

# Opportunities and constraints for implementing integrated land–sea management on islands

THEMED SECTION  
Humans and Island  
Environments

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## SUMMARY

Despite a growing body of literature on integrated land–sea management (ILSM), very little critical assessment has been conducted in order to evaluate ILSM in practice on island systems. Here we develop indicators for assessing 10 integrated island management principles and evaluate the performance of planning and implementation in four island ILSM projects from the tropical Pacific across different governance structures. We find that where customary governance is still strongly respected and enabled through national legislation, ILSM in practice can be very effective at restricting access and use according to fluctuations in resource availability. However, decision-making under customary governance systems may be vulnerable to mismanagement. Government-led ILSM processes have the potential to design management actions that address the spatial scale of ecosystem processes and threats within the context of national policy and legislation, but may not fully capture broad stakeholder interests, and implementation may be poorly coordinated across highly dispersed island archipelagos. Private sector partnerships offer unique opportunities for resourcing island ILSM, although these are highly likely to be geared towards private sector interests that may change in the future and no longer align with community and/or national objectives. We identify consistent challenges that arise during

island ILSM planning and implementation and offer recommendations for improvement.

*Keywords:* integrated coastal management, integrated island management, community-based management, management implementation, tropical Pacific

## INTRODUCTION

Isolation of island systems from continental landmasses has promoted unique biological and cultural attributes, particularly on small, remote islands (MacArthur & Wilson 1967). There is also especially tight connectivity between land and sea on high islands given the generally smaller sizes of their watersheds compared with those on continents (Ruddle *et al.* 1992; Jenkins *et al.* 2010). However, because these ecosystem connections operate across small geographies, the health and wellbeing of island peoples are highly vulnerable to large-scale disturbances (e.g. from tropical cyclones or flooding) that disrupt ecosystem processes and functions operating across multiple realms (Griffith & Ashe 1993; Aston 1999; Jenkins & Jupiter 2015). For instance, in-stream water quality and biodiversity can be degraded following periods of high rainfall and flooding: in high island watersheds with high rates of deforestation on erosion-prone soils, researchers have documented reduced abundance and diversity of freshwater resources and increased in-stream bacteria and incidence of waterborne bacterial disease (Jenkins & Jupiter 2011; Ragosta *et al.* 2011; Jenkins *et al.* 2016). Given the small size of many islands and often complex tenure or private property arrangements, affected island people may have limited opportunities to replace loss and damage to the natural resources upon which they depend for ecosystem service provisioning, thus heightening the need for proactive, integrated management across linked land and sea realms.

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**Table 1** Definitions of environmental management approaches applied in order to safeguard linked land and sea resources, with special reference to implementation in island systems (adapted from Jupiter *et al.* 2014a).

<i>Approach</i>	<i>Definition and relevance to islands</i>	<i>Supporting reference</i>
Community-based adaptive management	Integration of design, management and monitoring in order to learn and to improve responses to management efforts carried out by, or with a major role played by, local communities. In island systems, communities often have the ability to influence management over linked terrestrial and marine ecosystems at the scale in which ecosystem processes and threats are occurring.	Govan <i>et al.</i> (2008)
Customary management	Management of natural resources and systems as part of customary practice and institutions. For example, many Pacific Island peoples retain customary tenure over land and sea ecosystems and resources and can self-define rules for their access and use.	Ruddle <i>et al.</i> (1992)
Ecosystem-based management	Management of the cumulative impact of human activities in order to maintain ecosystems in a healthy, productive and resilient condition for the delivery of ecosystem services and the protection of biodiversity. Application of integrated land–sea management on island systems is a specific form of ecosystem-based management that targets the maintenance of ecosystem services and biodiversity that rely on connections between land and sea.	Clarke & Jupiter (2010a)
Integrated coastal (zone) management	A conscious management process that acknowledges the inter-relationships among the multiple objectives for the use of coastal areas and the environments that are affected by those uses. Islands are bound by coastlines and thus integrated coastal (zone) management should form an integral part of any natural resource management scheme.	Cicin-Sain & Knecht (1998)
Integrated island management	Sustainable and adaptive management of island natural resources through coordinated networks of institutions and communities that bridge habitats and stakeholders at the scale of social–ecological processes and threats, with the common goals of maintaining ecosystem services and securing human wellbeing.	Jupiter <i>et al.</i> (2014a)
Integrated land–sea management	Management that specifically targets cross-system threats and processes between linked terrestrial, freshwater and marine ecosystems in order to maintain or restore biodiversity, ecosystem services and human wellbeing. Because of the geographic proximity between water catchments and coastal marine areas in island systems, cross-realm processes and ecosystem functions are more easily disrupted by large-scale disturbances and thus require heightened consideration for integrated management.	Álvarez-Romero <i>et al.</i> (2011)

A number of environmental management approaches have been applied in order to safeguard island ecosystem functionality and maintain or increase the adaptive capacity of island social–ecological systems to respond to environmental change, which include community-based adaptive management, customary management, ecosystem-based management, integrated coastal management and integrated island management (IIM) (Table 1) (Jupiter *et al.* 2014a). Integrated land–sea management (ILSM), which specifically targets cross-system threats and processes (Table 1), can be applied on islands within the context of any of the above environmental management approaches in order to maintain or restore sensitive biodiversity, ecosystem services and human wellbeing. Important cross-system processes to maintain on islands include nutrient subsidies, which can influence the productivity and diversity of linked ecosystems (e.g. Polis & Hurd 1996; Anderson & Polis 1999), and species' movements across their life history stages (Polis *et al.* 1997; Hazlitt *et al.* 2010; Jenkins *et al.* 2010). Cross-system threats requiring management stem from both land-based activities

that affect marine realms (Stoms *et al.* 2005) and maritime activities that affect other realms (Gresh *et al.* 2000).

