Assessing Future Security Landscapes:
A View Through the Lens of Real Landscapes of Social-ecological Systems

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Introduction

The focus of this paper is human-environmental, non-traditional security issues.[1] In particular contexts, emerging conditions or natural disaster situations can be of importance to more traditional security matters – for example, through the breakdown of civil norms, destruction of social cohesion and civic loyalties – which in turn influence security matters of concern to nation states.

From this perspective, bio-physical and social-ecological interactions and interdependencies in the coming decades will produce considerable landscape changes, including changes to coastal systems, inshore waters and the oceans. A summary list would include:

- landscape systems change;
- natural disasters;
- food and water security;
- bio-security (closely linked to food and water security in rural areas);
- oceans security;
- energy security; and
- synergistic combinations (e.g., coastal settlement, degradation of protective coral reefs coupled with increasing climate change perturbations and a period of increased tectonic/volcanic activity around the Pacific Rim).

Our socially and culturally influenced attitudes and behaviors produce policies and actions – particularly in the use of natural resources – that over time create a variety of contexts and conditions. These past, present and future conditions will largely dictate disruptions to both social and ecological systems from which might emerge short-term or long-term human security issues, vulnerabilities and the capacities (or not) to address such issues (figure 1, p. 146). Space is itself a critical resource, particularly areas for human settlement and resource access and as location for environmental systems to function and provide essential services.
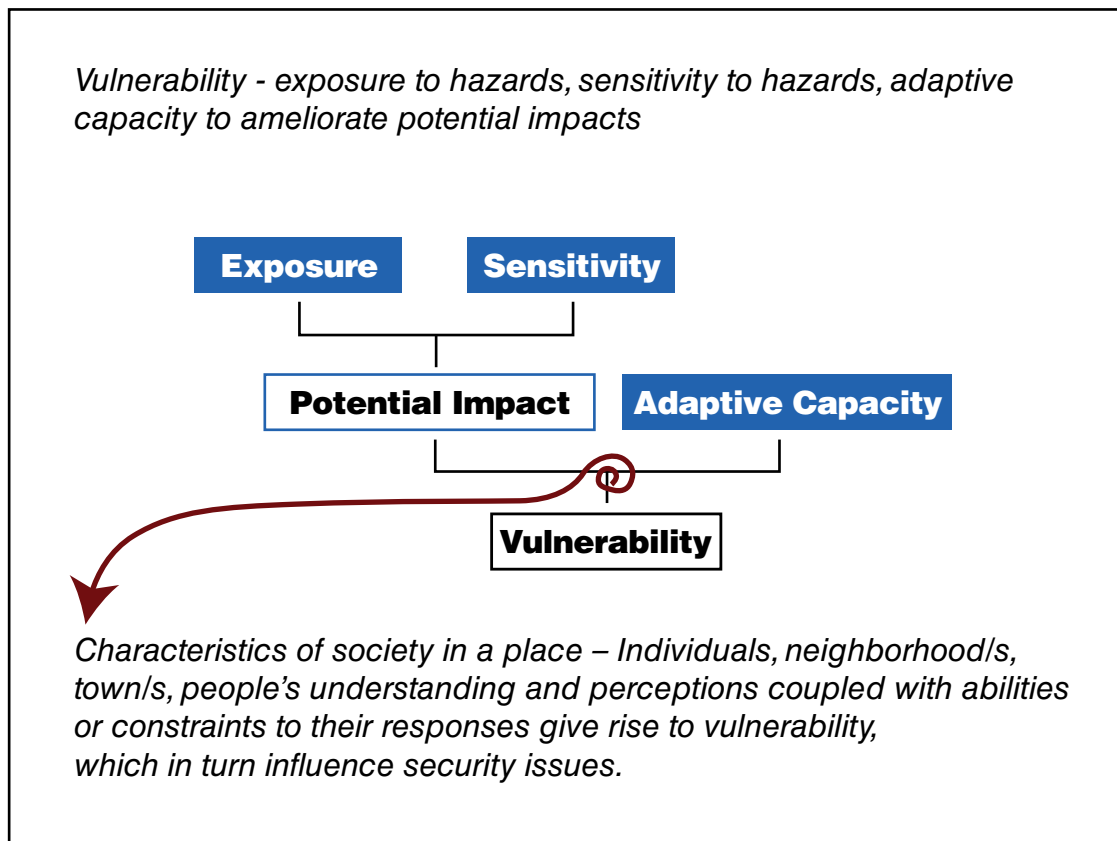
Vulnerability - exposure to hazards, sensitivity to hazards, adaptive capacity to ameliorate potential impacts

