

Evaluation of the Effects on Ecosystem Services in the Tamar Catchment

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ABSTRACT:

The River Tamar's main stem extends for around 80 km and rises 6.5 kilometers south of the town of Bode, on the north Cornwall coast. The Tamar then primarily follows a north-south direction, serving as a natural border between Devon and Cornwall for the majority of its course. The rivers Otter and Inn from Cornwall and the Tavy and Thrushel from Devon all join the river's main stem as it flows towards the sea. In south-west Devon, near Plymouth Sound, where it joins the rivers Tavy, Ply, and Lyn her, the Tamar empties into the sea. Plymouth Sound is a sizable rail or drowned estuary.

KEYWORDS:

Case Study, Ecosystem Services, Service Tamar, Tamar Valley, West Country.

INTRODUCTION

The River Tamar's main stem extends for around 80 km and rises 6.5 kilometers south of the town of Bode, on the north Cornwall coast. The Tamar then primarily follows a north-south direction, serving as a natural border between Devon and Cornwall for the majority of its course. The rivers Otter and Inn from Cornwall and the Tavy and Thrushel from Devon all join the river's main stem as it flows towards the sea. In south-west Devon, near Plymouth Sound, where it joins the rivers Tavy, Ply, and Lyn her, the Tamar empties into the sea. Plymouth Sound is a sizable rail or drowned estuary. The sole significant conurbation in the catchment is the city of Plymouth and the nearby Devonport Dockyard, while Launceston is located in the heart of the catchment and Tailstock in Devon spans the river Tavy. Tamar characteristics that make it suitable for this study The best study sites to ascertain the effects of targeted interventions on ecosystem services were those with a predominantly rural character, with fewer confounding factors introduced by higher population density, settlements, and urban areas with associated large-scale discharges.

This was suggested by screening pre-studies covering relevant attributes of a range of catchments. These preliminary investigations also revealed challenges with confounding variables at larger geographic scales, with the evidence indicating that in these situations, adopting a whole-catchment strategy is likely to result in less discrimination of ecosystem service benefits resulting from particular interventions. Because of this, smaller rural river catchments present the most reliable alternatives for determining the contributions of particular interventions to a variety of ecosystem services. The river Tamar was chosen for further investigation from the long list of prospective sub-catchment case studies that were identified for the goal of testing the ecosystem approach. The Tamar in the West Country is a rural catchment with comparatively few of the confounding variables that affect many other British catchments [1], [2].

Along its length, the watershed has Class 3 and Class 4 flood risk zones, and work on Making Space for Water projects is concentrated there. Initiatives for fish and biodiversity have been put in place, along with programmes addressing water quality and tourism qualities i.e. amenity and correcting problems with the EU Fisheries Directive. The West Country Rivers Trust (WRT), a river restoration and regional development NGO, has made interventions in the River Tamar watershed that are particularly well suited for pre- and post-project evaluation of impacts on ecosystem services. Benefit assessments for work packages carried out under various EU funding packages, including Tamar 2000 SUPPORT Sustainable Practices Project on the River Tamar and the Cornwall Rivers Project, have already been completed for some of these interventions. These externally audited studies offer this work useful desk input. The catchment's mix of upland and lowland regions also serves as a focus for carbon storage. The Tamar was approved as a viable case study catchment despite potential scale difficulties that had first led us to choose only a sub-catchment.

Excellent and established ties exist between the WRT and the Environment Agency. Neil Preyed (0117-914-2935) is modelling the Tamar utilizing both scales of the PSYCHIC model as part of the Environment Agency's Integrated Catchment Science (ICS) theme, which is likewise focused on the Tamar. Additionally, initiatives under the watershed Sensitive Farming (CSF) programme are focused on the Tamar watershed. Tamar Estuaries Consultative Forum, 2007, Tamar Estuaries Management Action Plan: 2007 to 2009, which specifies priority actions for the delivery of the Tamar Estuaries Management Plan 2006-2012 throughout upcoming financial years. 'Coordination of a Management Framework for the Tamar Estuaries', 'Marine Protected Areas Management', and 'Promoting Access and Regeneration in the Upper Estuary' are among the initiatives that should be prioritized. Despite their importance, neither Tamar 2000 nor the West country Rivers Trust are mentioned in the plan.

