International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 6, September-October 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Biophysical Foundations of Production and Consumption of Human Economy Sources and Sink Functions of the Ecosystem

Dr. Anshumala Chandangar

Assistant Professor, Department of Economics, Govt. V.Y.T. PG Autonomous College, Durg, Chhattisgarh, India

ABSTRACT

Three major problems associated with our management of the world's ecosystems are already causing significant harm to some people, particularly the poor, and unless addressed will substantially diminish the long-term benefits we obtain from ecosystems: First, approximately 60% (15 out of 24) of the ecosystem services examined during the Millennium Ecosystem Assessment are being degraded or used unsustainably, including fresh water, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests. The full costs of the loss and degradation of these ecosystem services are difficult to measure, but the available evidence demonstrates that they are substantial and growing. Many ecosystem services have been degraded as a consequence of actions taken to increase the supply of other services, such as food. These trade-offs often shift the costs of degradation from one group of people to another or defer costs to future generations. Second, there is established but incomplete evidence that changes being made in ecosystems are increasing the likelihood of nonlinear changes in ecosystems (including accelerating, abrupt, and potentially irreversible changes) that have important consequences for human well-being.

KEY WORDS: *production, consumption, human, economy, ecosystem, sustainable, management*

How to cite this paper: Dr. Anshumala Chandangar "Biophysical Foundations of Production and Consumption of Human Economy Sources and Sink Functions of the Ecosystem" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-6, October 2021, pp.1483-1491, URL: www.ijtsrd.com/papers/ijtsrd47663.pdf

IJTSRD47663

Examples of such changes include disease emergence, abrupt alterations in water quality, the creation of "dead zones" in coastal waters, the collapse of fisheries, and shifts in regional climate. Third, the harmful effects of the degradation of ecosystem services (the persistent decrease in the capacity of an ecosystem to deliver services) are being borne disproportionately by the poor, are contributing to growing inequities and disparities across groups of people, and are sometimes the principal factor causing poverty and social conflict. This is not to say that ecosystem changes such as increased food production have not also helped to lift many people out of poverty or hunger, but these changes have harmed other individuals and communities, and their plight has been largely overlooked. In all regions, and particularly in sub-Saharan Africa, the condition and management of ecosystem services is a dominant factor influencing prospects for reducing poverty. The degradation of ecosystem services is already a significant barrier to achieving the Millennium Development Goals agreed to by the international community in September 2000 and the harmful consequences of this degradation could grow significantly worse in the next 50 years. The consumption of ecosystem services, which is unsustainable in many cases, will continue to grow as a consequence of a likely three- to sixfold increase in global GDP by 2050 even while global population growth is expected to slow and level off in mid-century. Most of the important direct drivers of ecosystem change are unlikely to diminish in the first half of the century and two drivers— climate change and excessive nutrient loading—will become more severe. Already, many of the regions facing the greatest challenges in achieving the MDGs coincide with those facing significant problems of ecosystem degradation. Rural poor people, a primary target of the MDGs, tend to be most directly reliant on ecosystem services and most vulnerable to changes in those services. More generally, any progress achieved in addressing the MDGs of poverty and hunger eradication, improved health, and environmental sustainability is unlikely to be sustained if most of the ecosystem services on which humanity relies continue to be degraded. In contrast, the sound management of ecosystem services provides cost-effective opportunities for addressing multiple development goals in a synergistic manner. There is no simple fix to these problems since they arise from the interaction of many recognized challenges, including climate change, biodiversity loss, and land degradation, each of which is complex to address in its own right. Past actions to slow or reverse the degradation of ecosystems have yielded significant benefits, but these improvements have generally not kept pace with growing pressures and demands. Nevertheless, there is tremendous scope for action to reduce the severity of these problems in the coming decades.