Exposure   **Sensitivity**

Potential Impact   **Adaptive Capacity**

Vulnerability

Characteristics of society in a place – Individuals, neighborhood/s, town/s, people's understanding and perceptions coupled with abilities or constraints to their responses give rise to vulnerability, which in turn influence security issues.

FIGURE 1 Vulnerability to human security issues: vulnerabilities are a product of exposure and sensitivity to a disturbance and its impact. Local characteristics of human settlements and communities influence their adaptive capacity and response, which in turn might ameliorate or exacerbate human security.

Landscape Systems Security – Patterns and Context

Landscapes herein are considered as areas of local geography of recognizable pattern of ecosystems and living spaces having meaning to resident communities. The spatial arrangements of human interactions with ecological systems, along with biophysical elements, clearly create observable landscape patterns that reflect the processes of decisions about settlement and resource use and ecosystem function. Over time, landscapes internalize and reflect the affects of change.

Change begets change. Mosaics of changing landscape patterns reflect responses and feedbacks of social-ecological interactions that drive change in natural resource capacity and ecosystem health. Landscape ecology provides a useful regional approach to understanding social-ecological systems interactions to assist the design of institutional arrangements towards more enduring sustainability. This structuring of landscapes and regions through social-ecological systems interactions defines operational contexts in which to integrate cross-scale interactions of resource use, property rights, agency jurisdictions and ecological patterns and processes (figure 2, p. 147).
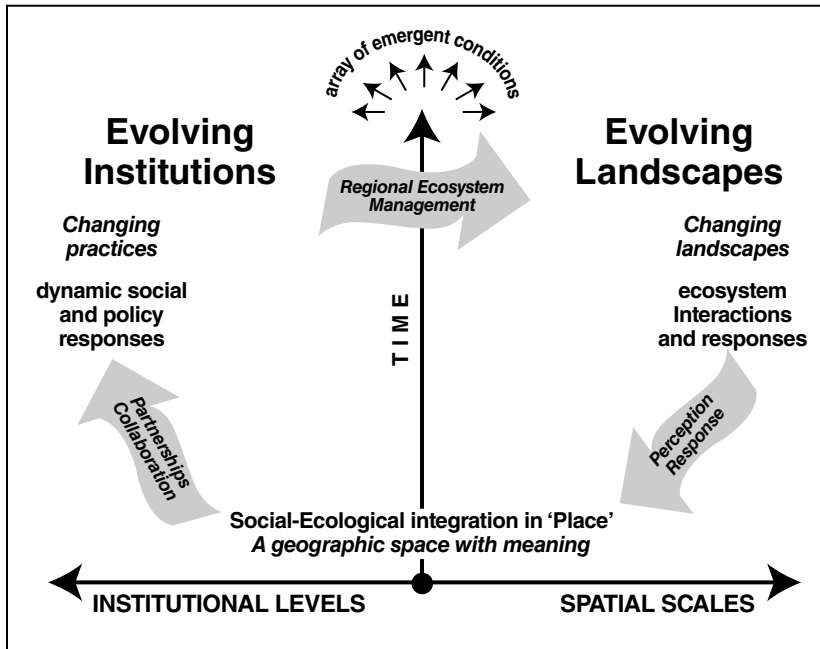
FIGURE 2 Social-ecological systems interactions and interdependencies operate as cycles of feedback and adjustment across spatial and institutional scales. Therefore, future landscapes are co-evolving and influence the emergence of stable or unstable conditions that shape human security.
SOURCE: "Using context in novel community-based natural resource management: landscapes of property, policy and place," by David J. Brunckhorst. *Journal of Environmental Conservation,* Volume 37, Issue 1 (2010), pp. 16-22. ©Copyright 2010 Foundation for Environmental Conservation. Reprinted with the permission of Cambridge University Press.

