CRISP

Coral Reef InitiativeS for the Pacific
Initiatives Corail pour le Pacifique

COMPONENT 3E - Project 3E2
Studies of governance for reef fisheries management

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STUDY REPORT

Social networks to support learning for improved governance of coastal ecosystems in Solomon Islands

Photo credit: Pip Cohen

ARC Centre of Excellence
Coral Reef Studies

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CRISP

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The CRISP Coordinating Unit (CCU) was integrated into the Secretariat of the Pacific Community in April 2008 to insure maximum coordination and synergy in work relating to coral reef management in the region.

SPREP/PROE

The CRISP Programme is implemented as part of the policy developed by the Secretariat of the Pacific Regional Environment Programme to contribute to the conservation and sustainable development of coral reefs in the Pacific.

The Initiative for the Protection and Management of Coral Reefs in the Pacific (CRISP), sponsored by France and established by the French Development Agency (AFD), is part of an inter-ministerial project that began in 2002. CRISP aims to develop a vision for the future of these unique ecosystems and the communities that depend on them and to introduce strategies and projects to conserve their biodiversity, while developing the economic and environmental services that they provide both locally and globally. CRISP also, has a role in fostering greater integration in this area between developed countries (Australia, New Zealand, Japan, USA), French overseas territories and Pacific Island developing countries.

The initiative follows a specific approach designed to:
- associate networking activities and fieldwork projects;
- bring together research, management and development endeavours;
- combine the contributions of a range of scientific disciplines, including biology, ecology, economics, law and social sciences;
- address the various land and marine factors affecting coral reefs (including watershed rehabilitation and management);
- avoid setting up any new body but supply financial resources to already operational partners wishing to develop their activities in a spirit of regional cooperation. This is why the initiative was established on the basis of a call for proposals to all institutions and networks.

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This approach is articulated through a series of thematic objectives:

Objective 1: Improved knowledge of the biodiversity, status and functioning of coral ecosystems.
Objective 2: Protection and management of coral ecosystems on a significant scale.
Objective 3: Development of the economic potential represented by the use values and biodiversity of coral ecosystems.
Objective 4: Dissemination of information and know-ledge; and capacitybuilding and leadership with local, national and international networks.

The CRISP Programme comprises three major components:
Component 1A: Integrated coastal management and watershed management
- 1A1: Marine biodiversity conservation planning
- 1A2: Marine Protected Areas
- 1A3: Institutional strengthening and networking
- 1A4: Integrated coastal reef zone and watershed management

Component 2: Development of coral ecosystems
- 2A: Knowledge, beneficial use and management of coral ecosytems
- 2B: Reef rehabilitation
- 2C: Development of active marine substances
- 2D: Development of regional data base (ReefBase Pacific)

Component 3: Programme coordination and development
- 3A: Capitalisation, value-adding and extension of CRISP programme activities
- 3B: Coordination, promotion and development of the CRISP programme
- 3C: Support to alternative livelihoods
- 3D: Vulnerability of ecosystems and species
- 3E: Economic task force

CRISP is funded by the following partners:

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Social networks to support learning for improved governance of coastal ecosystems in Solomon Islands

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Social Network Analysis – Background and Glossary

A **social network** is a social structure made up of individuals or organizations called "nodes", which are tied (connected) by one or more specific types of interdependency or relationships. Nodes are the individual actors within the networks, and ties are the relationships between the actors. The resulting graph-based structures are often very complex and patterns of relationships can be examined using social network analysis. For more background refer to http://en.wikipedia.org/wiki/Social_network

Centrality gives a measure of how connected an actor is in the network i.e. the number of relationships that actor has. There are several different ways to measure centrality;

> **Degree;** the number of links a given node maintains with the other nodes in the network
> **In-degree**; the number of links/relationships running to the node i.e. the number of relationships that node receives from other nodes
> **Out-degree;** the number of links/relationships running from the node i.e. the number of relationships that node has identified to other nodes
> **Betweenness;** how often a node is on the shortest path between other nodes in the network

Centralization is the difference between the number of links for each node divided by maximum possible sum of differences. A centralized network will have many of its links dispersed around one or a few nodes, while a decentralized network is one in which there is little variation between the number of links each node possesses.