In addition, a new initiative is beginning to conserve the Tamar Lakes, two lakes that are vulnerable to eutrophication due to intense dairy and beef farming in the 17 km² upper watershed and located 6 kilometers from the Tamar's headwaters. The Upper Tamar Lake has been in use since its construction in the 1980s, whereas the Lower Tamar Lake is about 100 years old. South West Water, a utility firm that will profit from any pollution reduction as nutrient reduction may partially offset the expenses of reservoir desertification, has agreed to support this initiative. Martin Ross is the main point of contact at South West Water. The West Country Rivers Trust, the Environment Agency, a number of British institutions, and partners from France, the Netherlands, and Ireland will collaborate on this Tamar Lakes project that will be supported by the EU Interred ALICE initiative. Along with preserving the viability of the water source for abstraction for supply, wider advantages for the river system are predicted [3], [4].

DISCUSSION

The Tamar has been the target of numerous interventions, similar to other British rivers, including investments in sewage and industrial waste treatment, agro-environment subsidies, angling and conservation projects, and others. The Tamar 2000 Project and the ensuing Cornwall Rivers Project are two noteworthy interventions that are of particular significance to this study on ecosystem services. Tamar 2000 is notably mentioned by the Convention on Biological Diversity's secretariat as the UK's example of the ecosystems approach's effective use highlighting its suitability for this ecosystem services study. An overview of Tamar 2000 and the Cornwall Rivers Project is given in Annex 1, together with studies that back it up. The West Country Rivers Trust (WRT) has also recognized the restoration of wetlands in the Tamar basin as a strategic and aspirational objective. This supports the findings of a research by Hogan et al. (2000), which found that due to historical land drainage and change in use, the Tamar is currently underdeveloped in terms of wetland extent, with the available resource only covering 5% of the watershed. Hogan et al. calculate that 20% of the Tamar basin might be made up of wetlands if draining were to stop based on soil mapping.

This goal may not be immediately attainable, but it does highlight the chance for habitat restoration and the associated ecosystem services. The latent resource of wetlands, for instance, offers a strategic method for delivery that is also likely to produce a wide range of collateral benefits if government policy were to favor a shift from provisioning services such as food production to regulating services such as natural flood regulation or carbon sequestration mitigating climate change. The 'stretch target' of 5 to 20% wetland extent is a strategic opportunity, but it is also a timely warning that we shouldn't automatically accept the current situation as a sound foundation for environmental management. The WRT goal is based on seizing opportunities to restore this missing 15% and ideally focusing restoration in the regions that are most important for catchment functioning. It is aspirational rather than detailed. Although time restrictions hindered this extrapolation of the study, our initial goal in this case study had been to find the public benefit linked with ecosystem service advantages resulting from restoring this 15% of hypothetical wetlands. Determining the effects of other catchment interventions that may be confounding. The Tamar was chosen as the research catchment mostly because to the low background noise in a catchment that is primarily rural.

Nevertheless, a number of projects have been and are being carried out within the watershed, including enhancements to wastewater treatment, catchment-sensitive farming, modifying land use, and so forth. As a result of a direct economic analysis of Tamar 2000 recommendations, we can eliminate the confounding impacts of various other efforts in the Tamar. Findings from the Tamar 2000 ecosystem services assessment. The Millennium Ecosystem Assessment's classification of ecosystem services into its four main categories of provisioning services, regulating services, cultural services, and sustaining services is used to value the advantages that result from Tamar 2000. Reduced fertilizer inputs, composting manure, under-sowing maize, fencing, rotational ditch clearing, separating roof and foul water, and hedge cutting regimes all resulted in significant cost savings for farmers who followed the advice. These savings qualify as marginal benefits in the

production of the provisioning service of food production. Tulsa's findings are strength need by evaluations of the related Cornwall Rivers Project and Angling 2000 projects because the benefits calculated by Tulsa (2000) were calculated to satisfy the economic and social reporting requirements of the EU Objective 5B structural funding (EAGGF) and were not primarily geared towards wider environmental improvement [5], [6].

Analysis and Recommendations

Below, we've highlighted some of the most important ideas that came up during the discussion that followed the review of Tamar 2000, particularly those that were noted at the case study session on December 11th. The generic discussion part previously in this report addresses and discusses in detail the key concerns that emerged and were combined with those from the Alkborough Flats case study.