INTRODUCTION

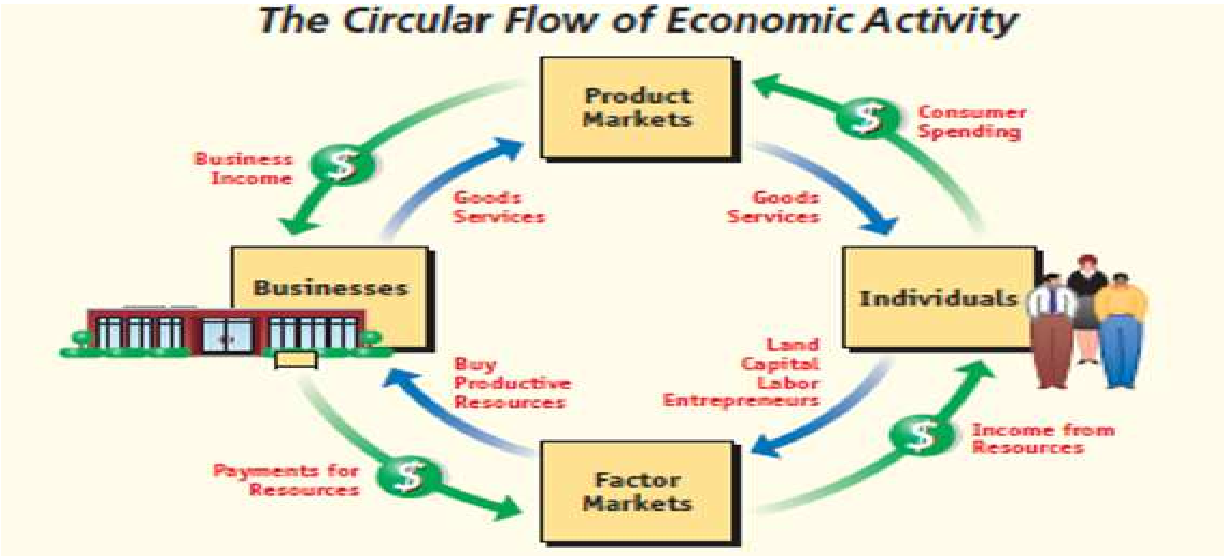
Ecosystems and the biological diversity contained within them provide a stream of goods and services, the continued delivery of which remains essential to our economic prosperity and other aspects of our welfare. In a broad sense, ecosystem services refer to the range of conditions and processes through which natural ecosystems, and the species that they contain, help sustain and fulfil human life (1). These services regulate the production of ecosystem goods, the natural products harvested or used by humans such as wild fruit and nuts, forage, timber, game, natural fibres, medicines and so on. More importantly, particularly for those in less developed economies, ecosystem services support life by regulating essential processes, such as purification of air and water, pollination of crops, nutrient cycling, decomposition of wastes, and generation and renewal of soils, as well as by moderating environmental conditions by stabilising climate, reducing the risk of extreme weather events, mitigating droughts and floods, and protecting soils from erosion. For the purposes of this report, ecosystem services have been grouped into six categories broadly based on both their ecological and economic function.

These are:

- Purification and Detoxification: filtration, purification and detoxification of air, water and soils;
- Cycling Processes: nutrient cycling, nitrogen fixation, carbon sequestration, soil formation;
- Regulation and Stabilisation: pest and disease control, climate regulation, mitigation of storms and floods, erosion control, regulation of rainfall and water supply
- Habitat Provision: refuge for animals and plants, storehouse for genetic material;
- Regeneration and Production: production of biomass providing raw materials and food, pollination and seed dispersal; and
- Information/Life-fulfilling: aesthetic, recreational, cultural and spiritual role, education and research.

The causes of biodiversity loss and ecosystem function damage due to unsustainable production and consumption patterns are almost too numerous to mention. The drivers can be interdependent, driven by local, national or global factors and include:

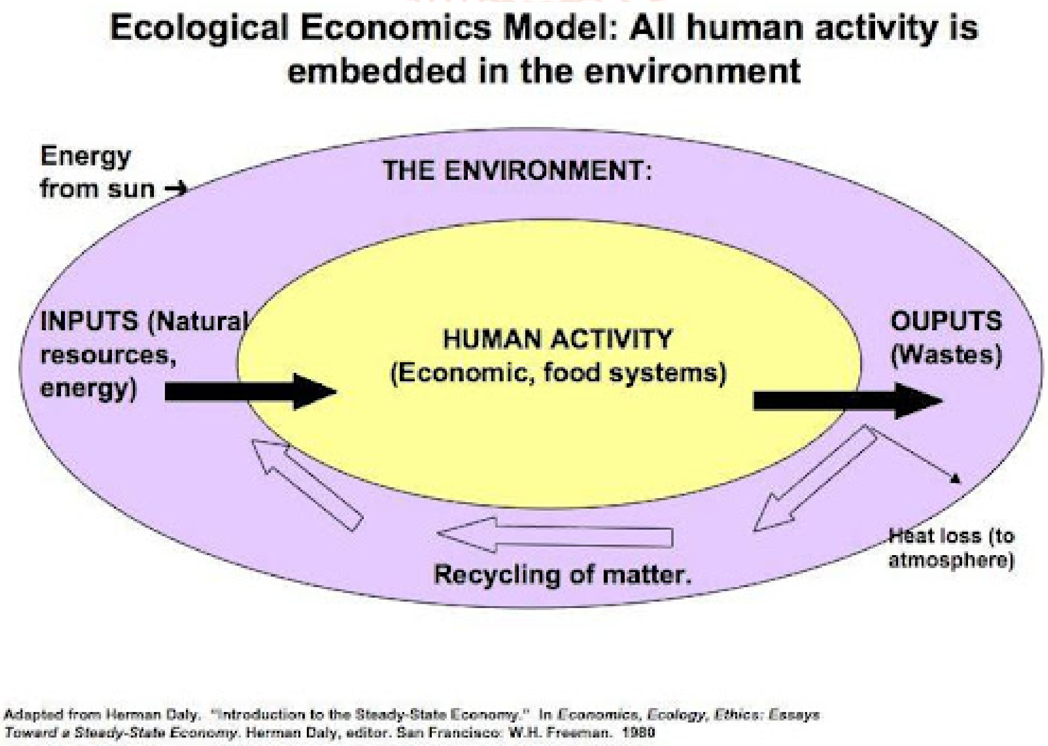
- Market and economic policy failures, such as perverse subsidies, absence of markets for ecosystem goods and services, and inadequate or non-existent information about the value of goods and services; • Issues of governance, such as absence of clearly defined and secure property rights, clear environmental policies and policy goals, poor enforcement of existing regulation, corruption, lack of political will, lack of capacity and inadequate information and knowledge; and
- Global demographic and other factors, such as human population growth, poverty, wars and unrest.