Yet despite a growing number of projects on islands funded under ILSM initiatives with differing environmental management approaches and governance structures, very few in practice are able to effectively manage these cross-system threats and processes in order to achieve biodiversity protection and positive livelihood outcomes (Álvarez-Romero *et al.* 2011; Adams *et al.* 2014; Jupiter *et al.* 2014a). Recent reviews (e.g. Álvarez-Romero *et al.* 2011; Álvarez-Romero *et al.* 2015; Reuter *et al.* 2016) highlight several hurdles to achieving effective ILSM outcomes in both continental and island systems. Barriers to effective ILSM planning and implementation include: (1) lack of mechanisms to coordinate institutions with different mandates and area jurisdictions across levels of government and between public and private sectors (Cicin-Sain & Belfiore 2005; Lane 2008); (2) conflict arising due to poor involvement of the full range of stakeholders with interests across the land and sea divide (Reuter *et al.* 2016); (3) an inability to address

potentially conflicting objectives and mandates across agencies (e.g. conservation through sustainable use versus economic gain from commercial extraction) (Álvarez-Romero *et al.* 2011); (4) a lack of adequate data on ecosystem responses to management measures in order to appropriately prioritize actions, particularly with regards to multi-objective project goals (Álvarez-Romero *et al.* 2015); (5) uncertainty about the effects of management actions across connected realms (Adams *et al.* 2014); and (6) the labour, time and complexity of analyses required to develop and/or adapt models and decision support systems that deal with the above issues (Álvarez-Romero *et al.* 2011). ILSM project implementation may be further hampered by the inability of responsible agencies and institutions to simultaneously schedule management actions in linked terrestrial and marine realms in order to comprehensively address threats at appropriate spatial and temporal scales (Álvarez-Romero *et al.* 2011).

Despite a large body of potential socioeconomic, governance and environmental indicators (e.g. Ehler 2003; Pollnac & Pomeroy 2005), little monitoring and evaluation has been conducted in order to assess ILSM planning and implementation (Christie 2005), although there are a few island examples that have been showcased as successes (Jupiter *et al.* 2014a). Here we provide novel indicators for island ILSM based on 10 IIM principles (Jupiter *et al.* 2014a) built on Ostrom's (1990) framework for the sustainable governance of common-pool resources that can be used to evaluate the potential effectiveness of island ILSM planning and implementation for managing cross-system processes and mitigating cross-system threats. We use our indicators in order to evaluate four island ILSM projects across community-, government- and private sector-led approaches. We showcase how each project embodies some aspects of best practice for ILSM and highlight the challenges faced. We then provide some recommendations for how the challenges may be addressed in order to improve island ILSM outcomes.

## METHODS

### Development of ILSM indicators

An expert working group convened in April 2015 to propose a list of monitoring and evaluation indicators within the context of 10 principles designed to guide best practice for IIM (Jupiter *et al.* 2014a). The principles are based on common-pool resources theory (e.g. Ostrom 1990; Cox *et al.* 2010) and consultations with regional practitioners (Jupiter *et al.* 2014a). The IIM principles, which can be grouped into planning and implementation categories, provide a clear framework under which island ILSM projects can be evaluated. Indicators were refined during a second workshop in January 2016, yielding a list of 32 such indicators (Table 2 & Table S1 (available online)). Of these, 22 (68.8%) specifically relate to ILSM, while the remaining indicators characterize aspects of best practice management that are relevant to any IIM project (Table 2). The principles and indicators are not necessarily

unique to island settings, but given smaller geographies, there are faster and tighter feedbacks between social and ecological systems across island terrestrial and marine realms, heightening the need for integrated management. Community and government managers, particularly in remote island settings, may additionally benefit from more efficient resource allocation through the integration and coordination of activities across sectors and realms in order to achieve mutual aims of maintaining ecosystem services and securing human health and wellbeing (Lane 2006; Jupiter *et al.* 2014a).

