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Ecosystem services management: an integrated approach

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Attracting professionals from diverse disciplines, the ecosystem services conceptual framework with integrative character strives to provide a solution to the drastic decline of the natural resources of our planet. Nonetheless, losses of ecosystem services accelerate more rapidly than ever. As humans interact with nature, increasing their global presence in both scale and intensity, the need for a new macroeconomic world emerges. This world should be based on an integration of nature and society (nature-societal) or society and ecosystems (socio-ecosystem), which will facilitate the transition toward sustainable ecosystem services management. Achieving this new macroeconomic economic paradigm would require redesigning a new thought process that embraces ecosystem services as precious goods, rather than unlimited and free, unappreciated resources. Market and government are not sufficient for this new macro-economics, in which ecosystem services are its main content. We suggest an integrated set of market, government, and human values to manage ecosystem services, as traditional, narrow, economic, political and scientific solutions alone do not adequately address the sustainable use of natural ecosystems. Culture, created from human values which, to a certain extent, can be influenced or directed, has the capacity to influence the interactions between nature, social and economic systems. The ancient Chinese philosophy of 'unity of man with nature' provides principles which can guide and develop human values into a new, positive force with the potential to harmoniously manage sustainable ecosystem services.

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Introduction

Population growth, rapid economic expansion and globalization assisted by ongoing advancements in technology have profoundly accelerated biophysical and cultural changes in our planet [1,2]. Once interdependent with each other, the relationship between humans and nature has now changed, threatening the ecosystem services which were usually defined as 'the benefits people obtain from ecosystems' [3,4]. We are quickly approaching the point where a catastrophic ecological crises coupled with a severe socio-economic crises is inevitable, and this is evident in climate changes, degrading water resources, declining biodiversity and the current world financial crisis [5,6••]. The harmonious relationship between humans and nature is decoupled, and must be reinstated in order to avoid this potential global crisis.

In hierarchical theories and system approaches, humans are considered an integral part of the whole planet's ecosphere, which includes lower level systems such as economic and social systems. Ecosystem services research shows that in recent decades, humans, and thus societies, have become increasingly reliant on natural systems with the increase of population and the improvement of living standard [7]. This awareness has attracted professionals from a diverse range of relevant disciplines, including ecology, geography, sociology, economics, the humanities and political sciences, to propose solutions under an umbrella of 'ecosystem services,' an integration of ideas that links environmental and socio-economic concepts, and supports inter and trans-disciplinary researches [8]. However, professionals from each of these disciplines bring their own specialized knowledge and paradigm to the subject, and working in isolation, create a potential for the field to become fragmented by the 'sickness of specialized deafness' [9••]. The particular theories and knowledge from each of these disciplines, in isolation, cannot adequately explain or solve a problem. A holistic and integrated approach is required in order to bridge the gaps between the different realms of natural and social sciences [9••,10–13].

Such an approach requires a complementary fusion of the different perspectives of disciplines, where no perspective is given prominence through the diminishment of others, and where the whole is greater than the sum of the parts. In this way, an appropriate approach can be found to describe and predict the complexity of the whole system with more certainty [9••,14]. Human beings are the stewards of this planet and it is time to adopt this integrative ecosystem services management concept. This concept embraces both its anthropocentric and natural system elements to ensure a healthy biosphere built from the local to the global level. Examples of such

integrative research and their applications can already be seen in landscape ecology, which has become an increasingly interdisciplinary field, offering significant contributions to ecosystem services management [10,15,16]. For example, pattern–process relationships and scale issues are essential to all natural and social sciences, and this research paradigm provides a powerful, unifying concept for developing integrative science [9••]. A holistic approach and integrative method is urgently needed to lead a revolution in human behavior to attain ecosystem services sustainable management.

The limitations of markets

Over the history of human development, markets and governments have emerged as the most important elements for the continuous improvement of economic production, social capacity and the development of civilizations. From very early stages, when the supply of natural resources and ecosystem services were not constrained, also known as the 'empty world' period [17,18••], markets were the key tool for regulating economic systems through supply and demand to promote rapid and efficient economic output. Markets can thus be seen as a highly influential 'invisible hand' that structurally supports human development. In brief, the 'invisible hand' of the market has been the chief means of resource allocation for thousands of years, and is now becoming restricted as it applies to the economic sphere of the social system exclusive of public goods, whose values are not considered, thus creating negative externalities. The majority of the ecosystem services are public goods and consequently market mechanism may result in the loss of ecosystem services and accelerate environmental degradation.

Government and its limitations

While the 'invisible hand' supports economic development through markets, governments operate to ensure that the social system functions appropriately, especially where market failure or economic crises occur. They can be seen as the 'visible hand,' assisting the development of societies, and often reducing externalities through the creation of laws and policies resulting in taxes and subsidies, and so on. This hand is also limited in its application to ecosystem services management since it mostly pursues benefits for people in a contemporary time frame and according to the norms and dictates of the specific country, countries or region(s) it represents. Inevitably, there is competition with other regions and between generations, leading to uneven or conflicting spatial development and actions which are unsustainable over time [2,19].

The role of the 'third hand'

The 'invisible hand' of markets and the 'visible hand' of governments provide constant contributions to the growth, development and well being of societies. As a result, almost all ecosystems and landscapes around the world have been influenced or even domesticated by humans [20], to the point where we may have reached the threshold of maximum ecological capacity of the planet, also known as the 'full world' period [17,18••]. An increasing number of interdisciplinary programs in ecological and social sciences have begun to study the integration of this larger world of coupled fields; for example, socio-ecological systems and human–environment systems. New and complex patterns and processes not evident when social and natural sciences are studied separately are revealed when the two are paired together [14]. From holistic and hierarchical perspectives, using scale matching principles, a third factor aside from those in markets and governments can be identified as playing a vital role in this coupled world, referred to here as the 'third hand' (see Figure 1).

Humans have a major influence in the natural–social system in this era. Therefore, human values, from which culture is created could become the 'third hand' in managing ecosystem services. While other species inherit and change their values passively through the 'survival of the fittest' and natural selection, people can actively initiate choices based on an understanding of the past and predictions for the future. Thus, the transition of human values can be influenced or directed to a certain extent [21]. Currently, the mainstream societal values orientation, which is also evident in the 'empty world' period, is the pursuit of economic growth which is no longer adequate given the deteriorating natural environment [17]. Human values now need to adapt and form a new culture for this 'full world' [18••].

Integrate markets, governments, and human values

Externality

Externalities are created when the scale of decision making is not sufficiently holistic. Most of the resource and environmental management problems are caused by negative or unforeseen externalities, such as demonstrated by the 'tragedy of the commons' [22,23]. Ecosystem services are obtained from the natural ecosystem for the benefit of the social system, a concept which inherently links the two systems together. At present, however, analyses and conceptual thinking habits are mostly confined to a basis in either the natural or social systems rather than the coexisting pair. Socio-economic decisions are often made with the belief that free markets offer the best means of resource allocation, based on the assumption that natural resources are constant and, should these resources become depleted, technological innovation will provide substitutes. These assumptions underestimate, or even ignore, the existence and sustainability of ecosystem services during the decision making process. As a result, the costs of individuals using these services are valued less than they should be, resulting in negative externalities [24,25]. It is crucial to consider the natural and social systems as a whole in order for a consensus