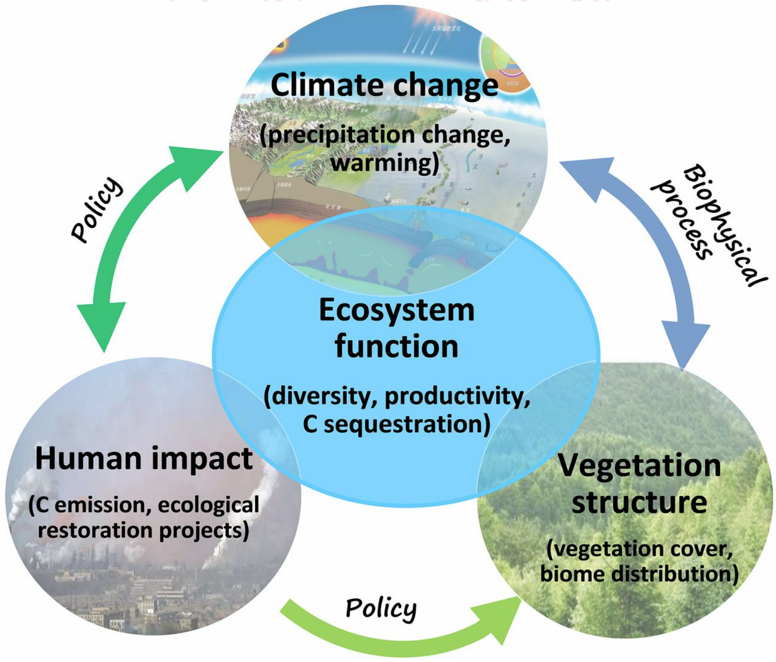
Information on the economic value of ecosystem services will not on its own provide a solution to ecosystem degradation. The real challenge is to use this information to redress market and policy failures. This can be done by removing perverse incentives such as subsidies that encourage degradation and creating positive incentives for achieving sustainable outcomes through payments for ecosystem services, creation of markets for services, or other incentives for sustainable resource management. This is the 'demonstration - capture' paradigm in environmental economics where demonstration of economic value should lead to their 'capture' through market or other mechanisms (where 'capture' infers turning at least some of the economic value into cash).

