

# Co-management approaches and incentives improve management effectiveness in the Karimunjawa National Park, Indonesia



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## ABSTRACT

Karimunjawa National Park (KNP) was among the first maritime areas recognized in Indonesia as being important for the conservation of marine biodiversity. Economic incentives in the KNP aim to decrease community dependency on wild-captured natural resources and achieve biodiversity and development objectives. Various participatory mechanisms facilitate community involvement in governance, whilst other incentives promoting awareness and support for fishery regulations are being delivered. Monitoring programs have demonstrated some ecological improvements and reductions in destructive fishing in the park over the past five years. The findings demonstrate that MPA policies and regulations can improve the social well-being and political power of fishing communities, particularly when appropriate economic, legal and participatory incentives are provided.

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## 1. Introduction

Karimunjawa National Park (KNP) was among the first maritime areas recognized in Indonesia as being important for the conservation of marine biodiversity. It was formally declared a Strict Natural Reserve in April 9, 1986 by the Minister of Forestry (PHKA Decree no. 123/Kpts-II/1986), and has since been declared a priority area for marine biodiversity conservation in Southeast Asia. In 1988, the Minister of Forestry declared the area a National Park and, in 1990, the park zonation plan was released. On February 22, 1999, the Karimunjawa archipelago was declared as the Karimunjawa Marine National Park, now referred to as Karimunjawa National Park under the Ministry of Forestry and Plantation Decree no. 78/kpts-II/1999. In 2001, all marine waters of Karimunjawa National Park were designated as a marine conservation area by the Ministry of Forestry Decree no.74/Kpts-II/2001. The park includes both marine and terrestrial components, including 1101 km<sup>2</sup> of sea, 13 km<sup>2</sup> of tropical lowland forest and 3 km<sup>2</sup> of mangrove forest (Fig. 1). The park includes a total of 27 islands with a resident population of around 9000, concentrated on the islands of Karimunjawa, Kemujan, Parang and Nyamuk. The islands were first zoned into four zones (i.e. core zone, protection zone, utilization zones and buffer zones) under Director General of PHKA Decree no. 127/Kpts/DJ-VI/1989. From 2003–2005 the Karimunjawa National Park Authority (KNPA), Wildlife Conservation Society (WCS), Taka

(local NGO) and the University Diponegoro conducted a spatial planning and stakeholder consultation process to revise the zoning system. The new zoning system was legislated on June 30, 2005 under the Director General of PHKA, Decree no. 79/IV/Set-3/2005. This zoning system consists of eight zones (i.e. core zone, protection zone, tourism zone, aquaculture zone, rehabilitation zone, religious and historical zone, residential zone and utilization of traditional fisheries zone). Subsequently as part of the governments remit to rezone the park every 5 years, the park was re-zoned in 2012 under Director General of PHKA, Decree no. 28/IV/Set/2012 on 6 March 2012.

The Ministry of Forestry, which retains responsibility for all of Indonesia's national parks, remains a highly centralized institution within the state government structure. However, decentralization reform and ineffective management by the KNPA since the park was established in 1999 have resulted in an increased emphasis on community involvement and participation in management activities. The need for decentralization and a more participatory approach in Indonesian coastal zone management emerged more than a decade ago [1]. These new decentralization laws provide an opportunity to recognize and institutionalize community-based management and co-management into the local and national systems of governance [2]. The laws also promote a system of shared responsibility among the great range of stakeholders who have a vested interest in the improved management of marine and coastal resources in an archipelagic nation as large and as diverse as Indonesia. In addition, the laws recognize that local community roles must be promoted in the management of local resources.