1. The case study analysis shows that the WRT Tamar 2000 project generated a sizable amount of net societal value that was dispersed across numerous categories of ecosystem service benefits. There are significant intended benefits for provisioning services food and other values boosting farm incomes and cultural services more broadly boosting the rural economy, but there are also unintended advantages for regulatory services such as climate regulation and supporting services such as habitat provision, nutrient cycling, etc.
2. Considering ecosystem services broadly helps prevent limited benefit-specific interests from obstructing decision-makers' ability to see possibilities and synergies.
3. 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.
4. The ecosystems approach provides a framework for the explicit identification of multiple benefits including financial one), which can inform strategies, schemes, projects, etc. to connect with investment and, more importantly, start to facilitate the justification and establishment of multifunctional funding streams i.e. meeting flood risk management, WFD, soil strategy, biodiversity object). This was another very significant benefit identified in the 11 December 2008 workshop.
5. The method also makes it possible to identify site-specific interactions. For instance, planting trees in some regions of the catchment can be beneficial (improve high flow), while doing so in others might have a negative effect decrease low flows. The conclusions of the Pitt Review of substantial summer flooding in the UK in 2007 are generally compatible with an ecosystems-centered strategy.
6. Deduced values are inexorably impacted by price changes, such as the recent doubling of land prices and rising wheat prices, etc. This should guide a cautious approach to values derived throughout a specific time period as well as their application to other investigations.
7. The application of economic valuation in the face of a future that is mainly unknown or unpredictable such as the environment, market prices, etc. introduces additional uncertainties.
8. During the project workshop, it was questioned if it was beneficial to express costs and benefits in monetary terms. The technique was generally seen as useful since it was crucial to better include the environment into the decision-making process, even though costs and benefits had to be geographically localized and altered. However, it is necessary to clearly describe the function and constraints of economics.
9. It's possible that monetary values aren't the best way to relate to people and situations at the most local level, leaving out some stakeholder concerns and problems.
10. The measurement of the costs and advantages of schooling has a hole in it. In a CEH case study (not identified) presented at the project workshop on December 11, 2008, the benefits of farmer financial incentives to enhance land management were compared to those of farmer training and education without payments; education was said to have yielded greater benefits [7], [8].
11. It was believed that in order to properly assess economic costs, there should be confidence limitations or lower/upper bands, and unambiguous descriptions 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. A sensitivity test that uses the cost range will make it easier to identify the critical services those that have the most impacts on the overall cost profile. Important services or services with low confidence limits may also contribute to the selection of research questions or the gathering of additional data.

12. It was necessary to treat habitats and biodiversity as different services, especially in the case of rare, sensitive, and historic habitats. This may have to do with the price of replacing or creating a habitat for the moment ignoring the viability of creating particular habitats.
13. The failure to properly identify and cost critical interactions across services was seen as a flaw in the methodology used in this study. 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.
14. The ecosystems approach needs to be utilised adaptably and flexibly given the growing awareness of future unpredictability, including taking into account changes in the typology of ecosystem services, costing methodologies, and other factors.
15. It would be advantageous for the Tamar 2000 case study to determine scale defined population for each service. For instance, carbon sequestration affects the entire world, whereas water affects it more locally.
16. In connection with the aforementioned point, it would be beneficial to identify institutional/organizational ties for each service, including who is in charge of administering it. Analyzing how these services fit into local structure plans, RBMPs, and other planning frameworks may make this easier. Additionally, this will make the ecosystem services framework's instructional role easier to perform.
17. In terms of the recommended actions, there were parallels found between this Tamar 2000 ecosystem services case study possibly a more bottom-up approach and ongoing Catchment Sensitive Farming (CSF) initiatives possibly a more top-down approach and thus less well received by landowners. As a result, our Tamar 2000 analysis might make it possible to identify and improve potential benefits for the CSF programmer.

Supplying Services

1. River water is often of a high caliber. The catchment serves as the primary source of water for Plymouth as well as the south Devon/Cornwall coast region. The Tamar Valley has historically been a significant place for market gardening due to its location and temperature. Apple orchards used to be large, and other crops including cherries, strawberries, and daffodils have also been grown for both local use and export.
2. Mineral extraction, which was previously the main activity in the Tamar Valley and dates back many centuries, had a lengthy history and is today carried out on a much lower scale in the Tamar valley. The mining landscape in Cornwall and West Devon was designated a World Heritage Site in 2006. In places like Lowell, Beer Alston, and Morwellham, tin, silver, lead, granite, and copper were all mined. The Tamar continues to support a sizable salmon fishery, including Atlantic salmon, sea trout, brown trout, and grayling. This resource is used in part for household purposes. The estuary maintains healthy fish stocks and provides support for the marine fishing sector. Governing services
3. Peat formation is possible in the Tamar catchment's upland, low-nutrient zone, while restoration efforts and drainage have an impact on the lowlands.
4. The catchment has concerns about flood risk, and a catchment flood management plan has been put in place to address those concerns. The Tamar is also a 'Making Space for Water' emphasis catchment, and portions of the watershed are Class 3 and Class 4 flood risk zones [9], [10].

