowered by this type of technology and inventories to assist in climate change adaptation. Land consolidation increases resilience and efficiency by reducing land fragmentation and altering physical landscapes to manage water and soil better. But modern land consolidation has a broad focus on integrated rural development including measures for sustainable use of the resources, environmental conservation and improving the local infrastructure. Competing interests between agriculture, transportation, environment, recreation, cultural heritage and tourism are balanced. Land consolidation can identify land for the construction of roads, for irrigation and drainage systems, communal drinking water and for sewage disposal installations, and cable and other telecommunication facilities etc. For example, the access to markets by agricultural and forest products can be systematically addressed in land consolidation.

[16]According to Mitchell and Zevenbergen (2011, p.61-62): "In most countries there is a legal pluralism regarding rights to land and resources. It is common for a statutory system of recording de jure land rights to operate in parallel with (but separate to) a local or customary system of understanding the de facto rights to land and resources. Only a rather small percentage of private land in developing countries is recorded under a statutory system; many ordinary and legitimate land users still do not enjoy full security of tenure for a variety of reasons. Much more common is that ordinary people in these societies occupy and use land under a range of socially legitimate (or otherwise) forms of tenure. An adequate understanding of both their de facto and de jure rights is needed before decisions can be made on who the likely participants in and beneficiaries of a […] project will be. Ignoring either the de facto or de jure rights is one of the main reasons for conflict over land and resources."

9. The Political Economy of Integrating Sectoral Practices under the Rubrics of Natural Resource Governance (NRG) and Natural Resource Tenure (NRT)

This proposed updated conceptual approach to land policy holds out numerous opportunities for local adaptations which are win-win and incentive-positive for actors, especially if all ecosystem service values can be included in the negotiations. The political economy of land use rights and responsibilities, and the regulatory and technological platforms for their management under climate change adaptation and mitigation, can no longer be uncritically divided into agricultural and forestry sectors, or land and water issues, or rural and urban areas and still expect to respond to the current challenges. Extending the concept of land tenure, NRT is the political economy of rules and regulations concerning natural resource use and disposal of waste products. The rules and regulations define how access is granted to right to use, control and transfer natural resources, as well as associated responsibilities and restrictions. NRG and NRT are about political relationships and processes. NRG and NRT structure the flows of benefits from natural resources and the distribution of the benefits (and costs) from natural resource use and disposal of wastes. Weak NRG is a cause of is a cause of many NRT-related problems, and attempts to address NRT problems are affected by the quality of NRG and broader governance issues at the various levels – down to the community level (and actually focusing attention on the community and local levels).

NRG and NRT are increasingly important to deal with linkages between land policy and climate change. This is especially true in regions where the livelihoods of the rural population are diversified, with household members cultivating crops, keeping livestock, engaging in fishing, and collecting food, firewood and medicines from forests. In addition to access to land for shelter and cultivation, their livelihoods are thus based on access to a variety of natural resources, including pastures, forests, fisheries and water. A given area often has multiple forms of tenure operating. For example, a forest may contain a variety of timber and non-timber products, while at the same time being a watershed, fish hatchery, wildlife reserve, tourist destination, etc. This creates a complicated web of resources, users, rights, restrictions and responsibilities.

An important aspect of NRG is related to the security and stability of NRT, and the interface between formal and informal or customary tenure. With respect to promoting efficient and equitable CCA via adoption of new farming practices and technologies, many of the NRT issues have been addressed over the years in terms of agricultural production (and agro-forestry) and the need for secure land tenure as a necessary condition for investments with a longer-term planning horizon. In this context, too, climate variability and extreme weather events, per se, are not new challenges for land governance and NRG. Concerns about climate change and reactions to climate change (e.g., increased interest in biofuel production and increased prices of food and feed commodities) have heightened the interest in the allocation of secure land tenure regimes. Likewise, even before the prominence of climate change, there were programs for PES, especially in the USA[17] and some EU countries.

In many cases, access to forests and pasture lands is dependent on customary rights. For example, on paper, most forest land is owned by national or local governments. However, the reality is that much of the public forests are managed not by public agencies, but instead by rural people who gain access to forest resources through customary rights which are not reflected in legislation. Emerging global issues such as PES and REDD are opportunities for sustained financial benefit flows, as emission reductions are expected to be matched by performance based financial compensation – whether market or non-market based.

Addressing NRT issues with NRG is essential to achieve PES and REDD in an efficient and equitable manner. Unclear tenure can aggravate deforestation and degradation: deforestation is a way of claiming rights to land, and degradation arises when NRT does not provide incentives to invest in improvements. NRT

[17] The most popular PES program in the USA is the Conservation Reserve Program (CRP), whereby farmers receive payments to voluntarily withdraw highly erodible crop land and to plant trees and/or permanent cover and/or other land /soil conservation practices. See: http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp

reforms, including the legal recognition of customary rights, are a necessary part of introducing sustainable forest management practices, and to ensure that local communities who are the de facto managers of forest lands are able to benefit from REDD payments. NRG/NRT requires that special attention be devoted to protecting the rights of indigenous people and local populations, especially the poor and vulnerable groups (e.g., women, minorities).

A constraint to NRG is the fact that planning and administration (including M&E) of natural resources is typically sectorial, with little coordination or interaction. Land policies, water policies, agricultural policies, forest policies, and fisheries policies tend to be managed independently from one another by different ministries or agencies. This is the case for managing water and land in "rural areas", and the lack of coordination and interaction is even greater for ministries and agencies dealing with urban areas, transport and energy, health and education, etc. In addition, NRG is typically confined within political boundaries that do not reflect NRM areas (e.g., watersheds or micro-basins).