Density; examines the number of existing relationships between agencies compared to the number of possible relationships that can exist i.e. if all agencies were perfectly connected to all others. The measurement can be given as a percentage.

Netdraw; a software package for analysing and visually representing networks.

Nodes; are organisations, agencies, people (represented by symbols in diagrams) of which the connection between are examined.

Reciprocity; examines the number of relationships that are reciprocated, for example if A says they collaborate with B and B says they collaborate with A then the relationships is reciprocated. Arc reciprocity (the statistic presented in this report) focuses on relations and determines the percentage of all possible ties that are reciprocated structures i.e. the number of ties that are involved in reciprocal relations relative to the total number of actual ties (not possible ties).

Relations/Ties; are relationships, relationships or ties between different organisations, agencies or people (i.e. nodes). Relations are represented by lines on social network graphs or diagrams.

UCINET – a software package designed specifically for the analysis of social network data (Borgatti, Everett et al. 2002).

To learn more about social network analysis, a free and very useful resource is; Hanneman, Robert A. and Mark Riddle. 2005. Introduction to social network methods. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/)

Executive Summary

Coastal ecosystems can be highly biodiverse and provide food and livelihoods for millions of people, particularly in developing countries (Moberg and Folke 1999; Roberts, McClean et al. 2002). Meeting conservation and fisheries goals within coastal ecosystems and for human populations is an ongoing challenge. Adaptive co-management is now a mainstream approach for meeting the challenge of biodiversity conservation and fisheries management within coastal ecosystems and is proliferating in the developing world (Govan 2009; Weeks, Russ et al. 2010). Adaptive co-management[1] refers to *flexible community-based systems of resource management tailored to specific places and situations and supported by, and working with, various organizations at different levels* (Olsson, Folke et al. 2004) and where the arrangement involves significant participation of resource users in decision making (Berkes and Turner 2006). In Solomon Islands locally managed marine areas (LMMAs) have arisen from adaptive co-management arrangements supported by a number of partner non-government or government agencies.

While a diverse body of numerous actors e.g. organizations/agencies or people, can strengthen and expand the implementation of adaptive co-management, managing relations between actors for optimal outcomes is complex. A vast array of agencies can be involved in facilitating and supporting on the ground actions; within Solomon Islands 10 such agencies are identified as providing direct support to co-management of marine resource. These 10 agencies interact in a national network of agencies called Solomon Islands Locally Managed Marine Area network (SILMMA). SILMMA is *a group of projects and practitioners including NGOs, government and communities who have joined together and are working to improve the success of their conservation and fisheries management efforts* (Solomon Islands Locally Managed Marine Area Network 2009). At least an additional 33 agencies are involved in providing scientific and technical support to marine resource management and conservation in Solomon Islands. In total agencies include four national non-government organisations (NGOs), seven universities, four regional organisations, nine provincial governments, six international NGOs, four national government agencies, two development agencies and three private enterprises. Local NGOs or community based organisations are critical in co-management arrangements and are numerous in Solomon Islands; a sample of four were included in this analysis as they were identified as being active in national information exchange fora.

This large amount of actors provide both challenges and opportunities for achieving goals of learning, coordination and collaboration that may lead to increased coverage and effectiveness of adaptive co-management. A social network is a set of actors linked to one another through social relations e.g. relationships such as collaborative work arrangements or information exchange (Wellman & Berkowitz, 1988). Social networks have been identified as critical institutions for collaborative governance; where the engagement of different stakeholders is required to progress natural resource management (Pretty and Ward 2001; Olsson, Folke et al. 2004; Hahn, Olsson et al. 2006; Pajaro, Mulrennan et al. 2010). This report focuses on how information and knowledge sharing between actors (via social networks) might lead to learning for improved coastal marine resource management in Solomon Islands. This research identifies where information exchange relationships are strong or weak, discusses the implications of patterns of relationships observed and presents some recommendations aimed at promoting learning amongst actors for optimal marine resource management outcomes.