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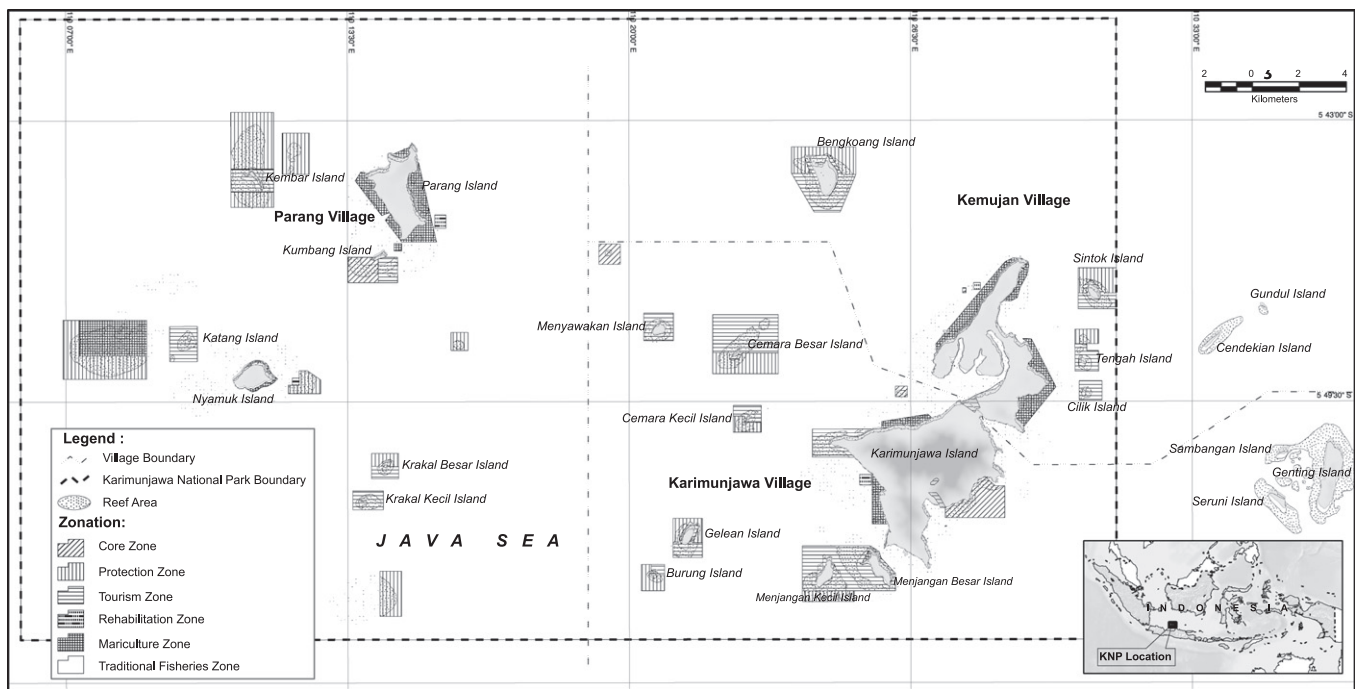


Fig. 1. Location map and 2012 zoning plan for the Karimunjawa National Park.

Table 1

Regulations governing activities in the KNP. Key: ✓: permitted; [✓]: permitted only in emergency; x: forbidden; p: prior permit required; n/s: not specified; n/a: not applicable.

	Core zone	Protection zone (marine)	Protection zone (terrestrial)	Utilization zone (terrestrial)	Tourism zone	Traditional use zone	Mariculture use zone	Religious and historical zone	Rehabilitation zone	Residential zone
Area covered (ha)	445	2600	1452	56	2733	100,327	1371	1	68	2572
Fishing (all techniques)	x	x	n/a	n/a	p	✓	x	n/a	✓	n/a
Research	p	p	p	n/a	p	p	p	n/a	p	n/s
Boat transit only	[✓]	✓	n/a	n/a	✓	✓	✓	n/a	✓	n/a
Boat transit and anchoring	[✓]	✓	n/a	n/a	✓	✓	✓	n/a	✓	n/a
Tourism	x	x	x	n/a	✓	✓	✓	n/a	✓	n/s
Restoration and rehabilitation	x	x	x	n/a	✓	✓	✓	n/a	✓	n/s
Education	p	p	p	n/a	p	✓	✓	n/a	✓	n/s
Traditional and ritual use	p	p	p	n/a	p	✓	✓	✓	✓	n/s

Community involvement and participation are widely acknowledged in the literature as providing opportunities for improving natural resource management [3–5]. From 2003 to 2005, the KNP conducted a spatial planning process that resulted in changes in the zones and regulations inside the park. The planning process involved consultation with a wide range of stakeholder groups and sought inputs from communities into the design and adoption of rules that impact marine resource use. Since 2005, communities have been more involved in park management including surveillance, monitoring and involvement in implementing management strategies to help reduce destructive fishing. A positive outcome of improved community participation has been the stabilization of reef fish biomass in some areas since new zoning regulations have been in place [6].