Cultural Offerings

The port city of Plymouth and Devonport Dockyard are located near the mouth of the Tamar on the Devon side, and the Tamar, Tavy, and Lyn her together make up an Area of Outstanding Natural Beauty. With evidence of Stone and Bronze Age civilizations, particularly on the Cornish side of the river, the Tamar valley has historical significance. The Tamar is spanned by a number of mediaeval stone arch bridges along its course, some of which are more than 500 years old. Kingdom, Isamar the famous Royal Albert Bridge, built by Brunel, crosses the lower Tamar. It was designed to support the weight of three express trains when it was finished in 1859.

1. The Tamar Bridge, which was opened to road traffic in 1961, was then the UK's longest suspension bridge. It continues to be the primary rail connection between Cornwall and the rest of the nation. The Tamar Valley is currently a World Heritage Site for its mining landscape. Devonport Dockyard's beginnings stretch back to 1691, when William of Orange commissioned the construction of a new dockyard to support the Royal Navy in the Western Approaches.
2. For a thousand years, the Devon side of the river's Morwellham Quay served as a hub for the shipping of minerals. The Quay is currently a popular tourist destination.
3. Before the introduction of the railways, the minerals were transported from the river to the sea.

4. Over the previous 200 years, a number of Trooping ferries have been in service.
5. There are currently three: the Ply, the Lyn her, and the Tamar. The Tamar is a well-liked recreation area that supports tourist attractions, strolling, boat rides, fishing, and taking in the landscape and fauna. It is still one of England's most recognizable county borders. It is one of the main tourist destinations in the South West of England and attracts lots of tourists. The Tamar is a well-known salmon fishery with great recreational value, including Atlantic salmon, sea trout, brown trout, and grayling.

Scope

The following elements would normally be included in the scope of the evaluation of the effects on ecosystem services in the Tamar Catchment:

1. **Ecosystem Service Assessment:** As part of the evaluation, the various ecosystem services offered by the Tamar Catchment would be evaluated. These services include provisioning services such as food and water, regulating services such as climate regulation and water purification, cultural services such as recreational value and cultural heritage, and supporting services such as soil formation and nutrient cycling. The results of this evaluation would be used to measure and clarify the ecosystems' contributions to human welfare within the catchment.
2. **Analysis of Land Use and Land Cover:** The Tamar Catchment's patterns of land use and land cover would be examined. The size of the natural habitats, agricultural lands, urbanized areas, and other land uses would be determined by this analysis. Additionally, it would look at how land use has changed over time, identifying any locations where habitat loss, fragmentation, or conversion may have an effect on ecosystem services.
3. **Assessment of Water Quality and Quantity:** As part of the evaluation, the catchment's water quality and quantity would be assessed. This evaluation would involve looking at variables like nutrient concentrations, pollutant concentrations, sedimentation rates, and flow patterns. It would make it easier to locate the causes of water pollution and comprehend how these effects affect ecosystem services involved in providing and purifying water.
4. **Biodiversity Assessment:** The evaluation would look at the variety and quantity of species in the Tamar Catchment as well as the presence of important indicator species or habitats. Insights on the potential effects on ecosystem services associated to biodiversity, such as pollination, pest management, and genetic resources, would be provided by this assessment.
5. **Analysis of Climate Change:** The assessment would take into account any potential effects that climate change may have on ecosystem services in the Tamar Catchment. In order to perform this study, it would be necessary to look at climate projections, such as changes in temperature, precipitation, and extreme weather, and determine whether these could have an impact on how ecosystems function and what services they can offer. Engaging relevant stakeholders, such as local communities, landowners, policymakers, and conservation organizations, is a key component of the evaluation. This involvement would guarantee that the review takes into account a variety of interests and attitudes, as well as local knowledge, perspectives, and concerns about ecosystem services.
6. **Recommendations and Management Strategies:** In order to improve the preservation and sustainable management of ecosystem services in the Tamar Catchment, recommendations and management strategies will be prepared based on the evaluation's findings. These could include actions like land-use planning, habitat restoration, pollution abatement, and plans for coping with climate change.

CONCLUSION

The analysis of how human activities affect the natural environment and how those influences affect ecosystem services in the Tamar Catchment offers insightful information. We can comprehend the overall health and functioning of the ecosystem and make educated decisions about its management and protection by evaluating the changes in ecosystem services within the watershed. The Tamar Catchment's altered water quality and quantity is one of the main impacts on ecosystem services. Agriculture, industrial processes, and urbanization are some examples of human activities that can contribute to pollution and nutrient runoff into water bodies, resulting in deteriorated water quality. The availability of clean water for drinking and irrigation could be impacted by this degradation, which would have an effect on both human and ecological well-being.

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