The analysis examines collaboration, information exchange and learning at the national level and focuses on relationships between agencies that support and/or implement marine resource management at multiple sites (i.e. communities, villages or LMMAs) in Solomon Islands. Relationships within the formal SILMMA network of agencies (10 agencies), and between SILMMA and an extended network of agencies (43 agencies) are examined. A sample of three community-based organisations (or local non-government organisations) were included in this analysis as they were identified as qualifying for membership of SILMMA (Solomon Islands Locally Managed Marine Area Network 2009) and were observed to participate in national information exchange. Twenty three interviews were conducted with people

[1] Within the Pacific a multitude of terms are used to describe marine resource management, for simplicity in this report we refer to adaptive co-management as we feel that many arrangements and approaches are captured by this definition

from SILMMA member agencies. Interviewees identified which other agencies their agency collaborates with to implement marine resource management and from which agencies they receive information that is useful or influential for the work of the agency to which they belong.

Social network analysis suggests that certain SILMMA agencies are more effective at collaborating and sharing information than other agencies. Where collaborations between agencies are present, information exchange relationships are also likely to be developed (and vice versa). Agencies often have one main partner for implementing management. Sourcing of information from within the SILMMA network is stronger than sourcing information from outside of the network. However some non-SILMMA agencies are just as important for providing influential and supportive information about marine resource management as some SILMMA members. So although these agencies are not formal network members they are clearly important players in marine resource management in Solomon Islands. One particular SILMMA member agency is outstandingly important for connecting agencies that would otherwise be only distantly connected or unconnected. This type of agency is exceptionally important for two reasons; firstly it forms a natural focal point for information distribution, and secondly if somehow it were to be reduced in effectiveness or removed from the network, many agencies would become further or completely removed from information sharing, learning and collaborative opportunities.

Similarities of approach to marine resource management represent existing shared knowledge or may highlight opportunities for learning between agencies. For example interviewees provided a summary of the resource management instruments (e.g. size limits, gear restrictions etc.) that are employed at 25 sites to which they provide support. Seven agencies and 80% of sites described are utilising non-permanent area closures. This (among other similarities) may suggest a high priority opportunity for national scale learning, particularly when also considering the global dearth of information regarding the fisheries management implications of this tool (Cinner, Marnane et al. 2006; Bartlett, Manua et al. 2009).

In the course of interviews, 72 people were identified as important contacts to support marine resource management activities in Solomon Islands. 39 of these individuals belonged to agencies that were members of SILMMA (and 23 of these individuals were interviewed). Most person-to-person connections existed between individuals who were employed by SILMMA member agencies. The 33 non-SILMMA members were generally identified by only one interviewee, demonstrating that support networks external to SILMMA are quite unique. This implies that if any person that is currently a SILMMA member is removed from the network (e.g. by changing jobs out of the sector or leaving the country) their contacts, and the collaborative and information opportunities that are associated with that contact, would no longer be available or accessible to the broader SILMMA network. Similarly, new members would likely bring their own personal network of contacts.

Qualitative data indicate that most interviewees feel that the SILMMA network is operating sub-optimally for facilitating collaborative and information exchange connections. Nine inter-agency channels or fora that potentially support information exchange were identified; seven CD/DVD and online databases as well as ‘SILMMA meetings’ and ‘other meetings’. Database tools were largely not utilised by network members. Both SILMMA and other meetings were the dominant mechanisms for receiving lessons learned and information about best practice in marine resource management. This suggests that although SILMMA may not be currently viewed as effective, it is still one of the most important channels for exchanging information between agencies. However, predominant mechanisms that agencies currently utilise to obtain information about best or better practice in marine resource management are ‘learning-by-doing’ at sites they work in and learning within their own organisation in Solomon Islands. Notably for the agency and site to benefit from this knowledge inter-agency networking is not required.