## 2. Objectives

The revised 25 year management plan produced in 2005 defined a new vision for the park which involves the preservation of biological

diversity and ecosystem types for the enhancement of public welfare and quality of life through sustainable use principles and economic development strategies. These goals and objectives are in accordance with national regulations relating to marine conservation, fisheries and small island development. The change from the 1989 zoning plan, which for the most part prioritized protection of biodiversity, reflects the need for regional tiers of government to achieve greater financial self-sufficiency in the current era of decentralization within Indonesia [4]. Key habitats are identified as priorities in the management plan comprising coral reefs, seagrass meadows, fish spawning aggregation sites, mangroves, cetaceans, water bird nesting areas and turtle nesting sites, together with undefined economically valuable marine species. Reference is made to obligations associated with the Convention on Biological Diversity and domestic Acts, foremost amongst which is Act 5/1990 relating to the conservation of natural resources and protected area management. The current zoning plan and associated regulations are illustrated in Fig. 1 and Table 1. These are used to derive management objectives consisting of effective zone management and monitoring of reefs, seagrass meadows, mangroves and fish spawning aggregation sites, together with engaging in public

awareness raising exercises with local communities. The main changes to zoning in 2012, compared with 2005, included the doubling of maritime protection and tourism zones, a 42% increase in areas in mariculture zone coverage and the establishment of a zone to protect religious and historical features.

Awareness raising has been implemented through village meetings, development of village forums to administer community based economic and conservation strategies, public engagement activities, establishing boundary markers around core zones and assistance with livelihood development strategies linked to community obligations to comply with zoning. Effective zone management is also directly related to enforcement through patrolling, which is constrained by availability of sufficient funding. Monthly patrols take place and increasingly are being more effective at targeting and punishing fishers who violate the zoning laws. Yet resources available to effectively patrol the park are insufficient and the KNPA have begun to advocate training for communities to become more involved in the protection of their local natural resources.

### 3. Drivers and conflicts

#### 3.1. Fisheries pressure

Unsustainable large and small-scale fishing practices that deplete fish biomass and damage fish habitats represent the primary threat to biodiversity conservation within the park. Artisanal fishing is the most common activity in the KNP with 70% of the local community involved in fishing related activities. Fisheries resources have declined over the past 20 years and mariculture activities are expanding in the park [7]. Although destructive fishing practices including cyanide fishing and the use of illegal fishing gears are prohibited by park regulations, they are still practiced inside the national park and within the no-take zones. Commonly used fishing gears in the KNP include muro-ami nets [8], gill nets, hook-and-line, and fish traps. The number of muroami fleets, each consisting of three boats, declined from 18 in 2003 to one fleet in 2010, and presently no fleets operate and cyanide use is also declining. These changes are most likely associated with declines in catches, increasing enforcement from the marine park, incentives from the KNPA to practice sustainable fishing and changes in the economic viability of these practices. There has been an increase in awareness of spatial, species and gear

restrictions following the rezoning in 2005 and increase in coral health throughout the park [9]. Nonetheless many fishers perceive a decline in catches over the past 5 years, some fishers still use destructive fishing methods, and 250 boats were recorded fishing in protection and core zones in 2009–10. Management controls, and in particular spatial controls on fishing, are clearly not well acknowledged by all fishers, yet an increasing understanding by fishers of the effects of overfishing and destructive fishing is most likely a key factor that drives improvements in coral reef health.

The decline in the biomass of reef fish, the weak compliance by fishers with fishery closures [6,9], and low densities and size of species of high commercial value, indicates heavy fishing pressure [10]. To address the issue of declining biomass of highly valued carnivores and herbivores [6], the government and NGOs have since 2010 initiated community and tourism development programs (e.g. training for community tourism enterprises, RARE PRIDE campaign) which have resulted in new signage and marker buoys for fishery closures, and increased stakeholder awareness of fishery closures and bans on destructive fishing. These activities are the direct result of decentralization laws in Indonesia which allow more active involvement of local governments and communities in the management of the park with the aim of soliciting improvements in the biodiversity of the KNP.