Patterns or processes that develop out of interdependent interactions occurring across landscapes are uniquely different from the individual ecosystem elements that created them. Systems scientists refer to these as emergent properties or conditions of systems interactions. Emergent conditions of social-ecological systems interactions are often at the heart of sustainability issues and may involve interactions of fast and slow moving variables, feedbacks, threshold effects, responses and re-organization (figure 2). A subtle synthesis of systems interactions might lead to a manifestation of surprises including possible systems crash, e.g., collapse of viable species populations, ecosystems or whole social-ecological systems.

These regional landscapes and context-specific conditions can give rise to significant vulnerabilities to human security in terms of safety, well-being, health, social disorder, living space and essential services. For example, the social-ecological context of the hurricane disaster in and around New Orleans emerged out of a considerable range of ecological change, human settlement conditions and social conditions. Climate change-enhanced weather events in the future are likely to have even greater impacts.

Landscapes and their human residents are inseparable in their interdependent influences on each other. Future human security issues and vulnerabilities (or resilience) are being created now and over the intermediate time period. The future conditions they will impact upon are most likely

to be different from the present. There are five topics or issues of landscape systems security that I consider to be of particular importance in the future:

- water and other natural resources;
- production systems (protecting and sustaining good agricultural land, and sustained ocean fisheries);
- ecosystem services (not only for clean air and water, but also as buffers to increasing climate change perturbations);
- tenure ('living space,' amenities – urban / peri-urban / rural); and
- coastal systems (land-sea interface).

Resource security, bio-security and natural disasters are all interdependent with the above factors. Landscape change often reflects changes in all these parameters. Change is continuous, so the future will not be the same as the present. Understanding future human security issues such as those listed above requires an awareness of: first, how landscapes, human settlement patterns and resource access and use are changing; second, what future regional landscape patterns might manifest; and third the vulnerabilities that might emerge for human security in the event of natural disasters, climate change or other perturbations. Because the future will certainly be different, it is unwise, and likely to be misleading, to assess impacts on future human security based on present landscape patterns. Local circumstances and conditions provide the context within which sensitivity to impacts and adaptations occur. At various scales from the local landscape of social-ecological interactions and interdependencies, to broader regional situations (often dictated by externalities or linkages from lower levels), context is of critical importance to the emergence of circumstances around human security issues (figures 1-3, p. 146, 147 and 149). There is no panacea. As context and circumstances differ considerably from place to place and over time, policymakers and planners must be careful not to be tempted to create 'blue-print solutions.'

Science and Technology Developments Overview of Some Relevant Advances

Advances in spatially-attributed social network analysis (i.e., by Global Information Systems or GIS), community cohesion, place identity and social 'topographies' are providing valuable insights. Understanding scales of the social-ecological context is important to assessing, planning, and managing human security issues such as natural disasters. Community cohesion and human capital, important in such circumstances, are often based on contexts of community of interest, place identity and underlying natural resources. New techniques in combined social-ecological geographical analysis and spatially-attributed social survey techniques have opened the door to a better understanding of the spatial and institutional arrangements of such 'eco-civic' regions (figure 3, p. 149,). Coupled with local natural resource geographies, 'eco-civic' regionalization techniques offer particular insights to context and appropriate levels of community consultation and decision-making.