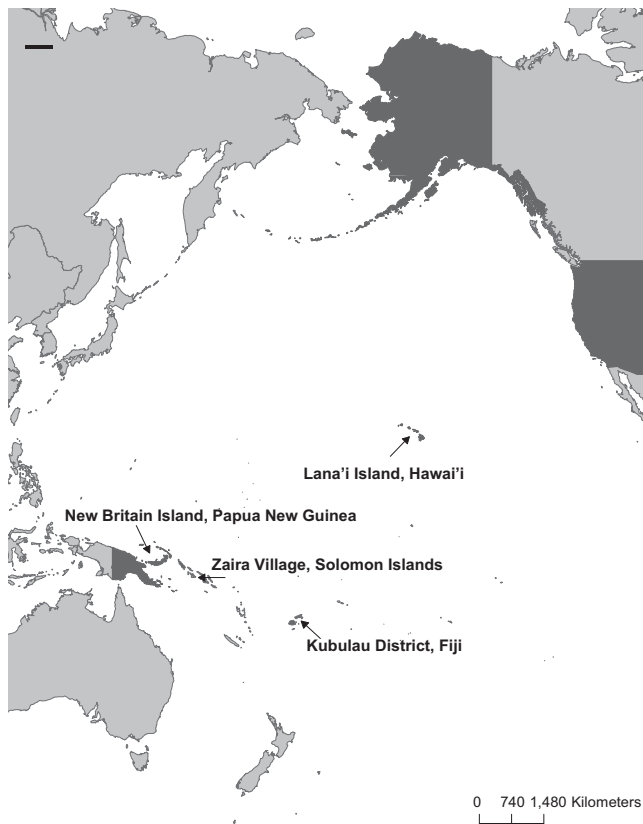
### Case selection and scoring

We selected four island ILSM projects from locations in the tropical western Pacific where there was adequate information from the literature or place-based expert knowledge to assess the characteristics of ILSM planning and implementation against the indicators (Fig. 1). Although we recognize the limitations of generalizing from our small sample size, we found that, similar to Jupiter *et al.* (2014a), very few island ILSM projects exist with adequate documentation on planning and implementation to enable critical evaluation. The selected projects cover a range of geographic scales, governance and management systems, including: (1) customary management of a single community of *c.* 150 people, with little external input and resources (Zaira Village, Solomon Islands); (2) community-based management at the district level, covering 10 villages and *c.* 1000 people, with financial and technical support from non-governmental organization (NGO) partners (Kubulau District, Fiji); (3) provincial-level government decision-making and prioritization, operating within the context of indigenous tenure systems across entire island systems with *c.* 450,000 residents (New Britain, Papua New Guinea (PNG)); and (4) top-down management from a private sector company that owns 98% of an island with *c.* 3100 local residents (Lānaʻi, Hawaiʻi) (Table 3).

In order to evaluate the projects, designated co-authors who were most familiar with each region entered supporting information into an Excel database from the literature and their own experiences regarding project planning and implementation as they related to the measurement of each indicator. In order to maintain some objectivity, only co-authors who were uninvolved in project planning and implementation scored each project on performance against each indicator using uniform scoring criteria (Table S2). Results were averaged across all scorers and the performance of each ILSM project against the indicators is described. Evaluation of these four projects is meant to highlight factors that contribute to successful planning and implementation while raising challenges that may ultimately impact ILSM outcomes and thus provide learning opportunities in order to improve practice at other sites. We hypothesize that projects that score highly across most indicators will be most successful at delivering on management objectives, which largely focus on protecting biodiversity, maintaining ecosystem functions and providing ecosystem services for human health, cultural

**Table 2** Indicators designed to evaluate island integrated land–sea management projects associated with the 10 integrated island management principles from Jupiter *et al.* (2014a). P = principle related to planning; I = principle related to implementation. \*Indicator specific to integrated land–sea management projects.

<i>Principle</i>	<i>Indicator</i>
1. Adopt a long-term, integrated approach to ecosystem management (P)	<ul style="list-style-type: none"> <li>a. Explicit timeframe of implementation stated (including overall timescale and review frequency)</li> <li>b. Proportion of linked ecosystems incorporated in plan*</li> <li>c. Presence of coordination body or mechanism to integrate sectors (e.g. public versus private; land versus sea mandates)*</li> <li>d. Accounting for the cumulative impact of multiple threats to the coastal zone*</li> <li>e. Accounting for lag time for impacts to be realized and benefits from management to accrue across realms*</li> <li>f. Objectives integrate ecological, social, economic and cultural issues and feedbacks that account for the connectivity between land and sea realms*</li> </ul>
2. Use clearly defined boundaries for ecological and governance systems (P)	<ul style="list-style-type: none"> <li>a. Degree to which the spatial boundaries of the management zone match the boundaries of watersheds and linked coastal areas*</li> <li>b. Management boundaries represent the scale of ecological processes and threats for priority features that are relevant to integrated land–sea management*</li> <li>c. Resource users are aware of management boundaries</li> <li>d. Decision-makers and decision-making processes are clearly identified</li> </ul>
3. Maintain and restore connectivity between complex social and ecological systems (P)	<ul style="list-style-type: none"> <li>a. Appropriate strategies proposed and management actions identified in order to minimize land-based threats to downstream systems relative to the number of issues*</li> <li>b. Appropriate strategies are proposed and management actions are identified in order to restore connectivity processes relative to the number of issues*</li> <li>c. Strength of social networks that connect people using land and sea resources*</li> </ul>
4. Incorporate stakeholders through participatory governance with collective choice arrangements that consider gender and social equity outcomes (P)	<ul style="list-style-type: none"> <li>a. Proportion of population who access and use land and sea resources in the management area are able to participate in management planning and implementation*</li> <li>b. Proportion of different sectors and stakeholder groups across land and sea realms are participating relative to presence in area*</li> <li>c. Opportunities for input from marginalized sectors of communities in affected areas</li> <li>d. Consistency of mandate through changes in political leadership</li> </ul>
5. Ensure that management rules reflect/incorporate local values and conditions (P)	<ul style="list-style-type: none"> <li>a. Management objectives reflect local concerns and issues related to cross-system threats and processes*</li> <li>b. Local perception that the benefits of management outweigh costs</li> <li>c. Equity in distribution of management costs and benefits across land and sea resource users*</li> </ul>
6. Ensure recognition of rights to organize and develop management rules (I)	<ul style="list-style-type: none"> <li>a. Level (formal or informal) of recognition of management authority</li> <li>b. Clearly defined and demarcated ownership of both land and sea and use rights of land and sea resources*</li> </ul>
7. Develop appropriate sanctions for users who violate rules (I)	<ul style="list-style-type: none"> <li>a. Frequency and effectiveness of monitoring, control and surveillance integrated across land and sea realms*</li> <li>b. Proportion of offenses that are adequately punished across both land and sea*</li> </ul>
8. Identify appropriate, efficient and cost-effective conflict resolution mechanisms (I)	<ul style="list-style-type: none"> <li>a. Existence of forum or means to settle disputes</li> <li>b. Perception that conflict resolution is handled fairly and in a culturally appropriate way</li> </ul>
9. Implement adaptive management where regular monitoring, evaluation and review in the face of uncertainty lead to evidence-based decision-making (I)	<ul style="list-style-type: none"> <li>a. Monitoring information relevant to the spatial scale of the impacts of human activities on linked ecosystems and responses of linked ecosystems to management interventions are communicated to decision-makers*</li> <li>b. Decision-makers use relevant information to adapt management measures*</li> <li>c. Adaptions to rules consider present and future uncertainty regarding cross-realm threats and processes*</li> </ul>
10. Nest management layers across sectors, social systems and habitats (P, I)	<ul style="list-style-type: none"> <li>a. Management actions/monitoring is carried out by individuals across land and sea realms who report to a coordinating body*</li> <li>b. Frequency and consistency of communication between lower to higher scales of nested systems (upward and downward communication)</li> <li>c. Consistency in goals and motivations between nested levels in achieving integrated land–sea management outcomes*</li> </ul>



**Figure 1** Locations of four island integrated land–sea management projects in the tropical Pacific.

practice and wellbeing (Table 3). For projects where periodic monitoring data have been collected, additional indicators could also be used to measure ILSM outcomes for biodiversity and livelihoods (e.g. changes in coral health and fish catch as a response to watershed management), although this is beyond the scope of this assessment because two of the projects (New Britain and Lānaʻi) are still in their planning phases.