#### 3.2. Live reef fish trade

The live reef fish supply network that extends across the Indo-Pacific [11] created demand for fish such as Serranidae which are caught mainly using cyanide in the KNP. The demand came from Hong Kong markets from 2000 to 2005, with around 2500 kg caught per annum, mostly from the wild. In 2009 the domestic market centered in Java has been the primary driver for live reef fish trade. Monitoring by the KNP authorities indicates that the live reef fish catch totaled 1104 kg in 2009. The highly valued napoleon wrasse (*Cheilinus undulatus*) is protected under national law within the national park as well as being regulated under Appendix II of the CITES Convention, and is generally not fished or exported to external markets.

#### 3.3. Tourism

Tourism has developed rapidly in the KNP [12], with visitor numbers increasing by a factor of 20 from 450 in 1998 to over

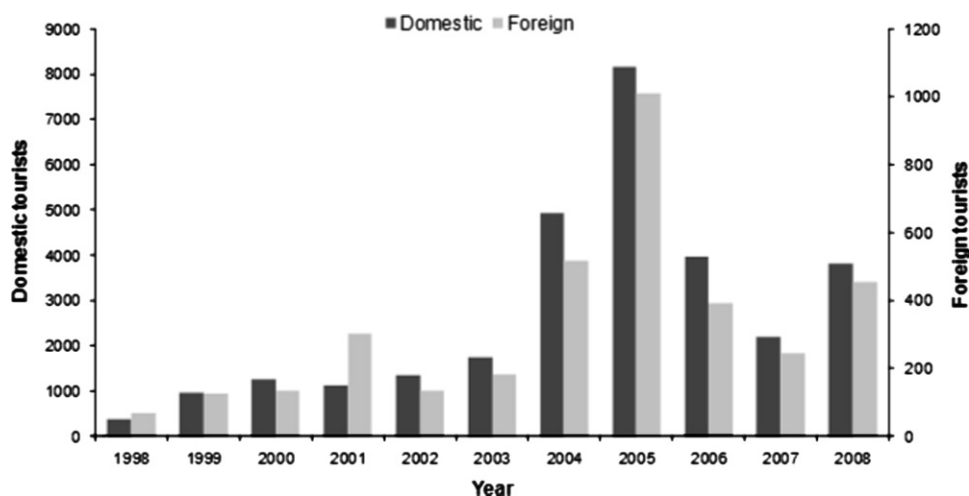


Fig. 2. Tourism (numbers of people) in the KNP from 1998 to 2008. Source: [52].

9000 in 2005 (Fig. 2). Improvements in political stability, local infrastructure and global economic factors are the likely drivers of the tourism sector. Tourism is driven mainly by the growing domestic and regional tourism markets, with foreign tourists accounting for around 12% of the total between 1998 and 2008. Tourism aims to promote sightseeing, diving and snorkeling, while educational tourism focused on sea turtles, mangroves and lowland forest and encourages the growth of tour guiding, home stays and local resorts. The latter has resulted in new buildings and resorts for accommodation and the increased use of boats for tourists. Zoning of terrestrial areas for accommodation and village infrastructure, along with the zoning of tourism in terrestrial and marine areas, aims to accommodate these activities in the park while achieving sustainable management of ecosystems. The proportion of reef habitats within marine tourism zones is 9.7% and tourism in these areas needs to be closely monitored and regulated so that activities do not damage marine habitats through anchor damage and trampling. Tourism may also increase demand for marine based food products, and demand driven improvements in access to and availability of fish markets may also deplete local fish stocks [13].

### 3.4. Marine pollution

The impacts of pollution from domestic sewage, infrastructure and mariculture developments are likely to increase as economic development accelerates in the KNP. Water pollution from coastal development, including the construction of hotels and new village infrastructure, has increased in recent years in the KNP. Such developments often have inadequate sewage controls and nearshore marine areas may be impacted by sewage runoff. The use of cyanide to catch high value reef fish contributes to water pollution and coral habitat mortality. Since 2008, an increased awareness within local communities of the detrimental consequences of destructive fishing has reduced the incidence of these practices. The need for economic alternatives to destructive fishing and use of highly exploitative fishing gears has led to the expansion of mariculture facilities in nearshore waters, driven by a high domestic demand for seaweed, clam and reef fish. Unpublished monitoring data collected by the KNPA shows annual seaweed mariculture production totaled 1151 kg in 2009. These facilities can pollute marine waters, through inputs of organic nitrogen from fish and seaweeds, causing anoxic conditions and mortality of benthic habitats. Zoning of mariculture within the KNP aims to manage, control and limit these impacts.