Focus group discussions among SILMMA member agencies highlighted factors that constrain learning and adoption of new knowledge when implementing management. Limits included agencies not taking the time to learn lessons of others, focussing on implementation at their own sites and failing to look at the ‘bigger picture’ advantages of sharing knowledge. Between-site and between-agency learning may be receiving lower priority by agencies as they prioritise

adapting to site specific conditions and 'learning-by-doing'. While the SILMMA network appears to serve information exchange, inter-agency learning remains a challenge. It also appears that the potential for SILMMA to facilitate the formation of common goals and collective action is largely, yet to be realised.

Qualitative case studies were conducted at three sites in Solomon Islands to examine links to, and between, community level groups. Inter-village social networks facilitate information exchanges which promote and expand interest in adaptive co-management initiatives. Further research would be required to determine if promotion and expansion of interest in management actually results in increased uptake of management activities, particularly without the direct support of a partner. The connection of partner agency to communities seems critical for a number of reasons. For example individual agencies often exclusively channel information and technical support to villages or regions engaged in adaptive co-management. Additionally the partner agency may be the only functional pathway for community level information, lessons learned and needs to reach national and international fora.

Expanding and coordinating resource governance via widespread adaptive co-management arrangements provides a major challenge to Solomon Islands. Literature and field experiences suggest that social networks may facilitate improvements in marine resource management effectiveness and coverage. The SILMMA network is functional and appears to facilitate collaboration and information exchange between agencies providing support to LMMAs. However optimising opportunities of learning, coordination and collective action requires recognition of current networking gaps, as well as potential functions and limitations of a national network. The results of this analysis, including comments of interviewees, have highlighted some recommendations for networking in Solomon Islands;

- Review and action recommendations provided by the SILMMA network members to overcome barriers to information exchange and learning
- Recognise and support, via allocation of time and resources for networking, agencies and individuals that are lead facilitators of collaboration and information exchange
- Examine reasons why existing information sharing mechanisms and channels, particularly databases, are under-utilised or insufficient before proceeding with a new database. Consider utilising and strengthening existing mechanisms and channels
- While adaptive co-management emphasises adaptations to site specificities and 'learning-by-doing', recognise that there may be some redundancies in 'learning-by-doing' i.e. the same lesson may have already been learned elsewhere
- Focus in on key issues, approaches or themes for inter-agency or inter-site learning. Broad goals of 'information sharing' or 'learning' are important but may be awkward to implement and difficult to measure progress against
- Recognize limits to networking and reflect these in common goals and commitments
- Provide mechanisms so that non-SILMMA-member agencies and individuals, involved in generating new knowledge and information about marine resource management, can interact with the SILMMA network as a whole or via the key facilitators of information exchange and collaboration
- Conduct ethnographic research into the relationship between inter-village information exchange pathways, the uptake of management and the proliferation of education and awareness
- Conduct ethnographic research into the transfer and persistence of education and awareness messages via inter-village information exchange pathways

This report provides a summary of results targeted primarily at the SILMMA group of agencies and their extended network for discussion. A second publication (in preparation) will discuss the implications of networking for learning, coordination and up-scaling.

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1. Introduction

Coastal ecosystems can be highly biodiverse and provide food and livelihoods for millions of people, particularly in developing countries (Moberg and Folke 1999; Roberts, McClean et al. 2002). Meeting conservation and fisheries goals within coastal ecosystems and for human populations is an ongoing challenge. Adaptive co-management is now a mainstream approach for meeting challenges within coastal ecosystems and the approach is proliferating in the developing world (Govan 2009; Weeks, Russ et al. 2010). Adaptive co-management[2] refers to *flexible community-based systems of resource management tailored to specific places and situations and supported by, and working with, various organizations at different levels* (Olsson, Folke et al. 2004) and where the arrangement involves significant participation of resource users in decision making (Berkes and Turner 2006). In Solomon Islands around 113 locally managed marine areas (LMMAs) have arisen from adaptive co-management arrangements supported by a number of partner non-government or government agencies (Govan 2009).