Mapping residents' 'sense of place', community of interest and social networks
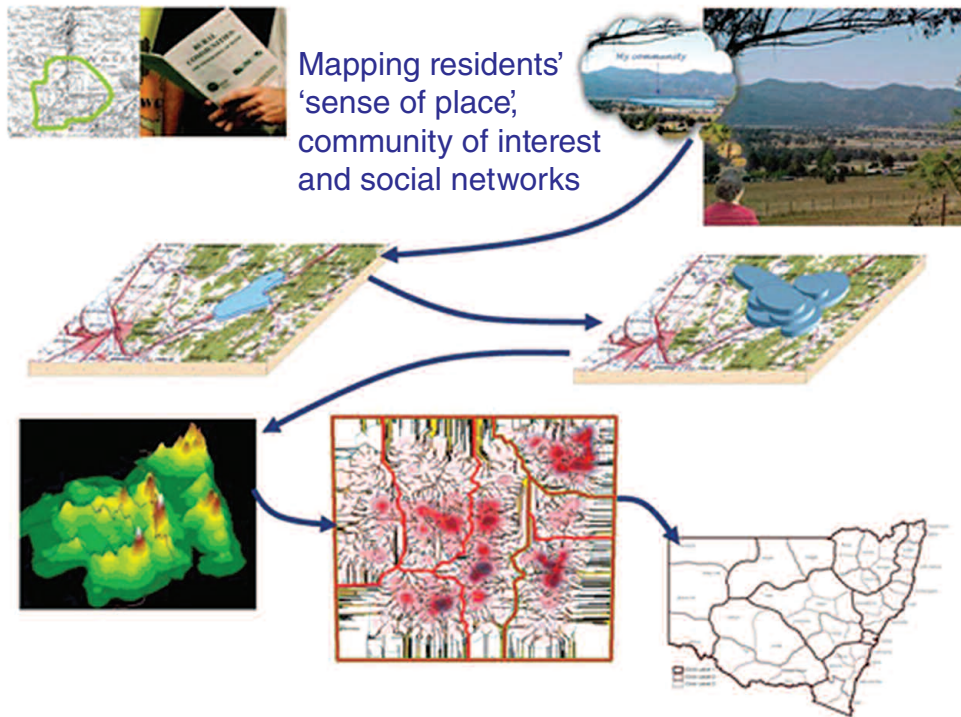
'Eco-Civic' Regionalization – A Social-ecological Synthesis (New South Wales State, Australia)

'Social Surface'
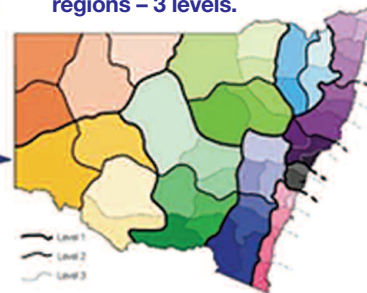Hierarchy of community attachment and social networks.

'Natural Resources'
Hierarchy of ecological regions/land use.

'Eco-Civic Regions'
Hierarchy of social-ecological regions – 3 levels.

Optimize boundary placement using 'valleys' in social-civic topography.

FIGURE 3 Mapping resident communities of interest and place attachment. Optimized with ecological regionalization, an 'eco-civic' regionalization can elucidate boundary scales for community-resource interactions, consultation and decision-making of relevance to human security issues and adaptive responses.

Identification of appropriately integrated contexts of communities and resource governance provides a much more meaningful basis for applying advanced (spatially-attributed) multi-criteria analysis techniques; for example, to concurrently assess levels of community sensitivity and adaptive capacity to a natural disaster or resource asset's security vulnerability – an example is illustrated in figure 4. Future community and socio-economic conditions are very difficult to predict. However, some advances are being made where trajectories of future settlement patterns can be modeled that will allow for more accurate predictions.

