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Introduction to Case Studies of Ecosystem Services

Dr. Krishnappa Venkatesharaju
Assistant Professor, Department of Environmental Science And Engineering, Presidency University, Bangalore, India,
Email Id-venkateshraju.k@presidencyuniversity.in

ABSTRACT:

The Tamar catchment and the Alkborough Flats managed realignment site served as the study's two case studies. This paper details the study's background, methodologies, conclusions, and recommendations. These studies had the aim of determining whether the ecosystems approach, or management based on ecosystem services was appropriate and valuable for the Environment Agency. The ecosystems approach could be applied proactively to schemes in the planning or inception stage in order to more effectively engage appropriate stakeholders, frame problems, explore alternative solutions, and agree upon priorities, as was acknowledged in both case studies, which focused on historical schemes.

KEYWORDS:

Alkborough Flats, Case Studies, Ecosystem Services, Ecosystems Approach, Public Benefits.

I. INTRODUCTION

The goal of this document is to draw conclusions from two ecosystem service case studies that were conducted on the Tamar watershed and the Alkborough Flats. The text has benefited from presentations and discussion in several fora that are covered later in this document, as well as from a workshop of practitioners and interested parties held in London on December 11, 2008. Ecosystem services are the many positive services that society derives from ecosystems. These services, which are numerous and important, serve basic human needs for health and survival as well as economic activity, potential fulfilment, and enjoyment of life. The goal of the ecosystems approach, which is the management of entire ecosystems and their benefits using the framework of ecosystem services, is to identify multiple, concurrent benefits so that the achievement of one benefit does not result in the unintentional deterioration of other benefits with a consequent negative impact on other beneficiaries which may include future generations. Studies that choose only a small subset of ecosystem services and ignore potential conflicts with others are, by definition, incongruent with the ecosystems approach.

Many of these ecological services have been largely ignored or discarded during our historical industrial development trajectory. In order to prevent the systematic undermining of human wellbeing, it is imperative to recognize and better manage the current trends in ecological degradation. The way we think about ecosystem services today reflects the fusion of several distinct streams of resource preservation theory and practice that have emerged since the 1980s. The publication of a study by Bob Costanzo and colleagues in 1997 titled The Value of the World's Ecosystem Services and Natural Capital marked a significant turning point in the history of environmental economics. On the basis of replacement prices at current market rates, Costanzo et al. conservatively assessed the worth of all of the Earth's ecosystem services at $33 trillion annually, at least. This was about equivalent to the global GDP at the time, despite the fact that many essential ecosystem functions cannot actually be replaced. This study continues to be the most well-known, if speculative, attempt to assign monetary values to the environmental services that society as a whole benefit from. The most important thing for our purposes is that understanding how important ecosystems are to human health will help us focus on more effective ways to use ecosystems sustainably. The strength of the ecosystem services idea is that it includes ecosystems in planning and other decision-making processes by recognizing and possibly quantifying the social benefits that follow. In decision-making processes, if something is not valued, it is effectively declared to be useless, which explains a large part of the unplanned but systematic historical decrease in ecosystems of all types and scales around the world [1], [2].

A strategy based on ecosystem services offers a consistent way to evaluate various ecosystem types and bioregions. These various scientific fields were combined into a single category of ecosystem services by the

UN's Millennium Ecosystem Assessment which served as a foundation for evaluating the condition of the world's ecosystems and their ability to support human wellbeing. Provisioning services, regulating services, cultural services, and supporting services were divided into four basic categories by the MA. According to a previous definition of ecosystem goods, provisioning services are those things that may be derived from ecosystems to meet human requirements. These tangible resources include fresh water, food fiber and fuel, among others. The processes that control the natural environment, such as those that control air quality, climate, water flows, erosion, pests, and so on, are referred to as regulatory services. The various facets of aesthetic, spiritual, recreational, and other cultural qualities are included in cultural services. Supporting services are those that support the provision of other benefits, such as soil formation, photosynthesis, and water recycling, but may not necessarily have a direct economic value. These case studies' selection criteria included:

1. Delivering case studies that explain the links between natural processes and how our interventions reach into natural systems and their larger values was a stated requirement Pam Gilder, Head of Wildlife, Recreation and Marine in the Environment Agency of these studies.
2. Two case studies, one at the site scale and the other at a larger, watershed scale, were required.
3. Benefits and costs must be linked to specific treatments.
4. It's crucial to choose programmers that offer greater ecosystem service benefits than the original aims.
5. It will be necessary to base benefit assessment on some metric of worth, but we cannot automatically assume that this evaluation will be well supported by prior data given that post-project monitoring is hardly ever done, especially when it comes to a variety of benefits that were not considered when the original scheme was designed.
6. If possible, benefits should be quantified by economic appraisal; however, if this is not possible, other methods of quantification such as counting the number of recipients of a less tangible benefit and qualitative benefits assessment should be used instead.
7. Enough data must exist to warrant a more thorough investigation.

II. DISCUSSION

An ecosystems approach to valuation provides a framework for looking at whole ecosystems in decision-making and for valuing the ecosystem services they provide, according to Defra. This will ensure that we can maintain a healthy and resilient natural environment now and for future generations. Given their sensitivity to a wide range of factors, such as what is included and excluded, explicit and implicit assumptions, valuation techniques, and the scale of evaluation, there is a long-standing and widespread consensus that financial values derived from such economic appraisals do not have absolute values. However, establishing relative values sometimes referred to as marginal values, which involve contrasting a starting point with an altered state, offer insight into the likelihood and magnitude of changes and are useful in guiding analysis and judgment. Given the vast area, the numerous necessary assumptions, and the unavoidable data gaps, identifying total baseline values for the various categories of ecosystem services in both case studies would not only be a difficult task but also one that is ultimately likely to produce subjective values [3], [4].

For this reason, the pre-intervention status served as the datum from which relative benefits and disbenefits were calculated, and the baseline value was typically assumed to be zero. Ecosystem services themselves are largely amenable to economic valuation as they relate to different categories of human benefit, and environmental economics provides a common and transferable basis for assessing the different categories of benefits and disbenefits associated with changes in ecosystem services as a result of interventions in environmental systems. To extract standard values, a number of references and standard databases are also employed, such as EVRITM, Woodward and Wii, etc. However, the economic benefits of the majority of ecosystem services are estimated using a variety of stated hypotheses connected to surrogate market pricing. When actual or substitute data is available to support the economic analysis in these two case studies, it frequently comes from earlier research carried out at various dates ranging from 2000 to the present. Despite the fact that future uncertainties are acknowledged, these transferred values are not corrected for current value in the two case studies because doing so would provide the false impression that the estimate and underlying assumptions are accurate.

Tulsa has previously completed a discrete economic appraisal for the evaluation of Tamar 2000. The Tulsa study offers a substantial body of evidence for benefit assessments in the Tamar, but it has some limitations, including the fact that not all ecosystem services are addressed, some methods do not produce data that are directly applicable to the MA categorization of ecosystem services, and the assessment was based on assumed rather than monitored uptake of farm advice recommendations for reasons that will be explained later. Because of this, Tulsa’s study is supplemented by a number of different sources from which advantages are transmitted either directly or according to stated assumptions. Surrogate values can occasionally act as market mechanisms that

reflect important characteristics of an ecosystem service. In order to quantify the production of some ecosystem services and to later monetize the presumed benefits, the scientific literature was examined. Similar techniques were used in the Alkborough Flats case study, as noted in the analytical tables once more. The following guidelines are followed for doing economic evaluation in both case studies:

1. All monetary values produced are NOT modified for current prices as this suggests a specious confidence in original values.
2. Tulsa's analysis is based on cautious estimations, which helps overcome exaggeration of the benefits measured. This helps prevent advantages from being overstated.
3. No monetary value is shown when monetary values cannot be assigned or when there are too many uncertainties.
4. No contribution value is thought to be absolute; rather, it is assumed to represent the importance of the impact on ecosystem services.
5. If more trustworthy data were to be generated, additional targeted research would typically be needed.
6. In general, relevant revealed preferences which represent deeper values than a general sense of amenity potential is superior to stated preferences derived using techniques like willingness to pay.
7. Because of the limitations of this study, there was no choice except to employ transferrable values from other studies or try to monetize substitute market indicators related to each ecosystem service. There was no funding available for customized, independent economic analyses. This more qualitative method is acceptable for many purposes because it provides ranges of likely impact. However, additional original valuation may be required for the most substantial consequences or in cases where the findings are likely to be disputed such as in a public inquiry.
8. We attempted to exert the proper effort for the appraisal within the constraints of the decision-making context.
9. Sensitivity analysis was not carried out within the parameters of this study; however, it would have been beneficial to admit and accept the possibility of considerable uncertainty.
10. By presenting an audit trail of important assumptions, transferred benefits, restrictions, omissions, and uncertainties, we have attempted to be transparent in our analysis.

In the following sections of this study, which deal with each of the two case studies, specific procedures, presumptions, and transferred values applicable to each ecosystem service are described. The 'Green Book' of the UK government (HM Treasury, undated) is used as a guide for figuring out how to calculate the entire economic value of the expenses and benefits involved in these case studies. A discount rate of 3.5% spread over 25 years is included in this. The Alkborough Flats ecosystem service of Natural hazard regulation is the exception to this rule, for which a 100-year assessment term with a progressive discount rate is employed. Pearce et al. discuss the 'tyranny of discounting' for environmental schemes, where higher discount rates and a relatively short assessment period can undervalue the frequently enduring benefits of environmental schemes. Turner et al. argue that trustworthy total valuations for wetlands can only be derived from 'willingness to pay' studies. In an operational setting, however, there is infrequently enough time or money to conduct such a customized analysis, which is already disputed because several assumptions, transferred values, and other simplifications call into question the absolute values determined. The usual 'Green Book' procedures are used in this study out of concern for proportionality and to reflect the fact that assessments conducted here and generally are for decision support rather than decision making purposes [5], [6].

Application of Ecosystem Services as a Teaching Tool

The general ecosystem services suite from the Millennium Ecosystem Assessment (MA) proved useful for intercomparison. The basic MA suite of services may occasionally require modification for particular purposes such as fire and salinity control in arid environments like South Africa, or live fish sales and resilience of salmon stocks in the Tamar, etc., according to an analysis of its application in the various workshops mentioned above. Even though the MA's array of ecosystem services is useful and essentially comparable across habitat types and bioregions, it may not be ideal for all applications. The case studies made it abundantly evident that every type of intervention, at every scale, rebalances the generation of ecosystem services. This observation applies to both ecosystem service categories, such as the surprising value neutrality of provisioning service benefits resulting from altered land use at Alkborough Flats, as well as across ecosystem service categories, such as the trading of provisioning i.e., food production for regulating, cultural, and supporting services, as for example in the change in emphasis of flood risk management, 2003 Common Agricultural Policy (CAP) reform, etc.

Considering the complete range of ecosystem services makes it easier to find several, potentially interconnected advantages. Being aware of this wide variety of potential outcomes from interventions can help with planning to

minimize risks environmental risks, missed opportunities, doing the wrong thing, reputation consequences, etc. and hence help in maximizing the benefits for the widest possible group of stakeholders. Having a wide perspective on ecosystem services prevents decision-makers from being blinded by narrow, benefit-specific interests. Although provision of habitat is a distinct supporting service, participants in the project workshop felt that habitats and biodiversity needed to be considered separately, especially in the case of rare, fragile, and ancient/irreplaceable environments. This may have to do with the price of replacing or creating a habitat for the moment ignoring the viability of creating particular habitats. The ecosystems approach may make it possible to identify site-specific interactions on larger ecosystems. For instance, planting trees may improve high flows in some portions of the catchment while negatively impacting low flows in other locations.

