International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-10, Special Issue-2, February-2022
Young Researchers' Conference on Indian Literatures, 2022
Organized by Presidency University, Bangalore, India

Evaluation of the Effects on Ecosystem Services in Alkborough Flats

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ABSTRACT:

A coastal setback plan is in place at the Alkborough Flats site in the Humber Estuary. On the south bank of the inner Humber Estuary, where the River Oise and the River Trent converge, is Alkborough Flats, one of the largest managed retreat sites and one of the largest flood storage facilities in Europe. The apartments are in the parish of Alkborough and are located beneath the village of Alkborough, close to the Trent and Humber. The flats' natural escarpment in the back makes them the perfect spot for managed realignment because the rising earth will contain the floodwaters. Natural England, Associated British Ports, and North Lincolnshire Council, was made to maintain the viability of nearby farms impacted by the change in land use and the navigability of the Humber Estuary while also reducing flood risks and enhancing biodiversity.

KEYWORDS:

Alkborough Flats, Ecosystem Services, Environmental Agency, Flats Site, Humber Estuary.

I. INTRODUCTION

A coastal setback plan is in place at the Alkborough Flats site in the Humber Estuary. On the south bank of the inner Humber Estuary, where the River Oise and the River Trent converge, is Alkborough Flats, one of the largest managed retreat sites and one of the largest flood storage facilities in Europe. The apartments are in the parish of Alkborough and are located beneath the village of Alkborough, close to the Trent and Humber. The flats' natural escarpment in the back makes them the perfect spot for managed realignment because the rising earth will contain the floodwaters. The £10.2 million multi-objective managed realignment scheme, a collaboration between the Environment Agency, Natural England, Associated British Ports, and North Lincolnshire Council, was made to maintain the viability of nearby farms impacted by the change in land use and the navigability of the Humber Estuary while also reducing flood risks and enhancing biodiversity. This £10.2 million amount includes operations costs, capital expenditures, property management fees, and land purchases.

One of the first and most significant managed realignment sites on the Humber Estuary was the Alkborough Flats location. It is a component of the larger Humber Estuary Strategy, a £320 million initiative over 25 years authorized by Defra, which aims to safeguard the homes and businesses of almost 400,000 people. By lowering high water levels elsewhere in the Humber Estuary and its tidal tributaries, allowing the Alkborough Flats to flood aids in protecting land throughout the Humber Trade Zone (HTZ). In addition, the Alkborough Flats project indirectly contributes to the long-term conservation of species by allowing the larger estuary to evolve and adapt to sea level rise in addition to providing 440 hectares of newly developed habitat. Natural England is the conservation lead. It will be one of the largest wetland habitat construction projects in England and will have a significant positive impact on the economy by creating new jobs in the conservation, visitor services, and green tourism sectors. It will also serve as a catalyst for community engagement, local business growth, and agricultural diversification. As a result, the Alkborough Flats Project will lessen the threat of flooding while allowing businesses along the Humber to grow and preserve current employment opportunities [1], [2].

The program's other goals include giving local communities a focal point for education and access opportunities, promoting sustainable development through the management of the Humber Estuary's flood defenses, and boosting the community's economy through the development of new green tourism and recreational facilities as well as agricultural diversification. Along the Humber from Barton to Alkborough, North Lincolnshire Council is also in charge of a £4 million project financed by Yorkshire Forward that will create a variety of new visitor and tourism options. Additionally, it will make it possible to implement a smart growth strategy for green tourism that incorporates economic, social, and environmental factors and benefits the entire community in accordance with

the tenets of Tomorrow's Tourism. The Environment Agency estimates that flooding the Alkborough Flats site will provide a vast flood storage area large enough to lower high tide levels over a significant portion of the upper estuary by 150 mm. The Alkborough Flats concept consequently alters the regime to account for possibly 25 years of this climate change impact at a projected yearly sea level rise of 4 mm until 2025, and then 8.5 mm per year until 2055.