From a human security perspective, a range of social variables can provide indicators of community sensitivity to impacts and the capacity of communities to respond and/or develop adaptive resilience over time. Multi-attribute, 3-D spatially-layered maps can provide a valuable first glance to policymakers of where multiple vulnerabilities and sensitivities might 'stack up' or produce other synergistic affects (figures 5 & 6, p. 152, 153). Such analysis is useful for planning and strategic deployment of, for example, disaster relief or control centers. Spatially-explicit models
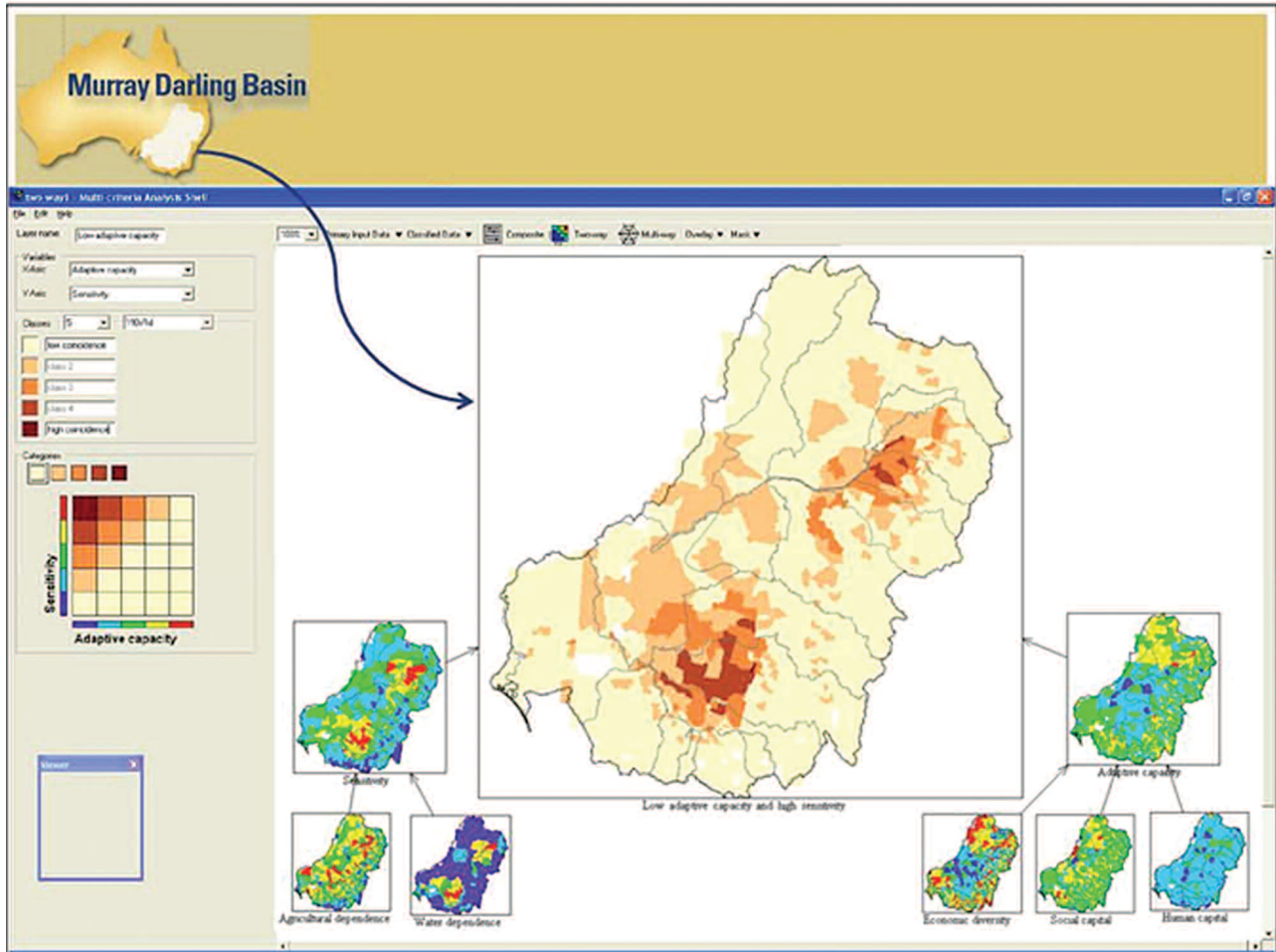

FIGURE 4 An example of spatially-attributed multi-criteria analysis of human community sensitivity vs. adaptive capacity for a particular social-ecological context (refer also to figure 1).

such as these can also be used to directly compare various current and future landscape patterns of vulnerability, landscape change and changes to vulnerabilities under a variety of scenarios.

The future will certainly be different. Constantly changing landscapes will be very different from present and past landscapes. For example, human security issues, from the impacts of climate change-enhanced storms in 2030 will be dissimilar from today because they will be impacting upon a very different landscape in 2030. Understanding patterns of the present landscape does provide a foundation to examine plausible land use and land cover (LULC) patterns of the future. Understanding past change and current pressures driving change help us to understand how and where present policies or decisions might create or ameliorate vulnerability and how various landscape elements might be vulnerable or human security issues arise. This past-present-future landscape analysis approach allows a more integrated analysis of landscape-scale social-ecological parameters that might change. This technology also allows for the examination of adaptation benefits of alternative landscape futures that need to be planned and achieved to increase resilience and reduce negative impacts. Despite the uncertainties in predicting future landscapes (patterns of land use and natural elements), a landscape futures approach provides greater insight for policymakers into the risks of not adapting to potential future exposure and vulnerability, compared to simply examining the effects of future climate change perturbations on the present landscape.