## RESULTS

### Zaira Village, Solomon Islands

#### *Positive attributes*

The Zaira project scored consistently highly on indicators related to: adopting a long-term integrated approach to management; using clearly defined management boundaries at the appropriate scale; accounting for connectivity between ecological realms and social networks; ensuring management systems reflect local values; monitoring and punishing offenders; and resolving conflicts (indicators associated with principles 1–3, 5, 7 and 8; Table 4). Through a commitment to longstanding cultural values, the three tribal groups that form Zaira have successfully managed their linked land and sea resources for millennia under a customary management system, which allows certain resources to be restricted at certain times and considers connectivity and feedback between the cultural interactions of people with land and sea systems

(Table 4, indicators 3a–c) (Hviding 1996). The customary practices are generally regarded as fair and equitable within the local social contexts (Table 4, indicators 5a–c). Zaira community members are committed to achieving sustainable resource management because the customary practices are parts of their identity; thus, ILSM benefits are as much about maintaining cultural practice as ensuring the availability of livelihoods and wellbeing derived from environmental services (Table 4, indicator 5b).

More recently, in 2010, the Zaira tribes independently adapted their customary resource management mechanisms to more formalized planning and implementation under an ILSM plan that integrates customary and scientific approaches, as per Aswani and Ruddle (2013). The plan: covers management rules for all linked ecosystems within the customary land and sea tenure boundaries of three cooperating tribes at the scale over which cross-system processes are occurring; has objectives that are focused on the maintenance of culture and tenure, food security, iconic species and education; and is discussed during annual meetings, with a 5-year timeline for review (Tables 3 & 4, indicators 1a, 1b, 1f & 2a–c). The evolution of Zaira's customary management system into more structured ILSM implementation has provided a platform of confidence, enabling the local management committee to enforce their authority on outsiders who are interested in resource extraction; recently, one high-profile case of a peaceful boarding of an international logging vessel that was illegally entering the management area was settled with significant financial compensation paid to Zaira community members (Table 4, indicators 7a & 7b) (S. Albert, personal communication 2016). Meanwhile, internal conflicts and punishments for local offenders are dealt with through customary mechanisms (Table 4, indicators 8a & 8b).

#### *Constraints*

The governance and decision-making systems in Zaira are clear (Table 4, indicator 2d), but they do not allow for full participation of all segments of the population affected by management decisions (Table 4, indicators 4a & 4c), which may ultimately lead to system vulnerabilities should future conditions change. Although the community-centric approach in Zaira is viewed by outsiders as bottom-up governance, internally the governance is relatively top-down and is not nested within broader government management systems (Table 4, indicator 10c). Lack of broad involvement is not currently an issue in Zaira, as resource users perceive that the chief represents their interests and values, but it may become a challenge in the future if respect for the customary governance system is eroded and top-down imposition of rules is perceived as less legitimate. Furthermore, there is no guarantee that the successor to the current chief will not be swayed by development interests (Table 4, indicator 4d). A further constraint is that although formal land and sea tenure rights are recognized by Solomon Islands legislation (Hviding & Baines 1994), the tenure and use rights boundaries

**Table 3** Summary information on integrated land–sea management project management objectives, resident populations within and/or affected by management area rules, sizes of management areas, nature of governance systems and entities driving the integrated land–sea management process. NGO = non-governmental organization.

<i>Project</i>	<i>Country</i>	<i>Management objective(s)</i>	<i>Resident population size</i>	<i>Management area</i>	<i>Governance</i>	<i>Entity driving management</i>
Zaira Resource Management Area	Solomon Islands	(1) Maintain traditional resource management regime and local leadership that recognizes cultural values and protects historical heritages; (2) sustainable use of natural resources to meet the basic present and future livelihood and development needs of the dependent local community; (3) protect iconic species; (4) support cultural and environmental education of current and future generations	150	Terrestrial: 25 km <sup>2</sup> ; marine: 15 km <sup>2</sup>	Tribal chief	Community
Kubulau District	Fiji	(1) Maintain or restore marine resources; (2) maintain ecosystem connectivity and functionality; (3) protect and provide good habitats for endemic forest species; (4) ensure sustainable land management; (5) protect water catchments; (6) provide economic opportunities for the people of Kubulau (WCS 2012)	~1000	Terrestrial: 98.5 km <sup>2</sup> ; marine: 260.1 km <sup>2</sup>	Tribal chiefs	NGO
New Britain East and West Provinces	Papua New Guinea	(1) Build capacity at the local, provincial and national levels to improve decision-making around marine resource management in the Bismarck Seascape; (2) develop a comprehensive spatial information dataset to support decision-making, which is accessible to a range of stakeholders (through comprehensive maps and a supporting ridges-to-reefs plan); (3) ridges-to-reefs planning and management capable of informing decisions across jurisdictions, as well as being institutionalized within provincial government, district and tribal governance structures	~450,000	Terrestrial: 37,000 km <sup>2</sup> ; marine: 11,170 km <sup>2</sup>	Tribal chiefs	Provincial government
Lānaʻi, Hawaiʻi	USA	Reducing threats to downstream systems, restoring connectivity across landscapes and across the land–sea interface and maintaining and restoring ecosystem services, particularly: (1) plant cover, which helps with aquifer recharge; (2) hunting opportunities for local community; and (3) productive, healthy coastal environments for recreational and provisioning purposes	~3100	Terrestrial: 364 km <sup>2</sup>	Private landowner	Private sector/NGO