With a tidal range of about 3.5 meters in the Humber, the tidal cycle involves substantial energy and massive amounts of water. Alkborough's flood storage will allow for the postponement of other flood defense upgrades that would otherwise be required to mitigate the effects of sea level rise in the tidal rivers upstream of the site. By being able to postpone these plans, the Environment Agency will be able to save the public millions of pounds, which may then be used for other, more urgent flood mitigation projects. The Humber is a significant estuary that receives drainage from a fifth of England's land area. Important intertidal and wetland ecosystems will disappear over the next 100 years as a result of sea level rise, according to studies done on the Humber Estuary. The Humber Estuary is a vital habitat for animals, including more than 160,000 ducks each year, thanks to its extensive tidal mudflats. Sand bars, shingle banks, saltmarsh, salty lagoons, reed beds, and freshwater marshes are additional important estuary habitats for species. Reed beds in the estuary are home to rare species including the bittern marsh harrier (Circus aeruginosus), and bearded tit (Penurious biarmicus), while breeding numbers of tiny tern (Sterna albifrons) use the coastal shingle.

The Humber Estuary is a Special Protection Area (SPA) under the EC Birds Directive and a Ramseur Site under the Ramseur Convention on Wetlands of International Importance. It contains seven Sites of Special Scientific Interest (SSSIs), which are further divided into a number of habitat units. The EU Habitats Regulations have officially identified a significant portion of the estuary as a potential Special Area of Conservation (pSAC). It is essential to enable the estuary to alter and adjust to sea level rise if long-term wildlife conservation interests are to be safeguarded. All of the Environment Agency's national Biodiversity Action Plan targets for saltmarsh and mudflat habitat creation for 2006–2007 were met by the new wetland habitats produced at the Alkborough Flats site. A portion of the Alkborough Flats property is also being transformed into freshwater reed beds in order to sustain a variety of species other than those found in the main intertidal zone.

II. DISCUSSION

The Alkborough Flats management team is investigating the viability of establishing a wet grassland area to provide crucial breeding wader habitats, which are disappearing in the lowlands as a result of problems like land development and drainage. Additionally, efforts are being made to create up to 20 hectares of freshwater reed beds to draw bittern and other specialized freshwater species. Another important goal for the Humber region is being achieved at the Alkborough Flats site: long-term recreational opportunities and advantages for local towns' economies, environments, and social structures. The overall pedestrian network at Alkborough Flats increased to 8 km with the completion of capital works and the inauguration of 5.5 kilometers of footpaths, many of which were made accessible for those with disabilities. Additionally, the first of the intended five bird hides has been built, and an event calendar and explanation panels have both been erected.

Throughout the year, a monthly volunteer group assists with on-site practical tasks. One of the tenant farming families has diversified to construct a caravan park and tea room on their site, adding to the overall tourist and tourism boom. The higher portions of the property will be used for grazing, which will increase the variety of plants and animals that the site can support in addition to offering these benefits for habitat, flood risk, and amenity. A significant archaeological record for the region reaching back to prehistoric times is one of the site's other intriguing features. Bronze Age and later artefacts are particularly noticeable, with discoveries including Bronze Age boats on the coastline and signs of villages on higher ground above the estuary. During Roman rule, the Humber was also a northern frontier, and several Romano-British villages were built there. The area was also colonized by the Saxons and Danes, who gave it several place names that are still in use today [3], [4].

The Managed Realignment Scheme's History and Structure

There has been substantial planning on the estuary over many years due to the Humber's significance to so many people and interests. A combined venture by the Environment Agency, the Countryside Agency, Natural England, and North Lincolnshire Council, the Humber Management Scheme (HMS), spans all of these. A sustainably managed estuary, in balance with natural processes and providing a home for prosperous ports, industry, and agriculture, thriving wildlife, and a vibrant community that understands, cares for, and enjoys the Humber is the overarching goal for the Humber that its partners share. A portion of the HMS accepts the risks brought on by climate change, which will increase the expense of maintaining current flood defense’s due to the anticipated rise in sea level. Below this top tier, the Environment Agency alone is in charge of leading the

Humber Flood Risk Management Strategy (FRMS) and implementing pertinent programmers. The old Humber Estuary Shoreline Management Plan, delivered in 2000, is replaced by the Humber FRMS.

A large portion of the defense line will stay in its current orientation under the Humber FRMS. But the plan also mentions managed realignment as a crucial element for creating a long-lasting flood defense system for the estuary. This method moves the line of current barriers backward in particular locations, allowing more land to flood. It makes it possible to develop new habitats for species and lessens the impact of sea level rise on other more strategically placed fortifications inside the estuary. A larger project called the Humber FRMS includes the Alkborough Flats Project. According to the Alkborough Flats Project research, both geological tilting and climate change will cause the Humber's sea level to increase by as much as half a meter by the year 2050. The Humber Estuary will experience a relative increase in wave height as a result of sea level rise, which poses a threat to topple existing flood defenses.