## 4. Governance framework

Overall, the governance system in the KNP has performed weakly in relation to addressing conflicts and achieving objectives, particularly those related to legal obligations on protecting fishery resources from unsustainable and destructive practices. That being said, improvements since 2009 have occurred with a cessation of dynamite fishing, a reduction in cyanide fishing, support from communities for no take zones, fines for those caught harvesting clams and other protected species and a reduction in the use of muro-ami nets. These changes are linked to both increasing efforts of governments in improving community awareness of fishing regulations, and the perception among fishers that fisheries have been depleted and consequent support for new industries (e.g. tourism, formal employment, animal husbandry, emerging industries) that provide increased disposable income which subsistence fishing cannot support [14,15]. Communities with a high dependency on marine resources, such

as those in the KNP, are generally more supportive of strategies that restrict fishing gears rather than fishery closures, as many fishers depend on subsistence fishing for food security more than income [16]. In the KNP the increasing support for and adoption of gear restrictions by government and communities are also viewed as long-term investments in marine resources and alternatives to the short-term profits gained by destructive fishing and muro-ami netting. Gear restrictions may reduce the cost of fishing, increase the proportion of self-employed fishers, build up the biomass of fisheries and improve catches and the price of fish [17]. More success in cross-sectoral efforts by government including the KNPA and representatives from fisheries and tourism authorities is needed to fulfill legal obligations related to the park.

Governance systems that respect customary knowledge, rules and decision-making processes are more likely to be supported by local communities [18–21] and are commonplace in many Pacific societies [22,23]. In Indonesia, there are relatively few cases of communities having co-management arrangements with governments in marine resource management [24]. The KNP represents an important exception as a collaborative management approach involving multiple government departments and community groups since 2007. Management outcomes have assisted local people with alternative incomes to unsustainable fishing, and have included community ranger patrols, alternative fisheries practices such as mariculture, switches in fishing gear use from destructive and exploitative net fishing to handlines, and an increase in tourism and support for the tourism industry. Such approaches by government should improve the socio-ecological outcomes for coastal communities in the KNP, whilst decentralized policies which provide greater management stewardship by local stakeholders are being developed through central government policies [2]. These policies aim to improve food and financial security for communities and access rights to resources, both of which have benefited coastal communities elsewhere [5,18].

Many of the drivers behind infringements including market pressure and demand for live reef fish are not easily addressed by national park laws and policies. Addressing such drivers requires that legislation at national and local levels in areas relating to conservation and fisheries management is effectively enforced. This in turn requires political will and increased capacity to support the implementation of existing laws. The poor implementation of national laws and policies in the fishery sector undermines the conservation objectives of the KNPA and makes the KNPA unable to control fishery resources within its jurisdiction. With recent community support for national park laws and zones, the situation is starting to stabilize with some infringements acted upon through legal processes. For example, although enforcement by government patrols has been poor in the past, since 2005 controls on the harvesting of clams and fish in protected areas are being enforced to some extent, reflecting the effect of community involvement in designing the new park rules and zones. Recently (2008–09), fishers harvesting clams and other species in no take zones have been fined, reflecting greater community support for these zones. The approach towards enforcement is evolving in response to government policies that aim to involve communities in management and reporting infringements through local community ranger patrols, with training provided by government and NGO's to support these efforts. Through support from government policies and local NGOs, community surveillance and livelihood programs such as grouper mariculture and micro-credit financing were established, which aim to reduce exploitative fishing activities and community dependency on natural resources.



## 5. Effectiveness

The effectiveness of marine park or marine spatial planning processes in Indonesia is rarely assessed or debated within the literature [24]. The KNP therefore provides an interesting case study as it represents one of the eight nationally protected marine parks under similar types of governance regimes, all of which are subject to decentralization policies, which in turn are influential with respect to park governance and zoning.