OBSERVATIONS

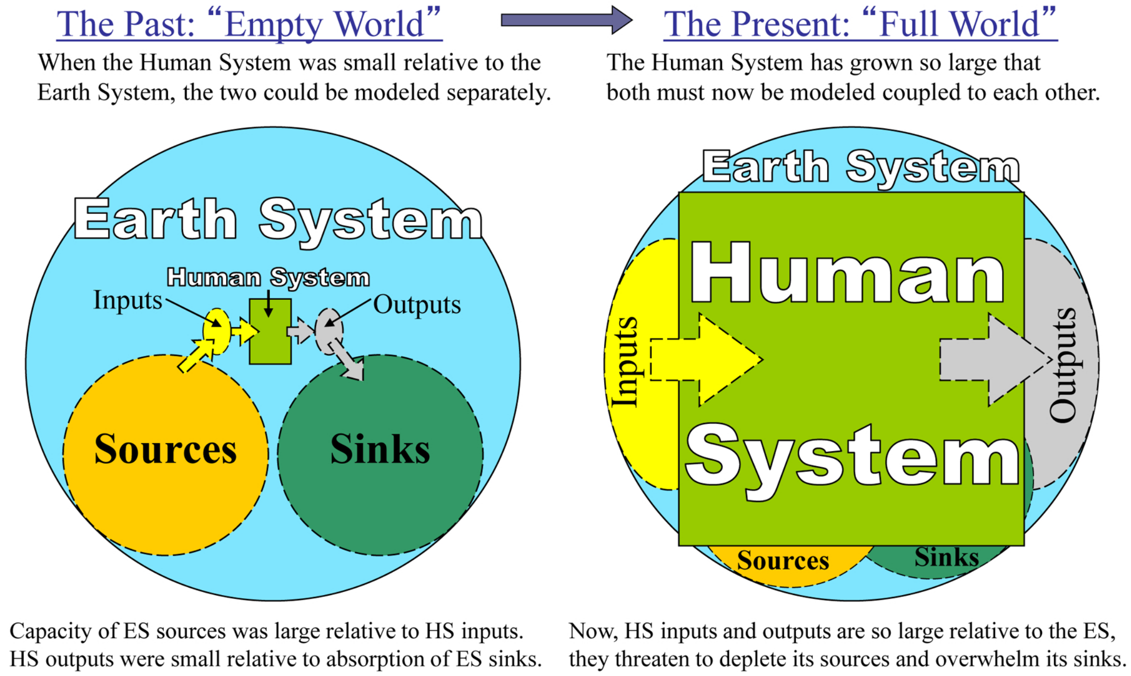
The distribution of benefits of ecosystem goods and services among different beneficiary groups at different time periods is a crucial factor when considering the value of ecosystem goods and services. In terms of beneficiaries, we can think of individuals (the basic unit in estimating the total economic value), commercial entities and the public sector as forming broad categories. Often when decisions are made about resource use, the inclusion of the interests of the global community can tip the balance. This is especially the case when it comes to nonuse and option values and even more so when mechanisms to capture these values for the local communities can be put in place. Another scale at which the conflicts between users, or trade-offs between uses, become evident is that of temporal variation of ecosystem goods and services. Benefits and beneficiaries vary between short vs. long term, and this variation is clearest when exploitation of ecosystem goods in the short term leads to a decline in ecosystem services in the long term. One of the most striking examples of this is logging in the short term, which may lead to decline or loss of watershed and other services of forests.



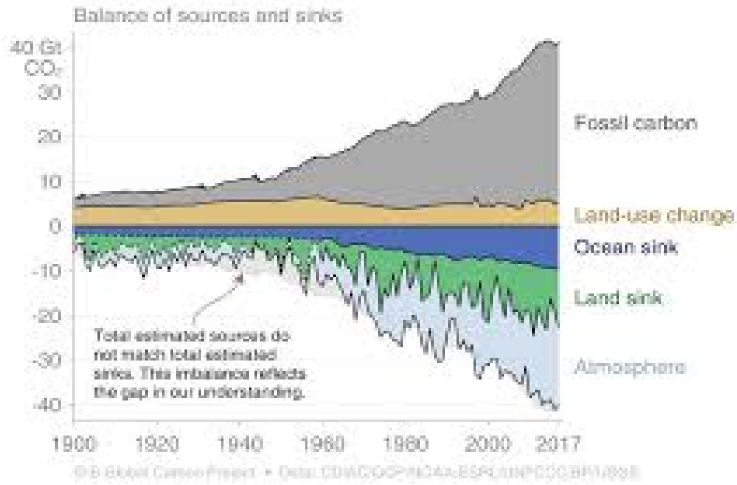
The Food and Agricultural Organisation (FAO) defines forests as an area with (a) an existing or expected tree canopy of more than 10%; and (b) a total area of more 0.5 hectares where trees reach at least 5 metres in size (FAO, 2000). This definition extends to natural forests, forest plantations and land from which forest has been cleared but that will be reforested in the foreseeable future. However, stands of trees established primarily for agricultural production, such as fruit tree plantations are excluded from this definition (2). Defined as such, forests are among the world's most important biomes in terms of the area of land surface they cover (approximately 30% of all land - over 3.8 billion hectares (3)), the goods and services they provide, and the biodiversity they contain (approximately 90% of terrestrial biodiversity). The World Bank (2001) highlights that more than 1 billion people depend on forests for their livelihoods to varying degrees. Sixty million indigenous people are almost wholly dependent on forests, while around 350 million people living within or adjacent to dense forests depend on them to a high degree for subsistence and income. In developing countries, agro-forestry farming schemes support 1.2 billion people and help sustain agricultural productivity and the generation of income. Forest industries provide employment for some 60 million people worldwide. The medical needs of approximately one billion people depend on drugs derived from forest plants, many of which have been long been used in traditional medicine In recognition of the importance of forest ecosystems and the services provided, the proportion of forest cover to total land area (excluding inland waters) has been adopted as an indicator measure for monitoring progress towards achieving the Millennium Development Goals (MDGs) adopted by the member states of the United Nations under the 2000/2002 Millennium Declaration (United Nations, 2001). Forest cover is monitored in relation to the target of 'integrating the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources' under the goal of 'ensuring environmental sustainability'. Monitoring forest cover reveals the relative importance of forest land within countries, while changes in forest cover reflect the demand for land from other competing uses (4).