The Humber Estuary, one of the busiest commercial estuaries in the UK and a significant worldwide wildlife site, has long been acknowledged as a key location for controlling and monitoring the consequences of the anticipated rise in sea level. Natural England, the Environment Agency, and Associated British Ports (ABP) jointly purchased the entire 400-acre Alkborough Flats site. A management committee is in charge of the land. 60% of this land area was once owned by one family, making the purchase easier. All of it was purchased at market prices without the danger of being forced to do so. One of the main obstacles to the managed retreat at Alkborough Flats was the requirement to maintain navigability in the Humber Estuary. To overcome this obstacle, engineers decided to lower the outer defense with the Humber while only breaching a 20-meter-wide armored gap through which the tidal cycle moves water onto and off of the inundated portion of the Alkborough Flats site. This 20-meter breach was constructed in 2006 and acts as a water flow throttle.

The final 1,500 meters of the Humber embankment were lowered to allow for overtopping in dire circumstances. The original flood bank was left in place along the river's shoreline where it meets the Oise on the outer corner of the Alkborough Flats site in order to avoid river remaindering and to safeguard Humber navigation as a result. On the landward side of the Alkborough Flats site, a new setback bank has been built to protect a pre-existing sewage treatment facility owned and run by Severn Trent Water. As a result of the site's 170 hectares being continually exposed to flooding, mudflat, saltmarsh, and, to some extent, reed bed has returned. Aside from the primary purpose of managing flood risk, this ecosystem currently supports a variety of animals, such as waders and other birds, as previously mentioned. Although this alters the nature of productive agriculture, the remaining 230 hectares of land outside the routinely inundated areas will act as storage capacity during extreme surge events. Previously, the land was intensively farmed for wheat and oilseed rape, but between 2006 and late 2007, this practice was phased out. This area is being converted back to grass and grazing land due to the potential of inundation during surge conditions, primarily by fresh water but also with some salt content.

As a result, it accomplishes three major goals at once managing flood risk, providing habitat for biodiversity, and managing farms economically. The two tenant farmers' actions are essential to the project's success. While one tenant farming family establishes a herd of Limousine cattle, the other establishes a flock of sheep to produce ewe lambs for breeding and sell on the food market. When undertaking this ecosystem services case study, construction was finished and the site was under permanent management. An on-site North Lincolnshire District Council office handles management coordination. Avocet is one of the 150 bird species that have been identified on the property. To date, 30 red- and amber-listed bird species have also established breeding populations there. In the winter of 2007–2008, 10,000 lapwings (Vanillas vanillas), 6,500 golden plovers (Charladies precarious), and 600 she duck were also observed feeding and roosting there. 20 different butterfly species, 14 different dragonfly and damselfly species, and 14 different species of animals have also been identified.

The location has served as a demonstration project to assist advance innovative strategies for addressing the effects of sea level rise throughout Europe. The Humber Estuary's high tide levels are predicted to rise as a result of climate change, which would increase the risk of flooding for the 400,000 people who depend on the Humber Estuary's fortifications if current defenses were maintained. On September 20, 2006, Minister of the Environment and Climate Change Ian Pearson formally started the programmer. Since then, the Alkborough Flats programmer is said to have met its challenging design requirements while also achieving broader advantages, which may include carbon sequestration, biodiversity, and the stimulation of nearby enterprises. The South Humber Collection, a collaboration initiative to showcase the cultural and natural treasures along the south bank of the estuary, now includes Alkborough Flats [5], [6].

Alkborough Flats' Suitability as a Case Study for Ecosystem Services

The Humber Strategy Group of the Environment Agency is eager for this assessment of extra benefits to move forward. Humber Strategies Manager for the Environment Agency, is eager for this assessment of broader benefits to move forward in the hopes that it would eventually be expanded out to the larger Humber Estuary. Local backing, coastal position, and the possibility to take into account elements like carbon sequestration, amenity, and business diversification all benefit the Alkborough Flats site. Flood defense is a major concern due to the abundance of settlements; port facilities of significant national economic value Google, Hull, Birmingham, and Grimsby collectively account for 12–15% of all seaborne trade in the UK, including the movement of one-third of the nation's oil), much industry, and many thousands of hectares of high-grade agricultural land within the Humber floodplain and hinterland). The interests of each of these groups are influenced by the same processes that shape the estuary for wildlife, therefore any solutions to the issue of sea level rise must be supported by all estuary users.