While a diverse body of numerous actors (e.g. organizations/agencies or people) can strengthen and expand the implementation of adaptive co-management, managing relations between actors for optimal outcomes is complex. A vast array of agencies, at times with disparate objectives, can be involved in facilitating and supporting on the ground actions for adaptive co-management of marine resources. Within a nation or region, a mosaic of actors and relationships (i.e. social networks) develop upon an ecologically and socially diverse landscape.

Within Solomon Islands, 10 agencies are identified as implementing or providing direct support to adaptive co-management of marine resources. These 10 agencies interact in a national network called Solomon Islands Locally Managed Marine Area Network (SILMMA). SILMMA is *a group of projects and practitioners including NGOs, government and communities who have joined together and are working to improve the success of their conservation and fisheries management efforts* (Solomon Islands Locally Managed Marine Area Network 2009). SILMMA is a national branch of the Asia-Pacific Locally Managed Marine Area network of practitioners of marine conservation projects; a network that aims to share knowledge, skills and experiences (LMMA 2005; The Locally-Managed Marine Area (LMMA) Network 2009). The SILMMA network is one of the most enduring (established in 2003) institutions, of many initiatives, to promote coordination and collaboration across government ministries and Non-Government Organisations (NGOs) for marine resource management in Solomon Islands (Govan, Schwarz et al. 2011). Recognition as a network member is dependent on meeting membership criteria and at the time of writing, formal membership processes were in place but were not being rigorously implemented. Additional to SILMMA network members, many other agencies are involved in providing scientific and technical support to marine resource management and conservation in Solomon Islands. A large number of actors produce both challenges and opportunities for achieving goals of learning, coordination and collaboration that may lead to increased coverage and effectiveness of adaptive co-management.

Social networks[3] have been identified as critical institutions for collaborative governance where the engagement of different stakeholders is required to progress natural resource management (Crona and Bodin 2006; Pajaro, Mulrennan et al. 2010; Sandström and Rova 2010). Social networks can facilitate vertical linkages connecting scales i.e. from local to international, and horizontal linkages connecting sectors or agencies within one sector (Pajaro, Mulrennan et al. 2010). Social networks, and their structural properties, affect the qualities of collaboration and learning processes, and may influence success and failure of management (Crona and Bodin 2006; Sandström and Rova 2010). A well connected and developed social network of agencies can facilitate knowledge and information sharing, mobilise resources to support management, motivate participation and acceptance of management and foster collective vision and action (Ostrom 1994; Olsson, Folke et al. 2004). Conversely agencies networking poorly are more likely to develop only localised impacts, specialised knowledge and contribute less to the governance of complex and expansive systems (Berkes and Folke 1998).

[2] Within the Pacific, a multitude of terms are used to describe marine resource management. For simplicity, in this report we refer to adaptive co-management as we feel that many arrangements and approaches are captured by this definition

[3] A *social network* refers to a set of *actors* linked to one another through *social relations* (Wellman & Berkowitz, 1988).

Critical to successful adaptive management is the generation of new and improved knowledge via ongoing, and learning-by-doing processes (Berkes 2009). Learning and resultant adaptation of management arrangements can occur at localised scales accounting for site specific conditions and changes. Additionally, global or national level learning of the successes and failures of adaptive co-management approaches is also required to optimise broad scale conservation and fisheries outcomes. Social networks are envisaged to support information exchange between multiple actors operating at multiple scales (Berkes 2009; Pajaro, Mulrennan et al. 2010), and therefore may facilitate in learning to improve effectiveness of management. Important lessons for learning will also relate to the potentials and limits of localised adaptive co-management, and thereby highlighting where engagements with national, international or inter-sectoral policy arenas may be advantageous or essential (Berkes 2007).