Ecosystem Services

It is necessary to take a proportionate approach, transferring values where there is little disagreement while conducting custom appraisals where the stakes are expected to be high, contentious, or uncharted. The Defra risk-based filter may be sufficient for many first-pass applications even if we have attempted to monetize ecosystem services in this case study. The ideal method for ecosystem value is marginal valuation, not total valuation. To make operational use of ecosystem service value easier, we require a growing and accessible transferable benefit database. Price variations, such as the recent doubling of land prices and rising wheat prices, among others, inexorably affect the values that can be determined. This should guide a cautious approach to values derived throughout a specific time period as well as their application to other investigations. Additional uncertainties result from the way economic valuation is used to address a future that is mostly unknown or unpredictable e.g., climate, market prices, etc. Others only go down to hundreds of pounds, even if some values that have been calculated are presented down to the level of cents.

For smaller denomination, no increased assurance is inferred. In fact, it was impossible to assign a value to certain ecosystem functions with certainty. Because of this, there is a significant gap in our existing capacity to assign values for all ecosystem services, whether through transferrable benefits or by identifying actual or fictitious markets for example, when attempting to assign monetary values to pollination or social relations. Two things were thought to be necessary for economic costs. Confidence bounds or lower and upper-bands. Unambiguous representations about the underlying assumptions and facts. It was believed that in order to sell or explain the results to others, it is essential to explain how expenses are calculated. As a result, it will be possible to identify the services that are inexpensive, while those that are more difficult to estimate will have broader confidence intervals. The cost range will assist sensitivity testing, enabling the identification of the important services those that contribute the most to the overall cost profile. Important services or services with low confidence limits may also contribute to identifying the need for additional data gathering or investigation [7], [8].

Participant Involvement

A connected set of interdependent winners and losers are brought about by the rebalancing of ecosystem service production across catchments as a result of all interventions, and they all raise equity concerns from environmental management decisions. Thus, the ecosystems method aids in identifying the complete range of stakeholders impacted or potentially impacted by interventions in environmental systems. Ecosystem services offer a framework for identifying original answers and evaluating alternative approaches, raising awareness of ecosystems as the basis for human benefits and maybe inspiring innovations that maximize sustainability of results. Ecologists, social scientists, and economists can communicate using ecosystem services as a shared language. The specific services fresh water, spiritual and religious significance, soil creation, temperature management, and so forth are also easily understood and communicated to the general public, despite the fact that the idea of ecosystem services as a whole is fairly complex for a lay audience. Ecosystem services can serve as the basis for negotiations aimed at achieving fair and sustainable results since they support human livelihoods. Therefore, ecosystem services are a solid foundation upon which to build inclusive dialogue through the identification of all affected stakeholders, communication about related benefits resulting from natural resources, negotiation over how these benefits are shared, and dialogue to maximize value to all stakeholders in interventions.

Needs for Research

There are large information gaps, and these gaps can influence research questions. Our study to date has identified three key areas:

1. Significant research gaps.

2. Areas where enhanced methodologies would add rigor and reliability.
3. The need for tools development to enhance practical use.

Particular Take Aways from Case Studies

Reflecting on the draught case studies led to the overall conclusion that it would be good to involve more diverse stakeholders in valuation in order to reflect various site/catchment objectives. The case study analysis shows that the Tamar 2000 project generated a sizable amount of net societal value that was dispersed across numerous categories of ecosystem service benefits. In addition to the intended benefits for regulatory services like regulating the climate and supporting services like habitat provision, nutrient cycling, etc., incidental benefits include incidental benefits for provisioning services food and other values contributing to farm incomes and cultural services broader contribution to the rural economy. The Alkborough Flats case study showed a similar pattern, with several benefits at various scales and no appreciable net loss for the provisioning services that were previously anticipated to have been cut back for the agricultural business.