**Table 4** Evaluation of island integrated land–sea management projects: mean scores for Zaira (Z), Kubulau (K), New Britain (NB) and Lāna‘i (L) projects are shown. Cells shaded white show mean scores  $\geq 1.5$ , indicating strong project performance against the indicator. Cells shaded light grey show mean scores  $>0.5$  and  $<1.5$ . Cells shaded dark grey show mean scores  $\leq 0.5$ , indicating poor project performance against the indicator.

Indicator	Z	K	NB	L
1a. Explicit timeframe of implementation stated (including overall timescale and review frequency)	2	2	2	1.6
1b. Proportion of linked ecosystems incorporated in plan	2	2	1.5	1
1c. Presence of coordination body or mechanism to integrate sectors (e.g. public versus private; land versus sea mandates)	1.2	2	1.7	1.8
1d. Accounting for cumulative impact of multiple threats to the coastal zone	2	2	0.8	0.6
1e. Accounting for lag time for impacts to be realized and benefits from management to accrue across realms	0	1	0	0.8
1f. Objectives integrate ecological, social, economic and cultural issues and feedbacks that account for connectivity between land and sea realms	2	2	2	2
2a. Degree to which the spatial boundaries of the management zone match the boundaries of watersheds and linked coastal areas	2	1	0	2
2b. Management boundaries represent the scale of ecological processes and threats for priority features relevant to integrated land–sea management	1.8	1	1	2
2c. Resource users are aware of management boundaries	2	1.4	1	2
2d. Decision-makers and decision-making processes are clearly identified	2	1.4	1	1
3a. Appropriate strategies proposed and management actions are identified in order to minimize land-based threats to downstream systems relative to the number of issues	2	1.8	1.3	1.2
3b. Appropriate strategies are proposed and management actions are identified in order to restore connectivity processes relative to the number of issues	2	1	1.5	1.2
3c. Strength of social networks that connect people using land and sea resources	2	2	2	2
4a. Proportion of population who access and use land and sea resources in the management area are able to participate in management planning and implementation	1	1.2	0.8	0.2
4b. Proportion of different sectors and stakeholder groups across land and sea realms are participating relative to presence in area	1.8	0.8	1.8	0.5
4c. Opportunities for input from marginalized sectors of communities in affected areas	0.4	1.2	1.3	0.2
4d. Consistency of mandate through changes in political leadership	1.6	2	1.2	0.4
5a. Management objectives reflect local concerns and issues related to cross-system threats and processes	2	2	1.5	0.8
5b. Local perception that the benefits of management outweigh costs	2	2	0.3	0
5c. Equity in distribution of management costs and benefits across land and sea resource users	2	2	0	0
6a. Level (formal or informal) of recognition of management authority	1.2	1.6	0.6	1.8
6b. Clearly defined and demarcated ownership of both land and sea and use rights of land and sea resources	0	2	0.3	2
7a. Frequency and effectiveness of monitoring, control and surveillance integrated across land and sea realms	1.8	1	0.5	0.8
7b. Proportion of offenses that are adequately punished across both land and sea	1.2	0.6	0	0
8a. Existence of forum or means to settle disputes	2	2	0.7	2
8b. Perception that conflict resolution is handled fairly and in a culturally appropriate way	1.8	1.8	0	0
9a. Monitoring information relevant to the spatial scale of the impacts of human activities on linked ecosystems and responses of linked ecosystems to management interventions are communicated to decision-makers	0.2	1.2	1.3	1.8
9b. Decision-makers use relevant information to adapt management measures	0	0	0	2
9c. Adaptions to rules consider present and future uncertainty regarding cross-system threats and processes	0.8	2	2	2
10a. Management actions/monitoring is carried out by individuals across land and sea realms who report to a coordinating body	0	2	0	1.8
10b. Frequency and consistency of communication between lower to higher scales of nested systems (upward and downward communication)	1	1	1	0.4
10c. Consistency in goals and motivations between nested levels in achieving integrated land–sea management outcomes	0	1.8	0	0

are not legally demarcated (Table 4, indicator 6b), which can create conflict when outsiders who are interested in resource extraction or conservation are also interested in distributing benefits to the resource owners (Hviding 1996). Moreover, the government has authority to award timber rights to a third party without landowner consent (Hviding & Bayliss Smith 2000), and has recently done so for the forests adjacent to Zaira (S. Albert, personal communication 2016), jeopardizing both land and linked sea ecosystems within the conservation area.

### Kubulau District, Fiji

#### *Positive attributes*

The Kubulau project scored highly on some but not all indicators related to: adopting a long-term integrated approach to management; ensuring management systems reflect local values; ensuring management authority and rules are recognized; resolving conflicts; implementing evidence-based adaptive management; and nesting ILSM within existing governance systems operating across land and sea sectors (indicators associated with principles 1, 5, 6 and 8–10; Table 4). As in Zaira, local communities in Kubulau traditionally regulated local land and sea resource use through customary management; however, by the early 1990s, they realized that customary measures alone were insufficient to prevent commercial overexploitation of marine resources by outside users (Clarke & Jupiter 2010b). The chiefs requested support from an international NGO specializing in natural resource management, who assisted the Kubulau leadership in 2009 to develop a district-level ILSM plan designed to regulate resource use and minimize the downstream impacts of land activities by facilitating dialogue across multiple stakeholders from the communities, government and private sector (Table 4, indicator 4a). The goals of the plan, which covers the entirety of the relatively intact Kubulau land and fisheries management area (Table 4, indicator 1b), reflect local values and are focused on ensuring ecosystem integrity for biodiversity conservation and maintaining important services (e.g. food and water provision) for livelihoods and wellbeing (Tables 3 & 4, indicators 1f & 5a).