In addition to reducing the buffering protection provided to flood defenses by the presence of intertidal mudflats and marshes, coastal squeeze can also compromise the Humber Estuary's significance for wildlife. These effects can lead to erosion and the undermining of defenses. Therefore, preservation of the estuary's marshes and mudflats is crucial for both wildlife and human life. The Environment Agency released its original Humber Estuary Shoreline Management Plan (HESMP) in September 2000. The HESMP outlined the Environment Agency's plan for the long-term management of the flood defenses along the Humber. The plan recognizes the role of the Environment Agency in carrying out the UK's duties to conserving coastal ecosystems and accounts for the economic, environmental, and social effects of proposed military activities. Establishing a number of setback sites where flood defenses can be reconfigured to create new intertidal zones is one of the HESMP's main proposals. The idea behind this realignment was to lessen the effects of sea level rise elsewhere in the estuary and its two main tributaries, the Rivers Oise and Trent. In a preliminary selection, many potential setback locations were identified the Alkborough Flats site was one of those that was ultimately chosen. The Environment Agency's long-term plan for reducing flood risk on the Humber Estuary includes the Alkborough Flats Project, one of the largest tidal defense and intertidal wetland habitat creation projects in the UK, which cost £10.2 million in public funds.

The 440 hectares of the Alkborough Flats property were low-lying agricultural land that had a flood wall erected around it in 1956 as a result of significant floods in 1954. The pre-existing embankment would have been in jeopardy within the following ten years as a result of bank settlement, erosion, and sea level rise. Gaining the backing of the nearby communities was crucial for the Alkborough Flats Project. Partners in the project understood that this could only be accomplished if community members were consulted and actively involved in its development from inception to completion. The project was able to operate as a rural and local regeneration project by maximizing chances to strengthen the regional tourist offering and supporting rural economic businesses in the Alkborough area. This goal was accomplished through thorough community-based feasibility and planning studies. With the aid of a community liaison officer, a number of community consultation events were also held. Additionally, connections were formed with similar programmers like the Vital Villages Project of the Countryside Agency. The Heritage Lottery Fund (HLF), the Department for Environment, Food, and Rural Affairs (Defra), as well as the European LIFE-Nature and Interred IIIb programmers, have all been engaged in securing financing for the project.

The magnitude of the intervention at the Alkborough Flats site dwarfs' other recent projects in the area of the Humber Estuary, such as sewage treatment upgrades, site management, navigation dredging, flood defense work in inflowing river systems, etc. Therefore, it is expected that changes in ecosystem services both on-site and elsewhere are largely due to the Alkborough Flats Project. An unspoken initial expectation was that the change in management regime would skew benefits away from those that were presumed to be providing services such as farmed food and fibe) and towards those that were regulatory such as flood risk, supporting such as biodiversity, and cultural such as amenity. But the outcomes do not support this. It is instructive to contrast the two provisioning services of Food and Fiber and fuel e.g., timber, wool, etc., accepting significant uncertainty in the derived values.

The value for Food is deduced to be -£28,075, with the loss of arable production being replaced by grazing returns. The value for Fiber is generated as a net +£26,820, which is calculated as returns from sales of wool minus production losses of straw. Additionally, a provisioning service benefit of £3,000 per year was calculated for Genetic resources. The important thing to remember is that the net effect of changing the regime on provisioning services is almost cost-neutral or positive, and may even be strongly positive if we can quantify the role that habitat plays in fish recruitment, which has both apparent significant food and recreational values. There

is no need to trade off other private benefits in order to maintain habitat for the benefit of the general public and services. This is a crucial message for the route that agricultural subsidies should take to benefit a larger portion of society [5], [7].

Significant Public Good

The research reveals a wide range of benefits stated throughout the complete range of ecosystem services, in addition to the typical costs and benefits of near-market goods and services mostly the provisioning services. While not all of them were targeted results of this intervention, many of them are very significant. Additionally, ecosystem services give the analysis a foundation for expressing the broader advantages of ecosystem-based interventions, counteracting the widespread but frequently implicit political belief that environmental protection and biodiversity conservation must necessarily come at a net cost and be a constraint on general development. Many of these clarified benefits are not part of the formal economy, are estimated using broad assumptions, and are vulnerable to additional uncertainties when surrogates are used to calculate values. Despite major uncertainties, when those values are appraised, the scope of public benefits resulting from better ecosystem functioning appears to be substantial.