The KNP is managed by the Karimunjawa National Park Authority (KNPA) within the Ministry of Forestry (MOF). The Wildlife Conservation Society has an MOU with MOF, and is giving technical assistance to the KNPA. The University of Diponegoro also provides technical assistance. The park zonation plan was finalized in 1999, re-evaluated from 2003 to 2005, amended in August 2005, and again revised in 2012 after a 2 year evaluation to improve the zoning regulations. Zoning of the park allows regulatory controls on uses to be defined within the context of conservation objectives outlined in the management plan, permits the use and harvest of some natural resources in a sustainable manner and reduces conflicts among natural resource user groups.

Small marine protected areas governed by local communities have been shown to provide greater improvements in biodiversity than larger government-controlled MPAs, due largely to a higher level of compliance [25]. Therefore the rezoning processes of the KNP have been used as opportunities to work more with local stakeholders, to help define KNP management policies and develop a zoning plan agreed to by all stakeholders. Workshops and consultation meetings during spatial planning were conducted in the district capital of Jepara and three villages in KNP to foster better communications and commitment from stakeholders to work together and to enable co-ordinated implementation of the agreed zoning plan. Surveys conducted to serve as the basis for planning and designing of the zones included ecological surveys (coral reef, invertebrates and reef fish); socio-economic perception surveys (to assess level of community understanding on zoning); and surveys of muro-ami fishing (to assess the ecological and socioeconomic impacts of such fishing activities).

The first KNP zonation plan was completed in 2005, incorporating basic ecological factors and sociopolitical considerations. The improved planning of the KNP led to an increased awareness of fishing restrictions and other regulations, enhanced compliance with fisheries controls and a higher level of support among coastal communities for zoning regulations [9]. The head of KNP requested that WCS help the community become more involved in direct management activities of KNP and increase their capacity to fulfill such functions. The process of 'Rencana Strategis' or 'Renstra' (strategic planning) is a formal process that WCS initiated in the village of Parang in 2007. A management plan that guides the implementation of a number of programs linked to economic development and conservation and exploitation of marine resources was produced. The process begins with informal meetings among village elders, followed by formal meetings among village officers and community groups. The outcome was the development of three community action plans for the villages of Parang, Karimunjawa, and Kemujan. The District Development Planning Board, which is the regional body responsible for planning and development, has adopted the Village Management Plans as the first strategic plans to facilitate communications between the community and other local government agencies within the district of Jepara. KNP leadership take the lead on organizing regular meetings and forums to facilitate community participation and assist communities to operationalize action plans with endorsement from the district government of Jepara. Through these plans, communities are provided with some

economic and participatory incentives to become engaged in livelihood programs, management programs and capacity building programs.

Ecological improvements in all zones have included increases in coral cover and reduced macroalgal cover, providing important habitats for reef fish. It could be that the benefits of the improved decentralized governance of the national park system have yet to be fully realized, as the biomass of reef fish remained relatively stable from 2004 to 2008 [6], including important trophic groups, such as herbivores that are essential for promoting reef resilience. More recent analyses suggest that some zones have shown some declines in reef fish biomass [9], whilst fish biomass in KNP is generally lower or comparable with estimates in other coral reef systems where management has restricted the use of fishing gears [26–29] and areas with permanent fisheries closures [30–32]. Although protected areas may take many years to yield improvements in fish biomass [33], the trends in KNP suggest that levels of non-compliance with fishing regulations continues to be a main threat to marine ecosystem health. Improvements in compliance with controls on destructive fishing and exploitative fishing gears will most likely increase the biomass of reef fish, by limiting damage to coral habitats and decreasing the catch of species vulnerable to fishing [29]. Such improvements are also important for protecting functionally important groups of fish that builds coral reef resilience [34].

Ongoing assessments of the effectiveness of the controls in KNP are providing management options to improve the processes through which KNP zones are further improved to achieve increases in fish populations. Such assessments provide critical feedback for management authorities to adapt its management to changes in the threats to marine resources. In combination with other management efforts and regulations, especially those relating to large scale threat reduction and targeted fisheries and conflict resolution instruments, performance evaluation should test for additional ecological and socio-economic improvements over time in comparison to unmanaged areas as part of an adaptive management regime [35].