The Kubulau ILSM plan outlines a governance structure that includes a coordination body (the Kubulau Resource Management Committee), made up of representatives from coastal and inland villages, which oversees management implementation (Table 4, indicator 1c). The Management Committee is nested within the traditional chiefly governance system, through which internal conflicts are resolved via customary mechanisms (Table 4, indicators 8a, 8b, 10a & 10c). The plan was reviewed and adapted in 2012 based on monitoring data, local knowledge and community aspirations that consider future uncertainty (Table 4, indicators 9a & 9c) (Weeks & Jupiter 2013). There is a general perception according to Kubulau community household survey data that management positively affects the state of resources (Table 4, indicator 5c), with a majority of respondents specifying some level of involvement in and a high degree of satisfaction with

the management process (Table 4, indicator 5b) (Egli *et al.* 2010).

#### *Constraints*

The mismatch between the scale of threats and management implementation is an issue in Kubulau, where local actors are not capable of managing all of the threats to their ecosystems (Table 4, indicator 2b). In 1998, local communities attributed mass fish kills and coral die-offs downstream of the Yanawai River mouth to runoff from tailings released from an upstream gold mine (Jupiter *et al.* 2010). As the tailings ponds are located outside of the boundaries of Kubulau District near the headwaters of the Yanawai, the community has no influence on mining operations there, particularly as mining leases in Fiji may be granted over native land under the Mining Act without landowner consent (Clarke & Jupiter 2010b). A second major constraint is that community ILSM plans are not legally recognized by the government (Clarke & Jupiter 2010b), which particularly affects local ability to enforce no-take freshwater and marine protected areas (Table 4, indicator 7b). The Fiji Fisheries Act permits all fishers to fish for subsistence anywhere in Fiji's fresh and coastal waters with certain permitted gear types, compromising the effectiveness of ILSM, as a large number of Fiji's fishes move between freshwater and marine realms during their lifecycles (Jenkins *et al.* 2010). Presently, the only legal mechanism available for completely prohibiting all subsistence and commercial fishing is for the Minister for Fisheries and Forests to gazette a marine protected area as a restricted area, but Kubulau communities, like others in Fiji, have been reluctant to use this instrument, as it would require ceding management control to the government (Clarke & Jupiter 2010b).

### New Britain, PNG

#### *Positive attributes*

The New Britain project scored highly on some but not all indicators related to: adopting a long-term integrated approach to management; ensuring broad sectoral participation in management planning across land and sea; ensuring management systems reflect local values; and adapting existing management (indicators associated with principles 1, 4, 5 and 9; Table 4). Through its commitments to the United Nations Convention on Biological Diversity's Programme of Work on Protected Areas and the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security, the PNG national government, with the support of NGOs and research partners, has developed national priorities for terrestrial and marine conservation. In recognition that these two prioritization processes were undertaken separately without considering the connectivity between land and sea, PNG's national Conservation and Environment Protection Authority, in partnership with the United Nations Development Programme (UNDP), funded an assessment of land-based threats to downstream coastal ecosystems from upstream land use and land cover change, using methods



developed by Tulloch *et al.* (2016) that consider uncertainty in future development scenarios (Table 4, indicator 9c). The outputs from this connectivity assessment are being integrated into ILSM planning that is decentralized to New Britain Island (covering two provinces), which includes prioritization of locations for protected areas in order to specifically manage cross-system threats from land-based activities that increase sedimentation and negatively impact biodiversity. There are aspirations that at least some of these priority areas will become legally protected under new protected area legislation that is in development in PNG, although the protected area type and agencies responsible for their management are not yet clear.

An international NGO and an Australian research organization are facilitating the development of an ILSM plan for East New Britain as part of the Bismarck Sea Adaptive Governance project, which complements an ILSM plan that has already been completed for West New Britain with UNDP support (V. Tulloch, personal communication 2016). The contents of the two plans will be incorporated into 5-year sustainable development plans for provincial governments (Table 4, indicator 1a) with the aim of enabling community and government stakeholders to make informed and inclusive decisions in order to support sustainable resource management and economic development within an ILSM framework. All coastal ecosystems will be covered in the finalized plans (Table 4, indicator 1b) and a broad range of stakeholders have been included in consultations, including the National Fisheries Authority, the Mineral Resources Authority, provincial government staff, oil palm and deep-sea mining companies and representatives from local communities (Table 4, indicator 4b). Local values surrounding how connected terrestrial, freshwater and marine resources are used are being captured through participatory planning workshops with provincial-, district- and local-level government stakeholders in order to collate ecosystem goods and services' values and define management rules (Table 1, indicator 5a).

#### *Constraints*

Actual implementation of the individual ILSM plans and the integrated sustainable development plan for New Britain is likely to be challenged by resourcing, buy-in and enforcement issues. Current ILSM plan development is based on a 2-year funded project; while there is hope that additional funding will become available for another 5–10 years, the PNG national government has no immediate plans to mainstream the plans' implementation into government budgets and there is presently little buy-in from provincial governments (Table 4, indicators 4d & 10a–c). Furthermore, because of customary tenure systems in PNG, implementation ultimately depends on land and reef owner participation in management. Yet the majority of indigenous land and reef owners have not been consulted regarding plan design (Table 4, indicator 4a) and may have contrary objectives. They may choose to log rather than restore lands (Table 4, indicator 5b), thus potentially preventing implementation across the scales necessary for

threat mitigation (Table 4, indicators 3a & 3b). Offenses for existing management are generally not punished (Table 4, indicator 7b) and corruption is rife.