Coastal landscapes around the Asia-Pacific in particular are changing rapidly. With increasing human settlement areas, concentrating coastal-urban populations, reduction of reefs, mangroves, complex estuaries and coastal forests (all of which contribute not only food but physical and biological buffers to various perturbations), these regional landscapes are rapidly altering. Mapping and spatial analysis of the current trends creating the trajectory and pattern of these future landscapes is an important but underutilized science and technology tool. Understanding future landscapes and settlement patterns together with comparisons to designed alternative landscape futures can strategically assist planners and policymakers to chart more resilient and adaptive contexts for the future. These techniques allow for direct analysis of impact and change to better understand and predict the consequences and human security sensitivities of various likely future landscapes or planned alternative future landscapes (figures 5 & 6, p. 152, 153). In order to design adaptive policy and planning mechanisms, policymakers often require an overview of the 'big picture' of where potential issues might arise or where problems might 'stack up' creating synergistic effects. For policy purposes, the vulnerability analyses can be summarized in a map of four geographically-related surfaces as shown in figure 6. It is also useful to have the capacity to drill down into the knowledge of underlying causes.
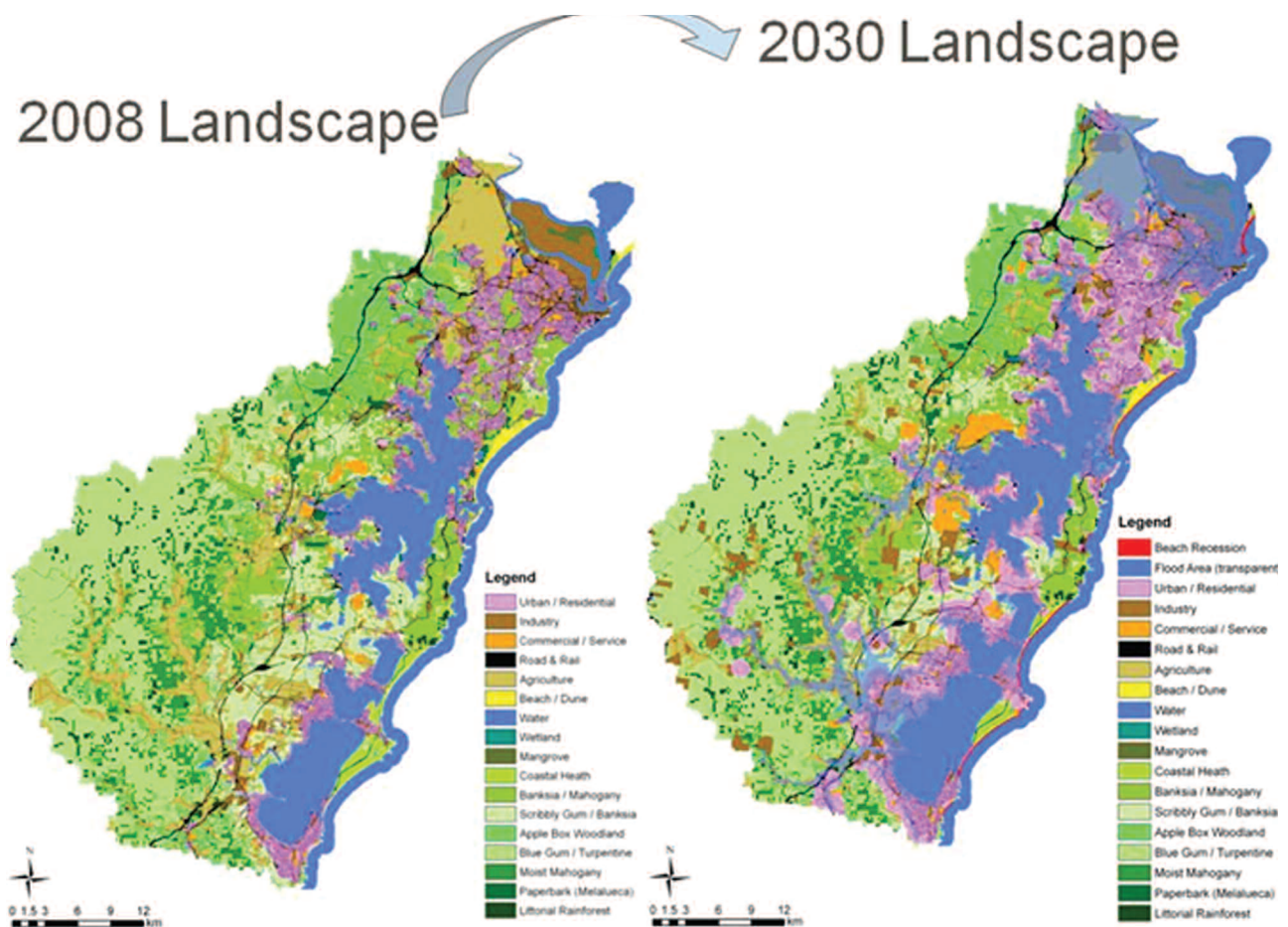
FIGURE 5 An example of a current and future landscape change analysis. In this example the past to present landscape change provides the basis for the trajectory and trends towards this (highly probable) 2030 landscape future for the Newcastle – Hunter coastal region, north of Sydney, Australia.