Expanding and coordinating resource governance via widespread adaptive co-management arrangements provides a major challenge. Social networks may facilitate expansions of marine resource management coverage. Information shared between agents or community groups implementing management and those where management is absent, may facilitate or complicate participation in management activities. On one hand, research suggests the establishment of co-managed protected areas have resulted in a 'ground swell of interest and enthusiasm' for establishing new areas among communities in the same region (Game, Lipsett-Moore et al. 2010). On the other, insights from diffusion of innovations theory suggest that while the spread of new ideas and knowledge can be facilitated by social relations, resultant adoption of new ideas is complicated by human behaviour and social conditions (Carrington, Scott et al. 2005). In some cases the engagement of external agents in local marine resource management initiatives may be critical to legitimise (or at least increase in the perception of legitimacy) of management by linking local scales to higher level policy or to nest local institutions in higher scale institutions (Ostrom 1990; Cudney-Bueno and Basurto 2009).

This report examines mechanisms, channels and pathways used for information and knowledge sharing between actors implementing and supporting adaptive co-management of near shore marine resources in Solomon Islands. Quantitative social network analysis (SNA) is employed alongside qualitative techniques. SNA is used to closely examine the collaborative and information sharing relationships between agencies that support multiple adaptive co-management initiatives. Three embedded localised case studies are conducted to explore the impacts of national and local networking in processes of management uptake, participation, design and adaptation. Information exchange practices and patterns that may lead to improvements in coastal marine resource management are discussed. This research identifies where information exchange relationships are strong or weak, discusses the implications of this, and, in the light of social network theory, presents some recommendations aimed at promoting learning amongst actors for optimal marine resource management outcomes in Solomon Islands.

2. Study Region

The reef systems of Solomon Islands are recognised as being of the most biologically diverse globally and are considered of very high conservation value (Interim Regional CTI Secretariat ; Green, Lokani et al. 2006). The predominantly coastal population of Solomon Islands depends on fisheries as the primary source of protein, and in many areas small scale commercial fisheries offer one of the few viable livelihood opportunities (Oreihaka 1997; Berdach and Llegu 2005; Legu 2007; World Resources Institute 2007; Bell, Kronen et al. 2009; Gillett 2009; Pinca, Vunisea et al. 2009). Coastal ecosystems are governed by the state through environment and fisheries legislations, but also substantially by coastal communities who have traditional and constitutional marine tenure rights (International Waters of the Pacific Islands 2003).

An apparent embrace of adaptive co-management has led to the establishment of 113 (recognised[4]) locally managed marine areas[5] covering an area of approximately 941 km^2; equivalent to approximately 10% of reef area or 0.001% of

[4] 127 marine managed areas, with coverage of 1 380 km^2 are reported but Govan (2009) notes that locally managed marine areas are the more dominant and active form of area management (as opposed to some marine protected areas that are designated but not actively recognised).

the total EEZ area (Govan 2009). There is widespread agreement that management of marine resources and coastal ecosystems is currently insufficient (Lane 2006). Solomon Islands' government has committed to employing and expanding co-management approaches in ongoing strategies for coastal ecosystem conservation and fisheries management (Ministry of Fisheries and Marine Resources 2008; Ministry of Fisheries and Marine Resources 2008; Ministry of Environment Conservation & Meteorology 2009; Ministry of Environment Conservation & Meteorology and Ministry of Fisheries & Marine Resources 2009). Solomon Islands' government has also committed to promote 'peer to peer' learning among those coastal village groups, government agencies, universities, international and local NGOs involved in facilitating conservation and management implementation (Ministry of Fisheries and Marine Resources 2008; Ministry of Fisheries and Marine Resources 2008).