Another challenge to NRG is the increase in investments for extraction of underground natural resources by both domestic and foreign investors. Most investments in natural resources being made in metallic ores and non-metallic minerals such as oil, gas and coal, the projects tend to result in increased competition between investors and the local communities over the land in which the minerals are located. There are increased concerns regarding how such investments will impact on the existing land-based rights and responsibilities, and the impact on related communities and natural resources, particularly water. NRG is important to resolve conflicts between competing uses and users, and to guarantee equitable, efficient and environmentally acceptable results.

Linking land policies with climate change action calls for an integration of traditional land policy areas of concern with the broader fields of NRT and NRG, and thus for new professional and policy-making constellations in ECA and elsewhere.

10. Concluding Remarks: Moving Forward

This paper addresses the subject of land policy and governance linkages with CCA, CCM and DRM. To do so, a proposed updated conceptual approach is proposed. This approach is a multi-dimensional landscape approach to NRG and NRT. The focus of the paper is on motivating and presenting the conceptual framework and proposing se priority policies and actions that are "no-regrets", including mainstreaming of ICT, GPS, GIS and SDI for land administration and EWS and rapid response systems. Low cost demarcation of parcel boundaries with information pertinent to NRG and NRT is also a priority "no regrets" intervention.

We propose that that utilization of this approach calls for a conceptual step towards place-based development planning which uses a multi-dimensional landscape approach to NRG and NRT in a territorial context. It calls for institutional innovation in building more participatory and spatially-enabled local resource governance within strategic planning processes that anticipate climate change. Utilization of this framework will be greatly assisted by using the improved technological tools for SDI and embedded and remote sensing. The approach will be require policy innovation in expanding and more precisely defining the bundle of rights and interests in land and natural resources in each particular location. A necessary condition is the demarcation, delineation and depiction of land parcels over landscapes, with all potential and actual property rights, responsibilities and interests, in order to promote and evaluate different land use management schemes for CCM, and to ensure that they are efficient, equitable and sustainable in the context of all relevant risks and uncertainties. Recent advances in land administration systems provide the potential to comprehensively record interests in a low-cost manner.[18] The process broadly involves adjudication, demarcation, recording of rights, and registration or certification using a combination of maps generated from aerial photography, satellite imagery and remote sensing to develop cadastral maps supported by field

[18] Although most of the best-practice applications to date have been in Sub-Saharan Africa, these should not be shunned or snubbed by technologically advanced ECA countries.

verification. It involves social innovation for land and resource governance involving flexible land market arrangements and financing, associations of land and resource users, land consolidation and landscape design in all their senses, improving systems of land valuation, improved soil management, more complex and dynamic spatial planning and monitoring, integration of spatial data sets and new tools for using them, and the wide adoption of PES and REDD mechanisms. These "no-regrets" interventions are critical because they help establish and mainstream the necessary conditions for subsequent policies and actions for NRG and NRT that facilitate efficient and equitable CCA, CCM and DRM.

On a technical level, the objective is to move toward the use of innovative technologies for land and resource administration. This includes technological tools such as ICT, GPS, GIS, SDI and satellite based remote sensing, in combination with similar types of spatially indexed data from DRM and CCA practitioners (notably from EWS and hazard/risk modeling) to carry out community-based and territorial approaches that are based on *spatially enabled governance*. The world is rapidly moving to a situation in which all this information will be united in a dynamic data model which is accessible from many platforms. On a social and institutional level, the objective is to use this technology in service of evidence-based, locally-realized agreements for natural resource tenure and governance which reflect populations' valuations and perceptions about the risks and rewards associated with the decisions they make about their landscapes.

"No-regrets" policies for land and natural resources like the use of ICT/GPS/GIS/SDI for improved NRG and NRT make sense in the price and incentive conditions of the present and provide the best-possible agenda for tackling future uncertainty and risk in a changing climate. The technology and basic experiences for making them work are present in the region. What remains is to take these concepts to scale within the available resource envelopes. To do this information sharing and dynamic learning from global experience is the key.

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ANNEX 1: Land Governance and Tenure => Natural Resource Governance and Tenure

Land governance is the process by which decisions are made regarding the access to and use of land, the way in which those decisions are implemented and the way that conflicting interests in land are reconciled. Land tenure is the relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land. (For convenience, "land" is used here to include other natural resources such as water and trees.). **Land tenure** is the set of rules to define how property rights to land are to be allocated within societies. See http://www.fao.org/DOCREP/005/Y4307E/y4307e05.htm which defines how access is granted to rights to use, control, and transfer land, as well as associated responsibilities and restraints. In simple terms, land tenure systems determine who can use what resources for how long, and under what conditions. Thus, *land tenure is the set of societal rules (formal and informal), and land governance include the broader processes with which land tenure rules are established, monitored and enforced.* "Natural resources are not just valuable economic resources; they're also political and social resources. At all levels - local, national and international – different actors from the public and private sectors compete to gain access, control and benefits from natural resources. How these competitions are played out and resolved, and who ultimately benefits from them, lies at the heart of **natural resource governance.**" See http://www.theidlgroup.com/FRR/NaturalResourceGovernance.htm

The authors refer to both natural resource governance (NRG) and natural resource tenure (NRT) to acknowledge both the existing rules and institutional contexts, and the potential for change (that is, tenure systems might change because of changes in governance systems). See also the recently completed final draft voluntary guidelines (VGs) for a "negotiated" definition of tenure etc. See the preface. The VGs are also a big stepping stone to promote landscape approaches. http://www.fao.org/fileadmin/user_upload/nr/land_tenure/pdf/VG_en_Final_March_2012.pdf