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## Environmental livelihood security in Southeast Asia and Oceania



This policy brief integrates sustainable livelihoods thinking into discussions on environmental security and the water-food-energy nexus, responding both to a gap in the literature and to emerging policy discourse. We present the first conceptualization of 'environmental livelihood security', a concept which draws upon frameworks of water-energy-food security and sustainable livelihoods. The geographical focus is Southeast Asia and Oceania, a region where populations are particularly vulnerable and threatened by the impacts of a changing climate. Various socio-environmental pressures act as an external forcing mechanism on communities attaining environmental livelihood security in this region. We provide a primer for using geospatial information to enable the development of a framework to spatially assess environmental livelihood security. The value of this research is highlighted through linkages to ongoing sustainable development and climate-compatible discussions, and by identifying the relevance for influencing policy agendas.

### Key messages

- Southeast Asia and Oceania is highly vulnerable to environmental change, owing to numerous island nations and low-lying coastal regions with a high dependency on the environment for sustaining livelihoods.
- Principle socio-environmental pressures in the region stem from meteorological hazards, sea level rise, changes in ocean composition, biodiversity threats, pollution, demographic change and urbanization.
- Through combining aspects of the water-energy-food nexus with sustainable livelihoods, we conceptualize 'environmental livelihood security' which can assist in assessing these environment-livelihood pressures.
- Geospatial information provides a valuable resource for assessing environment-livelihood change across multiple scales, and can help identify sustainable development solutions.

## Context

Environmental livelihood security (ELS) refers to the challenges of maintaining global food security, and universal access to freshwater and energy, in order to sustain livelihoods and promote inclusive economic growth whilst also sustaining environmental functionality. ELS explicitly incorporates the notion of sustainable livelihoods into the water-energy-food nexus concept whilst integrating aspects of environmental and human security. This approach, developed by a multi-disciplinary research team with the ability to link these concepts (in theory and practice) from both a quantitative and qualitative research perspective, provides a conceptualization for examining the influence of environmental resources availability on livelihood security across geographical scales. Southeast Asia and Oceania (SAO) was chosen as the region on which to develop the ELS concept, as livelihoods in this region have a high inter-dependency with the environment. We further discuss the value of geospatial information for assessing changes in ELS.

## The environment of Southeast Asia and Oceania

SAO comprises four broad climatic regions. **Arid and Semiarid Asia** is characterized by an arid tropical climate with hot summers and cold winters, and with 'mid-latitude westerlies' dominating. **Temperate Asia** receives the greater part of the precipitation during the summer wet season, driven by the East Asian monsoon, and has been affected by severe droughts and floods which are thought to be associated with the El Niño-Southern Oscillation (ENSO). **North Tropical Asia** and **South Tropical Asia** are characterized by minimal seasonal temperature variation with marked seasonal precipitation variation, resulting in distinct wet and dry seasons.

Given the climate characteristics of SAO, the region is perceived to be highly vulnerable to climate change, as the area geographically comprises many island nations (particularly small island developing states [SIDS]) and low-lying coastal zones. These areas have a low elevation and high dependency on ocean ecosystems for survival, leaving them highly exposed to the potential negative impacts of climate change.

Communities in SAO are highly dependent on the environment for sustaining their livelihoods, from fisheries to tourism, yet climate and environmental pressures severely impact on social vulnerabilities. For example:

- Meteorological hazards, such as tropical cyclones, present hazardous conditions from extreme winds, storm surge inundation, saltwater intrusion, flooding and landslides from intense precipitation.

- Sea level rise is threatening both society and ecosystems throughout the region, with the greatest rises observed in North Tropical Asia around Papua New Guinea and Western Australia.
- Changes in ocean temperatures and salinity are altering ocean stratification, resulting in inhibited mixing and the reduction of nutrient supplies. Ocean acidification is impacting marine ecosystems, particularly reef-building corals.
- The region is host to multiple biodiversity hot spots; yet, rapid land-use change has resulted in habitat fragmentation and a decline in biodiversity.
- Agricultural pollution affects land and water quality, and toxic contaminants from marine debris are further affecting ecosystems.

Anthropogenic climate warming is predicted to change the frequency and intensity of temperature and precipitation extremes, resulting in greater societal impacts from natural hazards such as drought and flooding. In addition, social, demographic, cultural and political factors further exacerbate vulnerabilities through pressures such as the following:

- Migration and population displacement is resulting in heightened vulnerability due to disproportionate exposure to health risks and natural disasters.
- Urbanization is resulting in rapid urban population growth and depopulation of rural regions, placing pressure on infrastructure and food production.
- Marginalization of ethnic minorities and indigenous groups in geographically isolated regions. Gender disparities are also apparent in parts of SAO.
- Issues of land availability and security of land tenure are affecting the sustainable production of food systems.

