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Applying Climate Compatible Development and economic valuation to coastal management: A case study of Kenya's mangrove forests

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ABSTRACT

Mangrove forests are under global pressure. Habitat destruction and degradation persist despite long-standing recognition of the important ecological functions of mangroves. Hence new approaches are needed to help stakeholders and policy-makers achieve sound management that is informed by the best science. Here we explore how the new policy concept of Climate Compatible Development (CCD) can be applied to achieve better outcomes. We use economic valuation approaches to combine socio-economic data, projections of forest cover based on quantitative risk mapping and storyline scenario building exercises to articulate the economic consequences of plausible alternative future scenarios for the mangrove forests of the South Kenya coast, as a case study of relevance to many other areas. Using data from 645 household surveys, 10 focus groups and 74 interviews conducted across four mangrove sites, and combining these with information on fish catches taken at three landing sites, a mangrove carbon trading project and published data allowed us to make a thorough (although still partial) economic valuation of the forests. This gave a current value of the South Coast mangroves of USD 6.5 million, or USD 1166 ha^{-1}, with 59% of this value on average derived from regulating services. Quantitative risk mapping, projecting recent trends over the next twenty years, suggests a 43% loss of forest cover over that time with 100% loss at the most vulnerable sites. Much of the forest lost between 1992 and 2012 has not been replaced by high value alternative land uses hence restoration of these areas is feasible and may not involve large opportunity costs. We invited thirty eight stakeholders to develop plausible storyline scenarios reflecting Business as Usual (BAU) and CCD – which emphasises sustainable forest conservation and management – in twenty years time, drawing on local and regional expert knowledge of relevant policy, social trends and cultures. Combining these scenarios with the quantitative projections and economic baseline allowed the modelling of likely value added and costs avoided under the CCD scenario. This suggests a net present value of more than US$20 million of adoption of CCD rather than BAU. This work adds to the economic evidence for mangrove conservation and helps to underline the importance of new real and emerging markets, such as for REDD + projects, in making this case for carbon-rich coastal habitats. It demonstrates a policy tool – CCD – that can be used to engage stakeholders and help to co-ordinate policy across different sectors towards mangrove conservation.

1. Introduction

Mangroves are the only woody plants to grow in the intertidal zone. They occur throughout tropical and subtropical latitudes where they may form extensive forests, particularly in sheltered bays and deltas. Their global extent, approximately 138,000 km^2 (Giri et al., 2011), is shrinking by around 0.7% per year, but this figure underestimates the problem since it applies only to complete removal of the forest and does not capture forest degradation. Causes of mangrove decline include shrimp aquaculture, conversion for tourism and coastal infrastructure, commercial extraction of timber and extensive but persistent extraction of wood for fuel

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and building materials. Climate change, and in particular sea level rise, is likely to exacerbate these impacts over the next century (Gilman et al., 2008).

Many studies have documented the impressive array of ecosystem services provided by mangroves. These include provisioning (such as fish, timber and medicines), cultural (such as spiritual sites and tourist attractions) and regulating (such as coastal protection and carbon sequestration). The continued destruction of the forests, despite their well-documented ecological value, has become a *cause celebre* amongst conservationists and is used to illustrate irrational or short-term planning (in for example the Millennium Ecosystem Assessment: Watson et al., 2005). It is often argued that undervaluation, in particular, remains a persistent problem; that the benefits associated with mangrove ecosystem services (and conversely, the economic costs associated with their degradation and loss) have long tended to be omitted from the economic calculations that are used to inform coastal development decisions (Emerton, 2006). In consequence, markets and prices fail to adequately reflect ecosystem service values, and so they are rarely considered when resource management decisions are made. The effects of undervaluation are also manifested at the policy level: there is a long history of economic policies which aim to stimulate production and growth having also hastened the process of mangrove degradation and loss. Examples include the generous tax breaks, import duty exemptions, export credits and preferential loans offered to shrimp farming in many countries (Primavera, 1997; Bailly and Willmann, 2001). The net result is that it frequently remains more profitable for people to engage in economic activities that degrade mangroves – even if the costs and losses that arise for other groups, or to society in general, outweigh the immediate gains to the land or resource user who is causing the damage. At worst, in the absence of information about ecosystem values, substantial misallocation of resources has occurred and gone unrecognized, and immense economic costs and ecological damage have been incurred (James, 1991).

