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Coastal livelihood vulnerability to marine resource degradation: A review of the Indonesian national coastal and marine policy framework

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ABSTRACT

In rapidly developing countries, where large sections of the population are highly dependent on marine resources, coastal livelihoods are vulnerable to sudden shocks and long-term change. National policy can attempt to mitigate this vulnerability within a multi-level framework by addressing the three aspects of vulnerability (exposure, sensitivity, adaptive capacity) through well-documented interventions. This article reviews the Indonesian policy framework for coastal and marine policy interventions that either directly or indirectly address different dimensions of coastal livelihood vulnerability. The findings show that the policy environment for addressing coastal livelihood vulnerability is heavily based on developing adaptive capacity and to a certain extent sensitivity without adequately addressing exposure, the initial cause of vulnerability. In addition, the complexities and inconsistencies within the Indonesian governmental structures, as well as more general issues of funding gaps and poor coordination, mean that policies created at national level rarely filter down to provide the intended benefits to coastal communities. It is recommended that practitioners and policymakers engage in a more cohesive and balanced approach to addressing livelihood vulnerability in coastal management by focusing more on the causes of the disease, exposure, rather than healing just the symptoms.

1. Introduction

1.1. Marine resources and coastal livelihoods

The majority of the world's population lives in coastal areas and human populations derive a variety of benefits from functions, goods and services marine ecosystems provide. The livelihoods of coastal communities are strongly linked to the health of the coastal and marine ecosystems on which the majority of these communities rely [1]. Globally, the fisheries sector alone provides about 170 million jobs, and more than 1.5 billion people rely on marine resources for their protein intake [2]. Small-scale, or artisanal fisheries employ the vast majority of the world's fishers [3]. Of the small-scale fishers, over a quarter fish on coral reefs, and half of all coral reef fishers are found in Southeast Asia [4]. Marine ecosystems in many regions of the world, however, show alarming signs of degradation [5]. Increasing demand on coastal and marine resources, especially in the tropics, has led to extensive and sometimes irreversible damage to the marine environment, whilst simultaneously compromising livelihoods [6]. This situation is particularly grave in Southeast Asia, where over 90% of coral reefs are at risk from local threats [7]. The amount of overexploited marine fish stocks has increased steadily over the past three decades to around one third, and less than 15% of fish stocks still hold potential for increased exploitation [8]. In the 2008 report 'The Sunken Billions', the total economic loss caused by the global decline in fish stocks is estimated to be approximately two trillion dollars for the last 3 decades [9]. The loss of functions, goods and services marine ecosystems provide is a significant barrier to the achievement of the Millennium Development Goals to eradicate

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extreme poverty and hunger [10]. The vulnerability of marine resource-dependent sectors of society to degradation of these resources, particularly in developing countries, requires policy responses that address the different factors contributing to this vulnerability [11]. Indonesia is taken as a case study to examine how national marine policy addresses vulnerability arising from marine resource dependency.

1.2. The Indonesian case

Indonesia is the world's largest archipelagic nation consisting of more than 17,000 islands. It is located within the Coral Triangle, the global hotspot of marine biodiversity. The country's coastline of about 81,000 km includes around 4000 ha of mangrove forests and the territory encompasses 5.8 million km^2 of sea area, of which approximately 51,000 km^2 are coral reefs [12]. It has been estimated that in 2005, 7.3 million people (or 8% of the working population [13]) were employed directly or indirectly by the fisheries sector, with the marine fisheries sector providing US$ 5.2 billion to the country's national gross domestic product (GDP) [14].