## Conceptualizing 'Environmental livelihood security'

Given the requirements for long-term **sustainable development** of natural resources in SAO, it is relevant to consider the water-energy-food nexus as a basis to conceptualize a framework to assess changes in environmental security. The **water-energy-food nexus** seeks to optimize efficiencies in food, energy and water systems through integrated and adaptive management approaches which recognize interdependencies between these systems. At the same time, such integrated and adaptive management should aim to reduce pressure

on ecosystems, reduce negative externalities and foster positive human development trajectories. Viewing the nexus through an environmental lens, one would consider 'security' to be achieved when the unit of analysis has the capabilities and assets to utilize environmental resources in a sustainable manner to support and further well-being. Climate is included within the nexus approach given its inextricable link to attaining a secure and sustainable livelihood throughout many communities of the SAO region. We term this quadrilateral mutualism the 'Environment Nexus', a concept which can be used to denote water, energy and food security for sustainable development under a changing climate.

However, what isn't denoted within nexus constructs is the explicit consideration of livelihoods. A **sustainable livelihoods approach** is a holistic method of addressing development through the establishment of objectives that focus on people's livelihoods, while providing an analytical tool for understanding the factors influencing a community's ability to enhance livelihoods and eradicate poverty. **Environmental security** is a concept linking human well-being to the state of the environment, and is considered as security from environmental shocks or stresses, linking societal well-being to environmental functioning. Strong parallels exist between the concepts of the environment nexus, environmental security and sustainable livelihoods. The fundamental issue of attaining 'sustainable livelihood security' led to the conceptualization of ELS, combining the strengths of the nexus approach with those of sustainable livelihoods (Figure 1).

## Geospatial information for assessing ELS

Currently, many 'security' assessments are still constrained by national boundaries, often masking intra-nation or intra-basin insecurity and gradients in environmental stresses and conditions. The use of geospatial information to assess changes in ELS can enable a move away from state-centered assessments of environmental threats, and sustainable development solutions can be explored at multiple scales. A mixed-methods approach can be developed to assess changes in ELS through the integrated use of Earth observation data. Satellite systems provide a unique opportunity to continuously monitor the Earth at regular intervals, with satellite-based information greatly enhancing our knowledge and understanding of the processes and dynamics within Earth systems. Quantification of biophysical variables using remote sensing satellites provides major advances in understanding environmental change. Proxy datasets can also be used for mapping socioeconomic change. Example uses for ELS monitoring include the following:

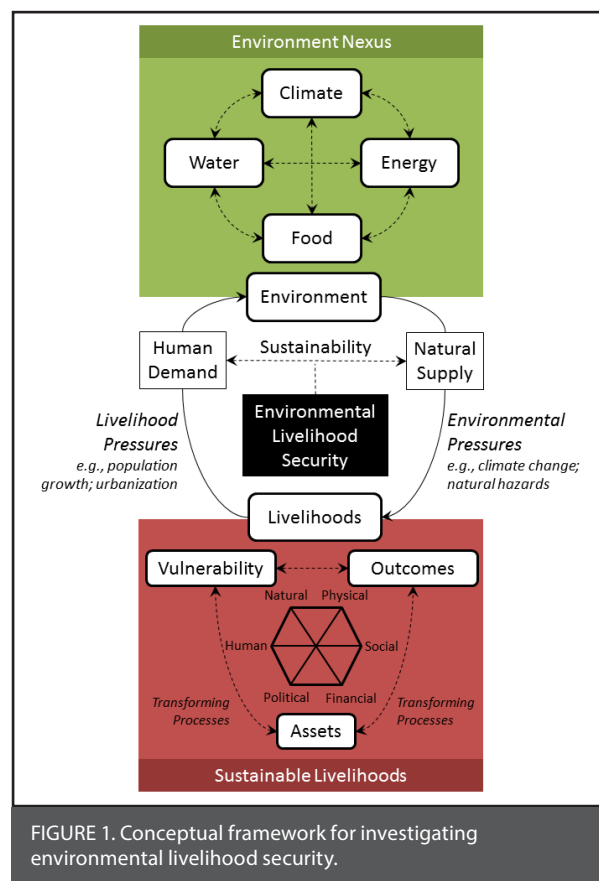


FIGURE 1. Conceptual framework for investigating environmental livelihood security.

- Evapotranspiration (e.g., Moderate Resolution Imaging Spectroradiometer [MODIS] satellite data) and precipitation (e.g., Tropical Rainfall Measuring Mission [TRMM] satellite data) information can be used to assess changes in water security components.
- Land cover products (e.g., MODIS and Landsat satellite data) can be used for monitoring changes in croplands, phenology, productivity and yield.
- Nighttime lights and land cover data can be used to examine changes in land use, population densities and urbanization (e.g., WorldPop).

Earth observation data can also be used for monitoring external pressures on ELS, such as the impact, response and recovery of natural disasters. Volunteered Geographic Information (VGI) obtained from crowdsourcing is also becoming an increasingly important source of contextual geospatial data for monitoring socio-environmental change. Supplementing these data with qualitative and in-depth data will be necessary depending on the scale of the system being assessed.

## How is ELS useful for policymakers?

- ELS explicitly accounts for livelihoods when considering sustainable development options for attaining water, energy and food security.
- The ELS construct has theoretically paved the way for providing a new and comprehensive framework for assessing human development and environmental change from a sustainable perspective.
- Spatial monitoring of ELS will enable organizations, such as the United Nations, to monitor the progress of development within and between nations.

### Source

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