In response a growing literature exploring the economic value of mangrove ecosystem services has emerged over the last two decades or so (see for example, Barbier et al., 2011; Dixon, 1989; Conservation International, 2008; TEEB, 2012; Wattage, 2011; UNEP-WCMC, 2011). Such studies often contain impressive figures; for example Barbier et al. (2011) cite values for coastal protection in Thailand in excess of US$10,000 ha^{-1} yr^{-1}, 1 ha of Mexican mangroves may contribute US$37,000 yr^{-1} to the value of local fisheries (Aburto-Oropeza et al., 2008), and mangroves in Benut, Johor State in Malaysia have been estimated to generate non-use values of almost $7500 ha^{-1} yr^{-1} – more than five times as much as the combined value of their provisioning and regulating services (Bann, 1999). The authors of such work hope that by expressing these values in monetary terms they will change how decisions are made about land use and conservation in favour of long-term sustainability of mangroves.

Critics of such 'market environmentalism' warn that it may imply a dangerously simplistic view of ecosystems (by, for example, separating out functions and services that in reality are synergistic), reinforce existing social inequalities, detract from the ethical or moral arguments for conserving wild nature and encourage the intrusion of market norms and psychology into inappropriate spheres of life (Kosoy and Corbera, 2010). Several authors also contend that there remains little evidence that providing monetary estimates of ecosystem values has actually resulted in improved conservation (King, 1998). Despite such concerns, we think valuation offers an important opportunity to improve the efficiency, equity and sustainability of land and resource management decisions. This is particularly true provided that uncertainties are explicitly acknowledged, care is taken to consider the underlying power structures that support different decisions and for goods and services that already have clearly understood market values for the poor but that may not have been fully assessed in ways accessible to policy makers.

However, the continued destruction of mangroves, despite the apparently compelling case made by scientific research and valuation studies for their conservation, points to other limitations to the idea that a simple lack of information drives damaging changes. One missing component may be active engagement with policy makers and other stakeholders during and after the research; without this academic studies may be ignored entirely, or seen as abstruse or irrelevant. Coastal scientists are aware of the pressing need for this engagement; a recent study identifying research priorities amongst scientists working in the coastal zone placed a better understanding of policy, legal and institutional arrangements and how these inter-relate with management as the top global priority (Rudd and Lawton, 2013). A related problem is one of context. Whilst it might be instructive to see estimates of total economic value for an ecosystem these need to be contextualised, for example by showing how much value could be lost under different scenarios, in order for them to have obvious traction. At the same time, while there is clearly a need to demonstrate and communicate the value of coastal and marine ecosystem services to decision-makers, if better and more informed choices are to be made between different land, resource and investment options (Agardy et al., 2005; Brown et al., 2008; UNEP-WCMC, 2011), valuation is not an end in itself. However high the value of mangrove ecosystems is demonstrated to be in theory, this has little meaning unless it actually translates into shifts in real-world policy and practice, and changes the economic opportunities, prices and markets that land and resource users face as they go about their day-to-day business (Emerton, 2006, 2013). Hence there needs to be explicit consideration of the policy landscape and a concern for plausible solutions; 'plausibility' here being informed by the stakeholders who could bring about change and by ways in which theoretical values might translate into actual conservation and management cash.

There are many examples in international policy of calls for integrated management of estuarine, coastal and marine habitats, with regards to their use, conservation, restoration and in climate change mitigation and adaptation (e.g. the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands (Ramsar) and UNEP Global Programme of Action for the Protection of the Marine Environment from Landbased Activities (GPA-Marine)). The limited success of these policies when applied to mangroves illustrates the failure of policy makers to effect new economic opportunities that support local conservation, but developments in climate change policy may open new ways to link global concerns with local action. The United Nations International Strategy for Disaster Reduction (ISDR) explicitly links ecosystem conservation with a reduction in risk factors exacerbated by climate change, implying the need to invest national risk reduction funding into ecosystem management. The United Nations Framework Convention on Climate Change (UNFCCC 1992, Article 4 (d)) now supports opportunities for forest conservation, principally through the Reduced Emissions from Deforestation and forest Degradation + (REDD+) and Nationally Appropriate Mitigation Actions (NAMAs) of the Durban Platform. Coupled with the growing recognition of the importance of coastal ecosystems as globally significant sinks for carbon (so-called Blue Carbon) and the emerging global market for carbon offsets, these developments provide new ways of linking theoretical values of two ecosystem services (risk reduction and carbon storage) with income for local people (Grimsditch, 2011); they help make conservation scenarios plausible.

Here we illustrate how an economic valuation approach can be