Agro-ecosystems are estimated to cover between 28 and 37% of total land area, though this includes some overlap with forests and grasslands, given ecosystem fragmentation. About 69% are permanent pasture while the remainder are crops, of which 91% are annual and 9% perennial (5). These human dominated landscapes range from highly intensive and mechanised agricultural systems to more extensive subsistence systems. Agriculture is a critical economic sector, especially in the developing world. It is most important to the economies of low-income countries, accounting for approximately 31% of GDP overall and 50% of GDP in SubSaharan Africa. In the middle and high income countries, by contrast, it accounts for 12% and 1-3% of GDP, respectively. Yet conventional measures of GDP greatly understate agriculture's contribution to the economy, which should also include upstream and downstream manufacturing and services. Agriculture also provides many jobs, in the order of 56% to 65% of the total labour force in Asia and Sub-Saharan Africa (6). The case of agriculture and ecosystem services is thus a particularly pertinent one, as agriculture is essentially a man-made ecosystem. At the same time as natural cycles (e.g. carbon and nutrient cycles) affect agriculture, they are altered by farming activities. Therefore, this section, in contrast to the previous two, highlights the role of biodiversity and ecosystem services in providing for agriculture, and examines the fragile relationship between certain farming practices and sustaining ecosystem services.

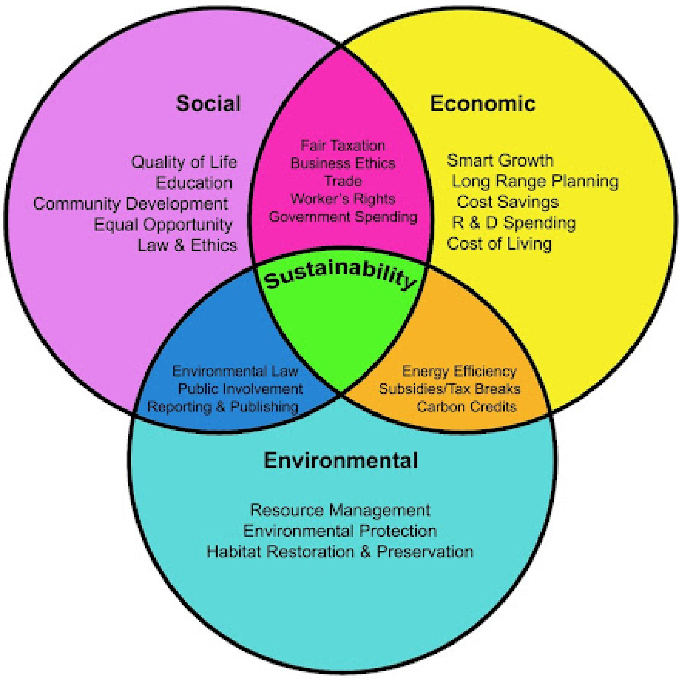


All ecosystems deliver goods and services to humankind and therefore have economic value, where economic value is defined as all contributions to human welfare (financial, social, environmental and health). These ecosystem services include the purification of air and water, the pollination of crops, nutrient cycling and decomposition of wastes, the generation and renewal of soils, stabilisation of climate, mitigation of droughts and floods, and protecting soils from erosion. This review of the ecological and economic literature for a subset of ecosystems, namely, forests, wetlands and agro-ecosystems, describes the value of ecosystem goods and services from a multi-disciplinary perspective, and uses examples to demonstrate key issues. Evidence from the ecological literature demonstrates the complexity of ecosystem functioning, and the unpredictability of ecosystem responses to the multitude of human pressures. In general, land management decisions tend to emphasise only a subset of these ecosystem consequences, and usually only at local scales, and the full range of ecosystem services is rarely recognised let alone explicitly considered. While ecological science has repeatedly highlighted the general pattern of ecosystem responses to human-imposed stress, including the existence of response discontinuities characterised by sudden and often catastrophic environmental change, quantifying these patterns and predicting the location of thresholds continue to elude us. Evidence from the economic literature of the value of ecosystem services, differentiates between the value of goods which are used directly (e.g. timber, fish, etc) and those services which indirectly support and contribute to production systems and human welfare (e.g. watershed services and nutrient cycling). Ecosystem services are also valuable for reasons not related to their use (non-use value), for example because we believe they should exist for others now or in future and for their own sake. Use and non-use values combine to give the total economic value (TEV) of a resource. Through analysing the changes in the TEV, economics provides a framework that recognises the distribution of economic benefits between (or economic values held by) different stakeholders, there are gaps in the quantitative evidence base, which are discussed below. Individual economic studies have generally been undertaken to inform a particular land-use decision at a local level, in most cases seeking to monetise the loss of total economic value due to degradation of ecosystem services. These studies have examined opportunity costs, replacement costs, contributions to local livelihoods (income), non-use values and so on. Evidence of large scale benefits from ecosystem services is demonstrated in this literature through high aggregate willingness to pay of affected populations for those services. Economic analysis also shows that maintaining ecosystems in an unused/undeveloped state is economically viable, i.e. generates higher welfare than use or development, generally only when all components of TEV are taken into account showing the importance of indirect use and non-use values.(21)