The condition of Indonesia's marine ecosystems reflects the global trend. In 2011, the Minisitry of Marine Affairs and Fisheries passed a decree (Kep. 45/Men/2011) to assess the status of marine fisheries resources in the eleven Indonesian fisheries management areas (*Wilayah Pengelolaan Perikanan*). The results showed clear signs of overexploitation (defined as fishing levels higher than the maximum sustainable yield, with decreasing yield at increasing fishing effort) in all management areas, particularly for small pelagic species [15]. Over the last few decades, unsustainable use of marine resources has dramatically risen in Indonesia, and the degradation of marine ecosystems including coral reefs, seagrass meadows and mangroves pose major threats to the viability of coastal ecosystems [16] from both land- and sea-based human activities [17]. The cumulative impact of the human drivers of change on marine ecosystems causes an ever-increasing concern for the livelihoods of coastal populations, especially the ones living in small coastal communities where marine natural resource dependence is often high. The main coastal pressures arise from population growth, pollution, exploitation of natural resources [7,18] and climate change [11]. In addition, unsustainable practices including coral mining, anchoring in reef areas and destructive fishing methods, such as cyanide fishing, dynamite fishing and the use of fine mesh nets [7], are jeopardizing environmental quality crucial for sustaining vulnerable local livelihoods [19–23]. Nowadays, 93% of Indonesia's coral reefs are at risk from these local threats[1] [7]. This situation is further exacerbated by the predicted impacts of global climate change, which is a key threat to coral reefs and marine fisheries [24,25]. Indonesia is projected to experience the strongest decline in marine fisheries of any nation—total marine fish catches are predicted to decrease by over 20% until 2055 [26]. Particularly for the livelihoods of inhabitants of many small rural coastal villages, marine ecosystems play a fundamental role [22,23,27]. Households in coastal communities thus are particularly vulnerable to the impacts of ongoing marine resource degradation.

1.3. Vulnerability in coastal and marine social-ecological systems

The concept of *vulnerability* is multi-faceted and has undergone several changes over time [28]. For this article, vulnerability is understood as "the degree to which a system is susceptible to and is unable to cope with adverse effects" [28] of resource degradation. Vulnerability is frequently understood as comprising the three key dimensions *exposure* (E), *sensitivity* (S) and *adaptive capacity* (AC) [11,25,28–31]. In the context of marine resources, exposure relates to the extent to which a system is subject to various environmental and anthropogenic factors such as climatic events, fishing impacts, nutrient inputs or habitat modification [11,30,32]. For example, it may describe the frequency and duration with which a coral reef experiences a thermal anomaly, or the amount of trawling that a particular benthic area is subject to. With regard to fishing communities, Cinner et al. [33] argue that socioeconomic exposure to marine resource degradation is a result of ecological vulnerability of those marine resources (which is caused by both environmental and socio-economic drivers). Sensitivity is the degree to which a system is affected or modified by perturbations or stressors [11,32,34]. There are both ecological and socio-economic components of sensitivity. For example, the stock of a species that grows and reproduces slowly is more sensitive to the removal of large individuals than that of an early-reproducing, fast-growing species, and a community of heat-tolerant coral species is less sensitive to a warming event than one comprising highly heat-sensitive species. Similarly, a coastal community with low dependence on marine resources is not overly sensitive to degradation of these resources. Adaptive capacity refers to the ability of a system to adapt and respond to change and to minimize, cope with, and recover from the consequences of change [11,30,35]. The socio-economic constituents of adaptive capacity can be broadly grouped into four key clusters: flexibility, capacity to learn, capacity to organize, and assets [36]. Adaptive capacity is related to, and sometimes equated with, *resilience* [29,30,32]. While the latter has conceptual origins in ecology, it is increasingly applied to linked social-ecological systems [37]. Resilient social-ecological systems are capable of absorbing larger shocks and long-term changes and contain the components needed for system survival [38]. Resilience is usually associated with adaptivity and diversity, including the diversity of species, of human capacities and of economic options [38]. In line with this requirement, marine resource conservation attempts call for adaptive approaches and the provision of alternative livelihood options in order to decrease the pressure on marine ecosystems and increase the resilience of small rural coastal communities [39,40].

2. Methods

2.1. Research approach

The continuing decline of marine resource abundance and the degradation of marine ecosystems result to a large extent from policies that are still structured around unsustainable approaches to marine resource use [2]. With respect to livelihoods based in coastal and marine social-ecological systems (CM-SES), national level law, policy and actions play a critical role in reducing vulnerability of resource dependent coastal communities [11,41]. Particularly in decentralized countries, such as Indonesia, fragmented legal systems are a common problem for an integrated policy framework [42]. Yet, clear directions need to be set by a consistent policy framework that addresses coastal vulnerability by building adaptive capacity [38,43]. This includes enabling flexible multi-level, multi-sector governance [23,38] and generating a diverse livelihood portfolio to increase resilience of coastal communities [19,44–46].

This article aims to provide feedback about the Indonesian policy framework for coastal and marine livelihoods to policy makers in

[1] Note that while these threats are localized in their impact (as opposed e.g. to large-scale eutrophication from terrestrial run-off or changes in ocean temperature and chemistry), they are often driven by dynamics at higher levels. An example is the use of cyanide, which is driven to a large extent by the demand for live reef fish on Asian markets (particularly Hong Kong and Singapore) and the international trade in marine ornamentals.