



Editorial

Ecosystem Service and Land-Use Changes in Asia: Implications for Regional Sustainability

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This Special Issue focuses on qualitative and quantitative analyses of ecosystem services (ESs) specifically toward sustainability in Asia. Asia is expected to experience population growth, peaking around 2030–2060 [1], which will likely result in unpredictable socio-economic changes that will present new challenges for land management. Sustainable land and natural resource management will play a crucial role in addressing these issues in the region. In particular, assessing land-use change and its effects on ESs is necessary to foster regional sustainability.

In response to the trade-offs in multiple land use, the concept of ESs has been introduced to find synergies between nature conservation and other aspects of human wellbeing. In recent years, many studies have addressed the impacts of land-use change on bundles of ESs by considering the influences of direct and indirect factors, e.g., region-specific changes in population and other socio-economic statuses. These case studies provide insight on how land use, with the interaction of historical land management, has configured the services provided by ecosystems. Thus, the findings from such empirical studies contribute to developing sustainability in Asia at both local and regional scales.

This Special Issue includes fifteen research papers that explore the impacts of direct and indirect drivers affecting ES provision in Asian countries, including China, India, Mongolia, Sri Lanka, and Vietnam. In this editorial, we briefly describe the contributions of each paper and how the analysis revealed the changes in ESs and could contribute to the intervention for regional sustainability in Asia.

The driving factor most frequently discussed in the Special Issue is urban development. The world's urban population is expected to nearly double by 2050, making urbanization one of the most disruptive developments. Yang and Liu [2], in their study titled "Spatio-Temporal Evolution and Driving Factors of Ecosystem Service Value of Urban Agglomeration in Central Yunnan", examined the spatiotemporal pattern of urban land changes in central Yunnan and found a significant decline of ecosystem service values (ESVs). The study highlights the need to have a balance between ecological conservation and urban development.

In examining the impacts of land change, scenario analysis is an effective method for providing implications for future land use planning and development. Yang and Su [3], in their study titled "Multi-Scenario Simulation of Ecosystem Service Values in the Guanzhong Plain Urban Agglomeration, China", investigated the response of ESVs to land use change in an urban agglomeration under different future scenarios and the trade-offs among various ESVs. Peng et al. [4], in their study titled "Evaluation of ESV Change under Urban Expansion Based on Ecological Sensitivity: A Case Study of Three Gorges Reservoir Area in China", applied the ecological sensitivity approach as a basis for predicting future urban expansion. These scenario assessments provide insight into ecosystem conservation under sustainable urbanization by predicting changes in urban land expansion that affect ESVs. In



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general, the scenario approach is applicable to other urban ecosystems. Athukorala et al. [5], in their study titled “Ecosystem Services Monitoring in the Muthurajawela Marsh and Negombo Lagoon, Sri Lanka, for Sustainable Landscape Planning”, examined the impacts of urbanization on the natural landscape and ecosystem services of Muthurajawela Marsh and Negombo Lagoon (MMNL), an important wetland ecosystem in Sri Lanka. Between a business-as-usual scenario and an ecological protection scenario, the study suggests the latter as the more desirable future scenario because ecological protection policies can help flatten the MMNL’s curve of continuous ecological degradation.

In contrast to these comprehensive scenario analyses, empirical approaches that focus on specific ecosystem services provide detailed evidence to practitioners in urban planning. Du et al. [6], in their study titled “The Impact of Impervious Surface Expansion on Soil Organic Carbon: A Case Study of 0–300 cm Soil Layer in Guangzhou City”, showed that impervious surface expansion leads to soil organic carbon (SOC) loss and that retrofitting residential areas with low-rise buildings can significantly reduce SOC loss compared to the urbanization of agricultural land. For a large-scale development, Zhang and Hu [7] analyzed the effect of topography on ES in their study titled “Spatial Variation and Terrain Gradient Effect of Ecosystem Services in Heihe River Basin over the Past 20 Years”. They showed that terrain gradient effects have a significant impact on ESs in inland watersheds, providing a scientific basis for optimizing local ecological patterns.