## 6. Incentives

The impacts of MPAs on local fishers and other stakeholders may either boost or thwart efforts to expand MPAs [36,37], and it is common for new resource governance regimes, as described here for KNP, to influence the involvement by communities in management planning through a range of incentives [38–40]. Incentives being applied by the KNPA to address conflicts and improve governance of the KNP include economic, interpretative and knowledge incentives, while although laws are in place to protect the park, enforcement of these laws is poor (Table 2).

Economic incentives are a primary mechanism through which the conflict between biodiversity conservation and local development needs is being addressed in the KNP. Promotion of economically and ecologically sustainable resource use is being supported through programs that improve local infrastructure and develop mariculture and tourism industries as alternative income sources for coastal communities. By legislating marine zones for aquaculture practices, the government has provided legal incentives resulting in a total of 2020 fishers being currently involved in seaweed mariculture and enabling a further 15 fishing families to diversify into grouper mariculture [41]. For the latter, village agreements between fishers and government require the commitment of those who receive economic assistance to comply with fisheries regulations and cease the use of destructive fishing practices. Incentives have included provision of infrastructure, training in husbandry and grants for obtaining grouper fry. All of these

**Table 2**  
Summary of governance incentives in the KNP.

Incentive type	Incentives applied	Incentives needed	Cross-cutting issues
Economic	Promoting economically and ecologically sustainable resource use Allocation or reinforcement of community/user property rights Promoting alternative livelihoods Improvements in local infrastructure and living standards Funding from private or NGO sources to promote the effectiveness of the MPA		Stewardship has been generated through recognizing the rights of local users for tourism, mariculture and fishing within the KNP, whilst also promoting community participation in park planning, monitoring and enforcement
Interpretative	Public communication, education and awareness raising Promoting recognition of MPA regulations and restrictions, including boundaries		
Knowledge	Maximizing scientific knowledge to guide/ inform MPA decision-making Promoting mutual respect and collective learning between different knowledge owners		
Legal		Legal or other official basis for cross-sectoral/ jurisdictional MPA restrictions Ensuring that sufficient state capacity, political will, surveillance technologies and financial resources are available to enforce all restrictions equitably on all local and incoming users, including addressing driving forces	
Participative	Participative governance structures and processes Participative enforcement		

economic incentives aim to empower fishing communities in MPA governance and decisions on fishing rights, minimize conflict among coastal communities through controls on fishing gears and offer a viable strategy for enhancing food security through greater stewardship of marine resources and improved governance over marine resource use [42,43].

Incentives were also provided to enable resource dependent communities of KNP to participate in new management revisions, building stewardship and rights of local users for fishing within the KNP, and promoting community participation in park planning, monitoring and enforcement. During the rezoning process in 2003–05, communities self-organized into village planning groups and received funding to help them contribute to MPA planning and help decide on new locations for fishery closures in core and protection zones, and decide on the location of new zones for aquaculture, tourism and traditional fishing where restrictions on fishing gear use and bans on destructive fishing apply. Village forums have also received training and resources to participate in monitoring of the MPA, in particular surveillance and reporting of destructive fishing. Participation in MPA planning and management also provided opportunities for communities to receive interpretative and knowledge incentives. These enabled community organization and involvement in public communication, education and awareness raising programs including community events promoting recognition of MPA regulations and sustainable fishing, and school education programs on marine conservation (Table 2).

Increased involvement of village institutions in community decision making related to park management and enforcement is also needed to reduce conflicts among fishers and improve legal obligations for protecting fishery resources from unsustainable and destructive practices. As communities have become involved in the surveillance and reporting on the poaching of protected marine species such as clams, napoleon wrasse and turtles, infringements have been acted upon by the KNPA through legal processes.

The strong support by some fishing communities for fisheries regulations reflects an alignment of shared objectives and stewardship among community and government institutions, which has been shown to improve the governance of natural resources [44]. Nonetheless, there exists considerable room for improvement to ensure that laws in place receive sufficient state capacity, political will, technological input and financial resources to provide effective enforcement practices that tackle external and internal factors driving non-compliance. In particular, the alignment of KNPA enforcement programs with those of the district fisheries government agency will improve consistency in the prosecution of laws. In many cases local fishers may support small no-take areas but violators are often not apprehended due to poor surveillance techniques. The inconsistent application of law is an important barrier for community support for fishing restrictions. To increase capacity and effort in law enforcement and target the organized offenders an integrated approach is needed that recognizes community involvement in harm reduction and law enforcement in the context of broader socio-

economic priorities [45]. Such approaches are becoming more closely aligned with emergent forms of marine area protection such as non-formal self-organizing island exclusion zones that are locally constructed within existing institutional frameworks [24].