Summary: Strategic Planning for Human Security in Changing Landscapes

There are serious upcoming challenges to human security from the combined interactions of rapid change across social-ecological systems in a variety of contexts around the Asia-Pacific, especially on coastal plains. Access to and use of resources (especially clean fresh water), changing land uses and increasing human settlement areas are changing the nature of the future landscapes upon which challenging impacts or conflicts might impact, e.g., climate change and resource access. In increasing the community's adaptive capacity and preparations for future changes, policymakers need to be cognizant of the importance of:

- context specificity, i.e., the local to regional landscape defined by the biophysical environment, people and their circumstances;

- change as a constant in a future that will be different in context and landscape;

Synthesis of layers of ecological, social and economic climate change vulnerabilities
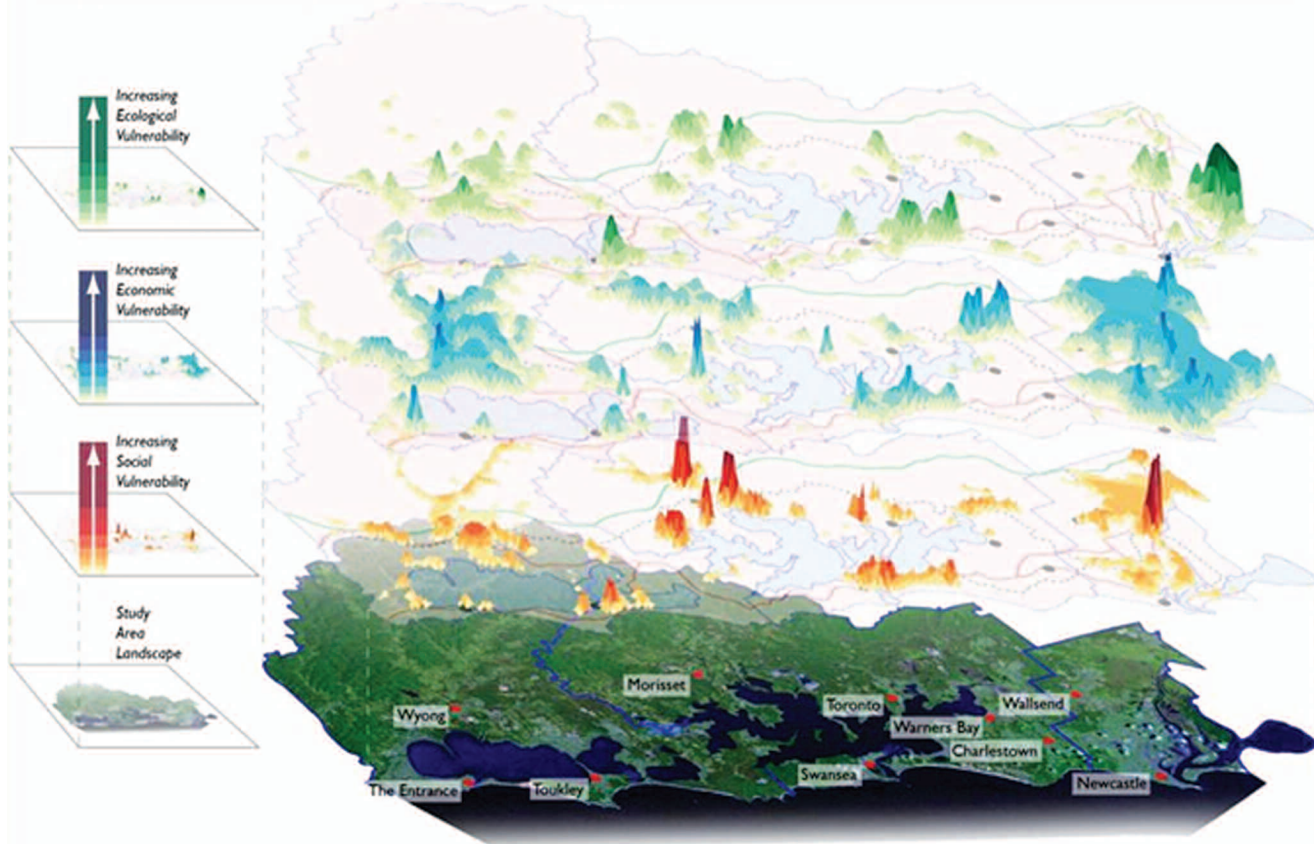

FIGURE 6 An example of spatially attributed 3-D visualization of multiple sensitivities that might influence human security issues of a likely 2030 regional landscape (current trend/trajectory) for the Newcastle – Hunter coastal region, north of Sydney, Australia (refer also to figure 5).

-   human security vulnerabilities (sensitivity & adaptive capacity) that stem from the context of the social-ecological landscape and pressures of change;

-   the uncertainties of "future landscape influences" on community and regional security;

-   the development of multiple planned options including those for adaptable futures, and designs and assessments of various alternative landscape futures.