This conclusion offers a compelling case for ecosystem-based interventions, for an assessment based on ecosystem service, and for the justification of a large portion of the work of the Environment Agency on the basis of contributions to the range of ecosystem services' contributions to optimal public value. This strongly supports the ecosystems approach's worth to the Environment Agency and its collaborators. This ecosystem services analysis, which focuses on Alkborough Flats and the larger Humber Estuary, offers convincing proof of how managed realignment can benefit the populace more broadly and sustainably. However, communicating this to the relevant stakeholders might be challenging from a practical standpoint. The confusing factors are that all modifications to the existing land use and other regimes are typically viewed as losses, and there may be a trade-off between localized, private effects and broader public benefits, for which careful marketing will be necessary. According to Philip Winn's experience thus far, the Humber Estuary Strategy is convincing from an urban perspective, but farmers frequently perceive it as a war in which some of the best agricultural land in the nation is lost [8], [9].

This must be balanced against the greater public benefits resulting from other ecosystem services as a result of ceasing defense for a predominantly small range of provisioning services crops, grazing, etc., often for private gain, as well as the fact that investment to maintain all flood defense’s is not available and may be unsustainable in any case. For instance, there are 15,000 hectares of property near the Humber where the justification for protecting the area is insufficiently compelling to be certain that the investments required to bolster the fortifications will be made. Other pertinent concerns include the equality of funding for flood risk management, which is mostly provided by tax revenues paid by people who are not at risk of flooding. The creation of a market for the greater array of ecosystem services at Alkborough Flats may show the utility of this method at considerably broader scales, as sea level rise may render some floodplain communities uninhabitable.

Indicators for Evaluating Effectiveness

Studies on evaluating the efficacy of ecological restoration must use evaluation indicators. As study on typical marine ecosystems becomes increasingly in-depth, several indicators are added to the system for assessing the efficacy of ecological restoration, and additional indicators can provide a more thorough reflection of that effectiveness. However, it will also result in the duplication of indicators and significantly increase the evaluation workload. Therefore, how to choose evaluation indicators and how to set up an indicator system are the primary issues facing ecological restoration effectiveness assessment at the moment. The three major techniques for restoring a sea grass bed's ecological balance are planting seeds, transplanting plants, and restoring the habitat. Sea grass community, biodiversity, water environment, and substrate environment are basically where the associated effectiveness evaluation indices fall under.

The most popular metric to assess the restoration status of the sea grass bed ecosystem is the sea grass community index. It indicates the recovery of the sea grass bed vegetation following ecological restoration. Similar to coral reef ecosystems, salt marsh ecosystem ecological restoration effectiveness metrics are starting to take social and economic factors into account. The outcomes of the restoration project of the salt marsh ecosystem are assessed in addition to ecological state and environmental pressure indicators. Additionally, the index for assessing the efficiency of project management by project managers as well as the indices for the societal impact of environmental protection awareness level, publicity level, per capita income, and degree of scientific research are added. Only common indicators are sorted out because there are limited studies on pertinent indicators for salt marsh ecological restoration effectiveness evaluation. Due to the frequently vast scale

nature of salt marsh wetlands, landscape ecological indicators can be correctly taken into account when evaluating performance.

III. CONCLUSION

The importance of this distinctive ecosystem and its function in delivering beneficial services to both humans and the environment are highlighted by the evaluation of the effects on ecosystem services in Alkborough Flats. It emphasizes the necessity of conservation initiatives and environmentally responsible land management techniques to safeguard the habitats, biodiversity, and general functionality of the flats. To preserve the long-term viability and ongoing provision of ecosystem services for future generations, cooperation across stakeholders, including local people, conservation organizations, and policymakers, is necessary for the preservation of Alkborough Flats and its ecosystem services. The assessment also identifies potential risks and difficulties for Alkborough Flats' ecological services. Within the flats, habitat has been lost, degraded, and fragmented as a result of human activities like drainage, farming methods, and land use changes. The biodiversity will be negatively affected by these changes, especially for species that depend on the local environments.

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