The very straightforward methodology used in both case studies had the drawback that interactions between services were not sufficiently discovered or priced. For instance, tourism increases visitor counts and revenue, but it also incurs expenses such as a rise in the number of transients, higher carbon emissions from travel, water use, pollutant creation, and foot traffic. Studies that are more thorough and have higher resources should address this. It would be advantageous for the Tamar 2000 case study to determine scale for each service. For instance, carbon sequestration affects the entire world, whereas water affects it more locally. The Alkborough Flats case study helped to identify the benefits associated with several ecosystem services. Analyzing the hypothetical stretch target proposed by the West Country Rivers Trust to double the amount of wetlands in the Tamar basin to 20% might be valuable. This might be in line with the Wetland Vision program's prioritized goals. We could extrapolate the advantages of Tamar 2000's wetland restoration linearly, but doing so would be risky. Making the argument for the value of restored wetlands and the associated ecosystem services throughout the catchment would require more research.

Further Uses of Ecosystem Services

The research, along with the lectures and workshop that accompanied it, revealed numerous other possible uses for the ecosystem's method. The following instances of applying the ecosystems approach:

1. Continuing to apply knowledge and techniques to the administration and dissemination of new controlled realignment sites under the Humber Estuary Strategy. Following his involvement in the Alkborough case study, Philip Winn, the Environment Agency's Humber Strategy Manager, asked specialists in ecosystem services-based activities to contribute to the ongoing effort.
2. Additional use in river restoration plans. The Tyne Rivers Trust has now added beneficial ecosystem services contribution as one of its project appraisal principles.
3. Assessment of current environmental improvement programmers based on larger public benefit, for instance

The UK's Environmental Stewardship Payment Scheme is more based on basic feature checklists than a link to the production of public benefits from land, despite the fact that the 2003 EU CAP reform's primary goal was to shift public payment for output subsidy towards land management for public benefit. Ecosystem services can help us understand the language of public benefits resulting from catchment management by acting as a foundation for marketplaces between producers and beneficiaries such as the general public or even specific water. The government's Catchment Sensitive Farming (CSF) programmer and the West Country Rivers Trust's Tamar 2000 project share a great deal in common, with the Trust scheme being observed to be a more bottom-up approach and CSF being more top-down with consequently less acceptance of prescribed actions by landowners [9], [10].

The Tamar 2000 ecosystem, services case study was thought to have been helpful in finding a wide range of advantages, and as a result, it could be possible to identify, improve upon, and communicate potential benefits for the CSF initiative. The ecosystems approach might help ongoing conservation efforts like the present north Devon proposal for a UNESCO Biosphere Reserve centered mostly on the Taw-Porridge catchments. Analyzing how function-specific policies and practices have broader, cross-disciplinary ramifications and dependencies. These include, for instance, identifying the wider public benefit from: o River Basin Management Plans (RBMPs) implemented to implement the Water Framework Directive (WFD); and o Initiatives for managing flood risk. It is obvious that using ecosystem services entails integrating them into a variety of operational tools and processes, which will then profit from the systemic nature of ecosystem services. The MA classification of

ecosystem services is compatible with many of the already available technologies because it is outcome-based and comprises an integrated set. These consist of:

1. Better determination of public benefits and optimization of public benefits from agro-environment payments consistent with the intent of the 2003 EU CAP reforms including the UK's Environmental Stewardship payment scheme of Environmental Impact Assessment (EIA).
2. Environmental Impact Assessment (EIA).
3. Better determination of public benefits and optimization of public benefits from agro-environment payments consistent with the 2003 EU CAP reforms.
4. Integrating with larger-scale planning principles. The simultaneous consideration of the ecosystem services suite can be beneficial in identifying novel options that maximize the public benefit from project design, such as to help identify opportunities for the best achievement of public value within plans and synergies between them, such as for example: o Regional Spatial Strategies; and o Shoreline Management Plans.
5. Ecosystem services also offer a strong, widely accepted and publicly comprehensible basis of public/stakeholder engagement around optimally equitable and sustainable outcomes in terms of who benefits from catchment/site management.
6. There was a sentiment expressed at the project workshop that the ecosystems approach would underpin issues that may be better delivered by local communities/NGOs rather than government agencies.
7. NGO participants in these dialogues and the subsequent discussion felt that the ecosystems approach gave them greater confidence to justify the schemes that they undertake on the basis of a broader set of public benefits likely to flow. The discovery of potentially bigger public benefits resulting from environmental interventions in ecosystem services may lead to the creation of new financing sources.