### **Lāna'i, Hawai'i, USA**

#### *Positive attributes*

The Lāna'i project scored highly on indicators related to: adopting a long-term integrated approach to management; using clearly defined management boundaries at the appropriate scale; accounting for connectivity between ecological realms and social networks; ensuring that management authority and rules are recognized; and establishing the framework to implement evidence-based adaptive management (indicators associated with principles 1–3, 6 and 9; Table 4). Lāna'i, the sixth largest (364 km<sup>2</sup>) of the main Hawaiian Islands, suffers from extensive soil erosion due to proliferation of invasive feral ungulates (e.g. deer and sheep), with significant capacity to devegetate large parts of the island. Over 3000 people live on the island, although the majority of the land is privately owned by a single for-profit company, Pūlama Lāna'i, who run resorts on the island. The company is developing an ILSM plan covering the 98% of the island that it owns, while the remaining 2% is owned by local people, the State of Hawai'i and The Nature Conservancy. Jurisdictionally, the management plan is likely to be easily implemented because: the local community and state recognize the management authority of the private land owner (Table 4, indicators 6a–c); land and sea ownership is clearly demarcated and recognized (Table 4, indicators 2a–c); and the management and monitoring of the company land is well coordinated (Table 4, indicator 10a).

The goals of the plan are to reduce threats to downstream systems, restore connectivity across landscapes and across the land–sea interface and maintain and restore ecosystem services (Table 3). Proposed activities for watershed restoration, terrestrial and marine invasive species management and marine debris management will minimize sedimentation and maximize the potential for recovery of the nearshore reefs (Table 4, indicators 3a & 3b). The ILSM plan will account for cumulative impacts to the coastal zone (Table 4, indicator 1e) by using outputs from quantitative models estimating soil erosion and dispersal to adjacent reefs, which will be coupled with evaluation of human fishing efforts and other marine uses (e.g. recreation) in order to assess reef impact and recovery potential. Scenarios will be developed based on various strategies for managing feral ungulates in order to prioritize areas for management and restoration. Plans are under development to install an integrated land–sea monitoring system once the watersheds for restoration have been determined in order to monitor and evaluate management effectiveness (Table 1, indicators 9a–c).

#### *Constraints*

Although a broad range of partners have been involved in discussions about management plan development, including

the Hawai'i Division of Aquatic Resources, the Hawai'i Department of Fish and Wildlife and the US Fish and Wildlife Service, local residents of Lāna'i have not been consulted (Table 4, indicators 4a–c). Local residents have some values that are contradictory to those of the company and its management partners with respect to their preference to maintain populations of feral ungulates for hunting. They are thus not convinced that the management benefits will outweigh the costs to them in terms of lost hunting opportunities and view the company with some distrust (Table 4, indicators 5a–c). The landowner is clear that the company will take local community concerns into account and will provide future opportunities for local engagement. However, there is little scope for local residents to question the company's management authority should their future interests diverge (Table 4, indicator 4d).

## DISCUSSION

Based on the constraints identified in the four island ILSM projects evaluated, we identify opportunities to improve the effectiveness of project planning and evaluation through increasing local participation in decision-making and mainstreaming ILSM into government, private sector or public–private partnership systems for durable and sustainable implementation. We additionally draw on the ILSM literature to identify best-practice examples from other regions that can serve as models for island ILSM projects, while recognizing that outcomes will additionally be influenced by the number of resources users and uses and governance capacity.

### Improving local participation in decision-making

The common-pool and community-based resource management literature is rich in theory and examples of how local participation promotes more effective and accountable resource management policies and outcomes because local resource users have higher stakes in maintaining the sustainability of resources and have good local knowledge about local processes and feedback (e.g. Ostrom 1990; Brechin *et al.* 2002; Cox *et al.* 2010). Furthermore, various evaluations of island projects have emphasized the importance of community-driven decisions for regulating resource use (World Bank 1999; Pollnac & Pomeroy 2005). For many Pacific Island systems, these local decision-making processes are embedded in customary governance structures operating across linked ridge-to-reef units (Ruddle *et al.* 1992; Hviding 1996). In places like Zaira and Kubulau, where customary governance is still strongly respected and largely supported by national legislation, participatory, community-based management systems can be extraordinarily effective at restricting access and use according to fluctuations in resource availability, particularly as systems of customary management blend with more contemporary concepts of ILSM (Johannes

2002; Aswani & Ruddle 2013). Thus, these customary systems should be supported and strengthened.

The ability to participate in management rule development during island ILSM planning will likely have a strong impact on the long-term sustainability of implementation. Giving all stakeholders the opportunity to voice opinions will improve buy-in (Kearney *et al.* 2007), although if these opinions are not valued, it can create dissatisfaction in the planning and implementation processes (e.g. Risvoll *et al.* 2014). In New Britain and Lāna'i, where outside actors are spearheading ILSM initiatives, the success of plan implementation will therefore hinge on engaging local landowners in order to ensure that they recognize both the process and the rules as legitimate.

Level of participation can potentially be increased by ensuring that local governance is nested within broader supporting agencies and structures (Ostrom 1990) and by working with influential actors to engage people across their social networks (Mills *et al.* 2014; Guerrero & Wilson 2016), noting that participation will likely be more effective where there is cultural predilection towards social cooperation (Gurney *et al.* 2016). Expectations of all stakeholders must be clearly articulated from the outset or this could ultimately result in project failure if and when local actors do not feel that their objectives are being met and/or benefits are not distributed equitably (Christie 2005). Adequate time and effort must be given for participatory consultations in order to define management objectives, systems and rules, which may require donor education to ensure that project budgets and timelines allow for enough facilitated discussion to build a consensus. As an example of this, the participatory processes supporting the re-zoning of the Great Barrier Reef Marine Park, which is often upheld as a model of ILSM, took 6 years and included over 1000 meetings and the consideration of 31,000 written submissions to the management authority (Hughes *et al.* 2007).