Two case studies in India are examples of analyses in which climate change scenarios were introduced in order to provide implications for climate change adaptation measures. Chandra et al. [8], in their study titled “Investigation of Spatio-Temporal Changes in Land Use and Heat Stress Indices over Jaipur City Using Geospatial Techniques”, estimated the rise of thermal stress in urban areas in India based on land use and climate change scenarios. They applied physical indicators to assess urban conditions during various periods of thermal stress. This detailed spatial analysis of environmental changes in urban spaces is an important contribution to urban planning that takes into account urban ESs such as green space structure. Mitra et al. [9], in their study titled “Assessment of the Impacts of Spatial Water Resource Variability on Energy Planning in the Ganges River Basin under Climate Change Scenarios”, simulated future water availability by applying climate change scenarios to examine the risks facing existing and planned power plants. The results provide development planners, energy planners, and investors with information on the spatial distribution of power plants that would be at risk, allowing them to make more accurate decisions regarding the siting of future power plants.

Asia also needs to address the vulnerability of arid ecosystems to climate change. Wang et al. [10], in their study titled “Evaluation of Qinghai-Tibet Plateau Wind Erosion Prevention Service Based on RWEQ Model”, assessed the use of wind erosion control services as a way for improving the quality of the ecological environment. They identified factors governing the spatial differentiation of wind erosion control services and showed that the ES can be improved by reverting agricultural land in this area to grassland and controlling desertification.

Indirect drivers such as indigenous and local knowledge, technology, and financial assets play a major role in influencing the direct drivers of change in nature, nature’s contribution to people, and quality of life at different spatial and temporal scales [11]. Ulziibaatar and Matsui [12], in their study titled “Herders’ Perceptions about Rangeland Degradation and Herd Management: A Case among Traditional and Non-Traditional Herders in Khentii Province of Mongolia”, focused on traditional and non-traditional pastoralists’ land management. Herders play essential roles in sustaining Mongolia’s economy and rangeland conditions. They found that pastoralists are willing to cooperate with local managers in rangeland management, providing implications for future management regimes.

Case studies exploring new systems in modern societies can provide insights into future natural resource management regimes in Asia. Pham et al. [13], in their study titled “Food Waste in Da Nang City of Vietnam: Trends, Challenges, and Perspectives toward Sustainable Resource Use”, investigated the extent of food waste generation at the consumption

stage, the eating habits of consumers, and the potential for reusing food waste as feed. They proposed both consumer waste prevention and waste management as effective measures for sustainable resource use. From a broader perspective, Morey et al. [14], in their study titled “Towards Circulating and Ecological Sphere in Urban Areas: An Indicator-Based Framework for Food-Energy-Water Security Assessment in Nagpur, India”, proposed a new framework of indicators to address integrated food, energy, and water security in urban areas, based on the principles of a new concept called the Circular Ecosphere (CES). They concluded that food–energy–water nexus thinking can help establish the linkages between different resource management sectors and policies, thereby facilitating the application of CES.

As a method for exploring the nature of institutions aimed at conserving and restoring ecosystems, participatory approaches have an effective role in encouraging the participation of diverse stakeholders. Ratnayake et al. [15], in their study titled “Land Use-Based Participatory Assessment of Ecosystem Services for Ecological Restoration in Village Tank Cascade Systems of Sri Lanka”, applied a participatory approach involving the integration of local knowledge, expert judgements and land use systems attribute data to assess the ESs. Chen et al. [16], in their study titled “Payments for Watershed Ecosystem Services in the Eyes of the Public, China”, showed that the public had limited knowledge of the payment for ESs schemes. Therefore, improving public acceptance is essential for more effective payment schemes, and further research is needed on the impact of payment schemes on the public.

The integration of participatory methods and scientific simulation is also important in the context of coastal water resource management. Kumar et al. [17], in their study titled “Scenario-Based Hydrological Modeling for Designing Climate-Resilient Coastal Water Resource Management Measures: Lessons from Brahmani River, Odisha, Eastern India”, applied a participatory modeling to evaluate current status and predict future conditions of river water quality, which is critical for people’s livelihood in the region. The integration of participatory approach and computer simulation modeling, with the active participation of stakeholders, can enhance the science–policy interface for natural resource conservation and help co-generate future options.

In conclusion, this Special Issue presents case studies relating to the management of lands, natural resources and ESs in Asia. A variety of methods are employed, depending on the intended policy intervention, ranging from studies of individual services to more comprehensive ES assessments, studies that consider direct and indirect factors, and policy-oriented studies that explore with stakeholders how future institutions could be introduced into the society. It is noteworthy that continued efforts to address issues of ecosystem change and sustainability in Asia require not only monitoring of Asia’s diverse ecosystems, but also recognition of the various values that can influence human engagement and policy decisions.

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