DISCUSSIONS

In the face of the uncertainties about the impact of human activities on ecosystems, the greatest challenge for ecologists is to parameterise existing models of ecosystem response allowing for an informed and economically optimal decision making environment. Finally, ecological science provides a conceptual framework by which the responses of different ecosystem services may be recognised at appropriate scales. Assessing the outcome of land use decisions requires explicit recognition of several spatial and temporal scales of analysis. Integrating our knowledge of ecosystem properties and dynamics into economic assessments of land use is essential to determine the full costs of alternative land-use options. Most of the economic studies reviewed for this report concentrate on a single use of a single good or service of a given ecosystem. This assessment of the literature is also made by (7). The difficulties in understanding the ecosystem dynamics and reflecting these in decision-making, however, lie in the interactions of multiple goods and services of ecosystems and how these affect the benefits received from these ecosystems. Therefore, future economic research in this area should consider a range of interdependent ecological functions, uses and economic benefits at a given site; or track changes in site values across different states of ecological disturbance. (20) The information from this will not only help decision makers with the complex trade-offs between conservation, sustainable use and development but also trade-offs between local, national / regional and global beneficiaries. The measures that can capture more of the economic value and increase the incentives for conservation are touched upon only briefly here due to the scope of the current study. Future research should investigate the necessary conditions for such measures and their relative merits. For example, the research could (i) examine the success of a particular incentive mechanism across locations (e.g. countries); (ii) consider the appropriateness of mechanisms for different ecosystems or types of ecosystem stress; or (iii) study the relative effectiveness of different mechanisms in a particular location. A starting point for this research would be a review of the literature on finance for ecosystem services, which is continually being updated.(19)