### Mainstreaming ILSM for long-term implementation

Governments have the capacity to create the legal enabling framework for ILSM and to harmonize laws across multiple sectors (e.g. forests, fisheries, environment and health) (Lane 2008) and multiple scales, from local rules to internationally agreed multilateral frameworks (e.g. Convention of Biological Diversity). While this does not happen frequently, it may improve policy implementation when local rules are recognized at higher levels (Christie 2005). Government-led processes, such as those from the New Britain project, also have the potential to design management that addresses the spatial scale of ecosystem processes and threats within the context of national policy and legislation. Decentralization and nesting of these broader government policies and plans should improve implementation when local actors have more ownership over decisions (Ostrom 1990). A prime example of this comes from island systems in the Philippines, where the Local Government Code of 1991 devolves most responsibility

for coastal resource management, including the management of cross-system processes and threats, to local government units to manage from their inland boundaries to 15 km offshore (White *et al.* 2005).

Funding for many ILSM projects in developing countries has historically been donor-driven, resulting in cessation of implementation following project termination (Christie 2005; Pollnac & Pomeroy 2005). Thus, mainstreaming ILSM into government budgets and agency mandates should enable long-term support, particularly for monitoring and enforcement, which local communities may be ill-equipped to carry out on their own (Christie & White 1997; Christie 2005). This is exemplified in the Philippines where a Coastal and Marine Management Office was created within the Department of Environment and Natural Resources and coastal management issues, including ILSM, were resourced with funding from national budget allocations (Christie 2005; White *et al.* 2005). In order to achieve this, policy-makers controlling national accounts will need to be convinced that effective ILSM can achieve desirable high-level policy outcomes for food security, livelihoods, sustainable development and biodiversity conservation (Jupiter *et al.* 2014a). Secondly, in order for locally driven projects to be able to access mainstreamed government resources, local management objectives need to be directly linked to broader policies and plans. For example, gazettal of the Zaira Resource Management Area under the Solomon Islands Protected Areas Act 2010 would make it eligible in principle to receive support through legally mandated government financing mechanisms, although in practice Solomon Islands has yet to declare a single national protected area under the Act or to mobilize funds for their management.

Across highly dispersed island archipelagos, central government will not always have the resources to lead ILSM planning and implementation in more remote areas, and thus decentralization and coordination are essential (Lane 2008). Decentralization will only be effective, however, where local rights to organize and make rules regarding access and use of resources are recognized by higher authorities (Ostrom 1990). Where these rights do not presently exist, granting them to cooperatives of resource users who would be issued exclusive access for harvesting can be effective for incentivizing local actors to self-police and manage for long-term sustainability (e.g. Afflerbach *et al.* 2014). In areas like Kubulau (Fiji), where indigenous people's inherited resource use and access rights have been partially eroded as a consequence of colonial systems, devolving marine tenure rights from the State to traditional fishing owners is highly contentious (Vukikomoala *et al.* 2012). Thus, in the absence of the ability to give local people more direct control over ILSM implementation, projects should focus on improving resources for the enforcement of existing rules and building relationships between local wardens and magistrates in order to enhance opportunities for successful prosecutions. Improved sub-national and national policies can encourage these relationships and benefit cooperation among

stakeholders that may not normally collaborate well with each other (White *et al.* 2006).

Where there are consistent roadblocks to accessing government funds for ILSM, opportunities can be investigated through private sector engagement, as in Lāna'i. In some cases, large-scale private landowners are motivated by the direct economic incentives of improving ecosystem service provision. For example, following presentations of modelled scenarios for land use planning incorporating ecosystem service values, Kamehameha Schools, a large landowner on the north shore of Oah'u (Hawai'i), is now working to implement a land use plan that prioritizes small-scale agriculture and forestry while also mitigating the negative impacts of runoff (Goldstein *et al.* 2012). Other landowners may be swayed to action through corporate social responsibility policies (MacDonald 2010). Small-scale private landholders can be incentivized towards better watershed management practices through payment for ecosystem services initiatives that collectively may act to reduce the pollution affecting downstream biodiversity (e.g. Brodie *et al.* 2012). In Kubulau, the management costs for implementing the district ILSM plan are offset by tourist user fees for entering the community-managed Namena Marine Reserve (Clarke & Jupiter 2010b), although such schemes are unlikely to be practical or effective in very remote areas (Jupiter *et al.* 2014b). Other opportunities may exist for harnessing developers' fees paid into trust funds that could be leveraged towards strategic ILSM implementation, although the risks of funds being absorbed into consolidated revenue or being mismanaged are high, particularly in developing countries (Maron *et al.* 2016).

In summary, we have identified variability in how island ILSM projects are planned and implemented across geographic scales and with different actors driving the process. All projects would benefit from more inclusive participation of all stakeholder groups that are affected by management decisions across the land–sea divide. Local-scale projects could benefit from being nested within government policy frameworks in terms of long-term resourcing and external support. In general, outcomes will only be achieved where adequate government legal and institutional policies encourage rather than disincentivize ILSM. Application of our framework for periodic island ILSM project evaluation throughout the lifetimes of projects should ultimately lead to the better achievement of project goals regarding biodiversity conservation, sustainable livelihoods and human wellbeing, although the practicality of its use will ultimately depend on ensuring that ILSM projects are well-documented and that the information is readily obtainable.

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### Supplementary Material

For supplementary material accompanying this paper, visit <https://doi.org/10.1017/S0376892917000091>

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