There are a range of very useful, strategic and policy-relevant, science and technology (S&T) tools that have recently been developed and are undergoing further development through case study applications and modelling. Some of these include: combined social-civic, resource and ecological regionalization techniques for planning, community engagement and multi-level policy and decision making; spatially-attributed, contextual, social sensitivity and adaptive capacity analysis; comparative analysis and modelling of current and future landscape change; and "Landscape Futures" scenario, design, modelling and analysis. Such context-relevant, multi-criteria, "alternative

landscape futures" range of S&T tools will be valuable in understanding future human security issues as well as provide policy options towards planning for both future resilience and adaptive responses.

Notes

1. A large volume of relevant research, science and technology, and case studies are cited and referenced in the following:

D.J. Brunckhorst, "Using Context in Novel Community Based Natural Resource Management: Landscapes of Property, Policy and Place," *Journal of Environmental Conservation* 37, no.1 (2010): 1-7.

D.J. Brunckhorst et al., "Strategic spatial governance: Deriving social-ecological frameworks for managing landscapes and regions," in *Landscape Analysis and Visualisation: Spatial Models for Natural Resource Management and Planning*, C. Pettit et al., eds. (Berlin: Springer, 2008): 253-276.

J. Graham, I. Reeve, and D.J. Brunckhorst, eds. *Landscape Futures: Social and Institutional Dimensions*. Refereed proceedings of the Second International Symposium on Landscape Futures, December 2001. (Armidale. NSW, Australia: Institute for Rural Futures, University of New England, 2002).

P. Morley and D.J. Brunckhorst, *Sea-Change and Landscape Change* (Saarbrucken, Germany: Lambert Academic Publishing, 2010).