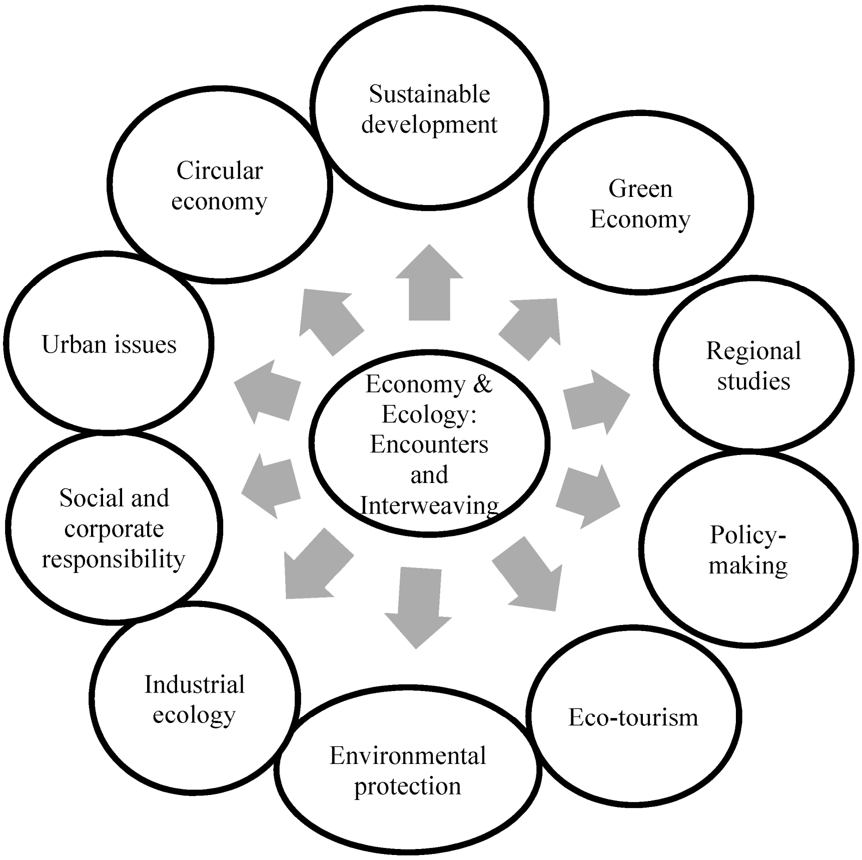


Proper valuation and accounting of natural resources are necessary for robust development planning. Just as necessary are transparent institutions and good governance. Decision-making that is inclusive helps provide not only legitimacy for resource management policies, but ensures that the range of knowledge and social interests and values are considered in policy-making. Managing natural resources generally entails also managing competing demands and multiple resources and values as well as providing for environmental protection, which requires an integrated approach. High-quality institutions that promote economic growth are at the heart of good governance. This includes regulatory authorities that are reliable and free of corruption, transparent and accountable; reliable property rights and functioning markets; the absence of harmful subsidies that interfere with sustainable resource use; the rule of law and adequate legal recourse.(18)

The wealth embodied in natural resources makes up a significant proportion of the wealth of most nations, often more than the wealth embodied in produced capital, therefore making natural resources management a key aspect of economic development (8). Many countries have seen significant rises in revenues from natural resources due to the rise in commodity prices. Natural resources such as oil, gas, minerals and timber are expected to continue to play a significant role in resource abundant economies, as demand from rapidly growing economies increases, and as supplies of non-renewable resources decline and renewable resource harvests approach maximum sustained yield levels. Not surprisingly, countries richly endowed with natural capital have the potential to derive significant current income from resources.

RESULTS

Payments for ecosystem services (PES) provide incentives for owners of natural resources such as farmers and forest owners to manage resources in order to provide ecological services. PES are defined as voluntary transactions in which a well defined environmental service is bought and sold by at least one buyer and one seller, provided that the seller actually ensures that the ecosystem service is provided (9). Key environmental services such as carbon sequestration, biodiversity protection, watershed protection, and landscape beauty may be targeted in a PES scheme (10). In order to be effective, then, PES systems must target a well-defined ecosystem service and ensure that payments add to the ecosystem service that would be provided under a business as usual scenario. Moreover, they must be able to monitor the provision of the ecosystem service. PES policies would in most instances complement other policies. The voluntary nature of PES means that they enjoy high legitimacy among participants. Payments are typically calculated on the basis of foregone revenue from resource use as well as costs incurred in providing the ecosystem service. PES systems are thus intended to maintain livelihoods while valuing, and paying for, the wider social benefits derived from ecosystem services. PES schemes are not particularly easy to design and implement and require a substantial amount of initial effort. Baselines for ecosystem services must be established in order to determine if PES provide additional value.(17) PES schemes also depend upon social capital embodies in the trust between buyers and sellers, and may require an intermediary such as an NGO to develop (11). Moreover, transaction costs may be high. Incorporating a PES scheme into the policy mix therefore necessitates a careful weighing of the costs and benefits of such a scheme in relation to other policy instrument options. However, PES schemes are increasing in number around the world, sometimes with the strategic support of the NGO and international communities. For instance, WWF has worked in Moldova, Romania, and Ukraine to identify land uses and environmental services that could trigger payments from the European Union and national agencies, thereby supporting rural residents and protecting the environment (12). Based on WWF‘s initiative, the Global Environment Facility has continued funding work in the Lower Danube Basin to mainstream PES schemes in an integrated river basin management context. The first PES project in Central Asia was launched in 2008 (16) by the Central Asia Regional Environmental Centre in Kyrgyzstan in cooperation with the Swiss government, the US Forest Service and the Global Environment Facility, and working with local stakeholders, including national and local authorities, the water user and pasture user associations, local experts and the local population. The project aims to improve the ecological health of alpine and sub-alpine ecosystems by making grazing practices more sustainable. The ecosystem services to be paid for are water supplies to the watershed, water quality, biodiversity and forest conservation, with upstream grazing farmers and national forest districts identified as sellers and irrigated agriculture farmers and tourists identified as buyers. Although this PES scheme has run into obstacles in the form of a low ability and willingness to pay for the environmental services and a limited understanding of the relationship between upstream grazing practices and downstream water quality, the project is providing a unique learning environment and is serving as a springboard for further PES schemes in the region (13).