Ecological Services into Practice

1. For the development of policy, the ecosystems approach offers a solid and complete evidence base.
2. Ecosystem services, however focused on human benefits rather than values inferred for habitats and organisms, assist show the origin of numerous societal advantages and, consequently, the crucial need of maintaining or enhancing ecosystems for insuring future prosperity. Instead of the situation that is prevalent today, when biodiversity is viewed as secondary to providing social and economic value, the ecosystems approach helps promote biodiversity into decision-making processes.
3. The ecosystems approach is in line with the agenda that Defra, the EU, and the UN are advancing.
4. Examining whole socioecological systems is crucial when using an ecosystems approach. One runs the danger of missing out on opportunities, synergies, and the maximization of public value by concentrating too intently on segmented services or localities of interest.
5. The value of ecosystem services has been established. If the ecosystems method is to be adopted, it must be included in operational tools that non-specialists may utilize.
6. Exploring the bigger picture is made easier by using the terminology of ecosystem services.
7. The local surrender of benefits (like intensive farming or flood-defended land) confers broader-scale benefits to other constituencies (i.e. flood risk management), which may make it harder to explain or rationalize to vested local interests. Effective markets between providers and users of ecosystem services would be advantageous in this situation.
8. The Environment Agency (and others) can communicate about shared desired outcomes with partner groups (such Natural England, the River Trusts, etc.) through ecosystem services.
9. The Alkborough Flats and Tamar case studies, as well as other river restoration initiatives, Catchment Sensitive Farming, Water Framework Directive, etc., demonstrate how ecosystem services give the Environment Agency (and other bodies) a language to identify the broader benefits of prior work.
10. Ecosystem valuation is a tool, not a replacement, for sound decision-making.
11. Ecosystem services must be developed further if their full potential is to be realized, until the approaches used are recognized by all relevant parties.
12. As a society, we are just beginning to adopt the ecosystems approach, which logically leads to complete market internalization.

The ecosystems method is thought to have the important benefit of facilitating knowledge management and education among various stakeholder groups, including policy, science, the community, and all facets of society. It is a framework for consultation at many levels, which case studies, real-world examples, success stories, etc. can help to support. To lead on this strategy, it is crucial to find and put in place the right advocates and ambassadors. The ecosystems approach's ability to give a framework for the explicit identification of several benefits, including financial ones, was another notable advantage. In addition to helping, they connect with

investment and, more crucially, begin to support the formation of multi-functional funding streams i.e., satisfying flood risk management, WFD, soil strategy, and biodiversity objectives, this can inform strategies, schemes, projects, etc. Learning and fundamental ideas can be transferred between locations, catchments, and scales with the necessary caution, just like benefit evaluation methodologies and values.

III. CONCLUSION

The case studies of ecosystem services offer insightful information about the various ways that ecosystems benefit people and the significance of their preservation. We can comprehend the intricate relationships between ecosystems and human cultures as well as the potential repercussions of ecosystem degradation or loss by looking at individual examples. The substantial role that ecosystems play in supporting and maintaining human livelihoods is one important finding from these case studies. The provision of food, clean water, and lumber are just a few examples of ecosystem services that directly enhance the economic, social, and cultural well-being of communities. The case examples emphasize how crucial it is to acknowledge and value these services because they support many different economic sectors and help human populations in a variety of ways.

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