## 7. Cross-cutting issues

In KNP the establishment of village institutions and forums for community decision making and leadership is comparable to co-management or 'hybrid' institutions of customary and modern management. These forms of management often are adaptively established with support from communal norms and practices and able to respond to changes in access to natural resources by allocating resources in accordance with the preferences of the majority of residents or ecosystem users [44]. More attention therefore should be placed on capacity building for adaptive management by local level management institutions and organizations to encourage mechanisms that promote flexible and responsive policies and management strategies [46]. For example, increased understanding of the ability of communities to adapt to and support localized fishery closures and fishing restrictions and take advantage of positive opportunities that may result from changes in fishing access can feed back to improve management of networks of protected areas in Indonesian national parks. In the KNP, the village institutions and government agencies are supporting the stewardship of marine resources by recognizing the rights of local users in zoning plans, with traditional fishing permitted in 83% of the park, building infrastructure and skill training in tourism and mariculture within the KNP, and promoting community participation in park planning, monitoring and enforcement.

## 8. Conclusion

A key finding of this paper is that economic support from government, community and non-governmental sectors is a crucial factor enabling the transition of livelihoods to sustainable fishing practices, reducing destructive fishing and achieving biodiversity protection [28]. The improved governance in KNP appears to meet, in part at least, many of the governance design principles recognized as being important for successful local management [32]. For example, resource dependent communities in the KNP recognized the social and economic implications of new management revisions being developed in 2003 and accordingly self-organized and contributed through participatory planning processes to protect their diverse interests (e.g., income, food security, sense of place) and directly influenced the final set of regulations legislated in 2005. The resulting promotion of community participation in management processes has raised awareness of graduated sanctions, clearly defined geographic boundaries and improved rights to participate in devising rules and regulations of fishing restrictions that have minimized conflict among coastal communities.

KNP management over the five year period from 2005 to 2010 has also improved community support for some controls on fishing, promoted the recovery of coral habitats through restrictions on destructive fishing practices and improved community involvement in MPA management. However, fish stocks in the KNP have not increased due to non-compliance with fishery closures [6,9] as external factors continue to drive infringements in the KNP. These include market pressure and demand for live reef fish which require increased enforcement of laws at both the national and regional levels and integration of community approaches in law enforcement in the context of broader socio-

economic priorities and harm reduction [45]. Increased involvement of village institutions in community decision making related to park management and enforcement will help reduce conflicts among fishers and enable legislation of community supported restrictions and sanctions that protect fishery resources from unsustainable and destructive practices.

A highly diversified approach is required to provide incentives for local communities to comply with fishing regulations in the KNP to reverse the depletion in coral reef fisheries. The establishment of village institutions and forums for community decision-making and leadership has provided incentives for communities to address conflicts between biodiversity conservation and local development needs. Through improved knowledge and participation in planning processes and management, and economic support from government and NGOs for livelihood programs such as grouper mariculture, seaweed culture, tourism ventures and micro-credit financing, the primary aim is to reduce exploitative fishing activities and decrease community dependency on wild-captured natural resources. The provision of capacity building and infrastructure is often conditional on recipients' compliance with fisheries regulations, including the prohibition of destructive fishing practices, that can have ecological impacts similar to prohibiting all extractive uses [47,48].

The governance approaches described in this study represent 'emergent' or hybrid forms of marine area protection in the local context [44] that are respected and locally enforced and may, if enforced, achieve high fishery compliance rates and food security [49,50,51]. The second re-zoning of the KNP was finalized in 2012 as part of the KNPA's adaptive management mandate. To achieve its primary aims of biodiversity protection and social improvement, sustained investment in resources and expertise is needed to deliver incentives that maintain and build sustainable industries, allow traditional subsistence fisheries to flourish, and provide disincentives to outside fishers and destructive fishing [13,52].

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