CONCLUSION

Natural resources decision-making is often a source of debate and conflicting values. While there may never be complete consensus within a given country on exactly how to put the principles of sustainable resources management into practice in the case of renewable resources, or on how optimally to exploit non-renewable resources and how to invest the revenues, depending on how they are approached, decision making processes can help or hinder sustainability and social and economic development.(15) Natural resources policy is inherently complex, involving scientific uncertainties, complex natural systems, technical considerations and long time frames. At the same time, social and political developments throughout the world, in developed, developing and transition countries alike, have ushered in an era in which public participation and multi-stakeholder participation processes are demanded, expected and required under freedom of information and participation laws such as those implementing the Aarhus Convention. While it is understood that a diversity of decision making processes is necessary across national contexts as well as policy-specific contexts, some basic principles of decision making, consistent with the principles for good governance in general and for natural resources in particular, will apply to all decision making processes in the context of sustainable development, including: (14)

- Credible mechanisms for reporting outcomes of policy decisions and for fostering accountability of results;
- Coherence across government departments and levels of government; and
- A transparent and inclusive approach to decision-making, so as to confront conflicting interest and points of view and to address policy trade-offs when these arise (OECD, 2001).

REFERENCES

[1] Abaza, H. & Rietbergen-McCracken, J. (2000). Environmental Valuation: A Worldwide Compendium of Case Studies. Earthscan: London.

[2] Ananda, J. (2007). Implementing Participatory Decision Making in Forest Planning. Environmental Management 39 (4).

[3] Asia Development Bank, (2010). Central Asia Atlas of Natural Resources. Manila: Asia Development Bank.

[4] Avramoski, O. (2002). Analysis of Public Participation Practices in Ecosystem Approaches to Environmental Management in the Region of Ohrid and Prespa Lakes. Master of Science Thesis, Central European University, Budapest, Hungary.

[5] Avramoski, O. (2010). Personal communication. O. Avramoski was the public

participation officer for the Lake Ohric Conservation Project in Macedonia.

[6] Bartczak, A., Lindhjem, H., Navrud, S., Zandersen, M., & Zylicz, T. (2008). Valuating Forest Recreation on a National Level in a Transition Economy: The Case of Poland. Munich Personal RePEc Archive, Paper No. 11483.

[7] Bell, J. C., and Faria, T. M. (2007). Critical Issues for a Revenue Management Law. In Humphreys M., Sachs, J. D. and Stiglitz J. E. (Eds.), Escaping the Resource Curse (New York: Columbia University Press).

[8] BMU (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit) (2008b), Investments for a Climate Friendly Germany, Synthesis report, BMU, Berlin.

[9] Bright, H, , Davis, J., Janowski, M., Low A., & Pearce, D., (2000). Rural Non-Farm Livelihoods in Central and Eastern Europe and Central Asia and the Reform Process: A Literature Review. Natural Resource Institute: Kent, United Kingdom.

[10] British Columbia Ministry of Forests. (2000). Definitions of adaptive management—Report. Alberta, Canada: British Columbia Ministry of Forests. Central Intelligence Agency (CIA), World Fact Book. https://www.cia.gov/library/publications/the-world-factbook/Costanza,

[11] R., et al., (1997). The Value of the World's Ecosystem Services and Natural Capital. Nature, Vol. 387, 15 May.

[12] Elbakidze, M., Angelstam, P., Sandstrom, C., and Axelsson, R. (2010). Multi-Stakeholder Collaboration in Russian and Swedish Model Forest Initiatives: Adaptive Governance Toward Sustainable Forest Management? Ecology and Society 15 (2).

[13] Fumagalli, M. (2008). The Food-Energy-Water Nexus in Central Asia: Regional Implications of the International Response to the Crisis in Tajikistan. EU- Central Asia Monitoring, Centre for European Policy Studies and the Fundacion par alas Relaciones Internacionales y el Dialogo Exterior.

[14] Graves, A., Morris, J., Chatterton, J., Angus, A., & Harris, J. (2009). Valuation of Natural Resources: A NERC Scoping Study. Cranfield University, UK.

[15] Gylfason, T. (2001). Natural Resources, Education, and Economic Development. European Economic Review 45.

[16] Havro, G., and Santiso, J. (2008) To benefit from plenty: Lessons from Chile and Norway. OECD Development Centre, Policy Brief No. 37

[17] Humphreys, M., Sachs J., & Stiglitz, J., (2007). Escaping the Resource Curse. New York: Columbia University Press.

[18] International Institute for Sustainable Development (IISD) and Netherlands Environmental Assessment Agency (NEAA) (2010). Prospects for Mainstreaming Ecosystem Goods and Services In International Policies.

[19] The Netherlands Environmental Assessment Agency, The Hague. International Institute for Sustainable Development (IISD). (2008). The Natural Capital Approach: A Concept Paper. Prepared by Vivek Anand Voora and Henry David Venema.

[20] Winnipeg: International Institute for Sustainable Development. International Institute for Sustainable Development (2005). Aiding, Trading, or Abetting: Managing Revenues from Natural Resources and Aid.

[21] International Labour Organization (ILO) (2011), Global Employment Trends 2011: The challenge of a jobs recovery, ILO, Geneva.