The Ministry of Fisheries and Marine Resources (MFMR) currently facilitates a formal network of conservation and management practitioners; the SILMMA network (Ministry of Fisheries and Marine Resources 2008). SILMMA presents 5 strategic areas of focus (Solomon Islands Locally Managed Marine Area Network 2009). This research has not been specifically designed to explore these 5 areas, however I note in Table 1 how this research contributes to understanding progress to date, and barriers or possibilities in advancing SILMMA strategic goals.

SILMMA Strategic Focus	Contribution of this research to strategic focus
Operational	Explores network cohesion and implication on commitment to common goals
Policy	Documents perceptions of past and future potential influence of SILMMA agencies on national and provincial policy development
Implementation of sustainable resource management	Documents existing collaborations and collaborative gaps in the implementation of MMAs
Coordination and information	Explores information exchange patterns between SILMMA member agencies Understands usage of information exchange mechanisms and channels Understands limitations and barriers to information exchange
Capacity building and awareness	Explores how information sharing patterns may influence awareness raising activities.

Table 1. The contribution of this report to understanding status and achievement of SILMMA strategic areas;

[5] A "locally managed marine area is an area of near-shore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the immediate area" (Govan, 2009)

3. Methods

3.1 Social Networks Operating at National Scale - Interview and Focus Group Methodology

The analysis of national level networking considered agencies/organizations that support multiple sites of marine management and conservation in Solomon Islands. Ten different agencies (Table 1) were pre-identified via membership[6] of a formal 'SILMMA' network (Solomon Islands Locally Managed Marine Area Network 2009). Agencies in the extended network (i.e. other agencies involved in supporting marine resource management but not SILMMA members) were identified through literature review and snowballing[7] in the interview process[8]. 23 individuals were selected for key informant interviews. Selection of interviewees was based on the criteria that individuals were an employee or affiliate of the identified agencies and that they personally were involved in marine resource conservation or management programs. These individuals were deemed knowledgeable of; 1. their agencies' engagement in marine resource management and conservation and; 2. their agencies' relationships with other marine resource practitioners and agencies. Each respondent acted as a representative for his or her organization. Depending on the size of agency, between 1 and 4 people were interviewed from each agency. In May – November 2010 semi-structured interviews were conducted in the respondents own work settings, with the exception of 1 interview which was conducted via Skype™. Interviews lasted between fifty minutes and 2 hours. Interviews were conducted in English; responses were hand written *in situ* and digitally recorded (Sony ICD-SX700) for later transcription.

Agency Name	Agency Type
Ministry of Environment, Climate change, Disaster Management and Meteorology	National government agency
Ministry of Fisheries and Marine Resources	National government agency
Marau	Local non-government organisation
Roviana Conservation Foundation	Local non-government organisation
Tetepare Descendants Association	Local non-government organisation
The Nature Conservancy	International non-government organisation
Foundation of Peoples of the South Pacific International	International non-government organisation
WorldFish Center	International non-government organisation
WWF	International non-government organisation
University of Queensland	University

Table 2. Agencies interviewed and identified as qualifying for membership of SILMMA (Solomon Islands Locally Managed Marine Area Network 2009).

Focus group discussion points were identified subsequent to analysis of interview and case study data (see below). In November 2010 at a SILMMA annual general meeting, discussions were conducted with the meeting attendants. Over half of the individual respondents to interviews were present at this meeting and 100% of agencies interviewed were represented within the group.

In interviews and focus groups discussions respondents were asked to share their views on the following topics: (1) preferred sources of information to support conservation and management action; (2) usage and perceptions of the adequacies of existing networking and information exchange behaviors and support structures; (3) the influence of new

[6] Recognition as a network member is dependent on meeting membership criteria, however at the time of writing formal membership processes were in place but were not rigorously implemented. Agencies who meet membership criteria are identified in (SILMMA, 2009) and these agents are referred to from here on as SILMMA member agencies.

[7] Snowballing is a sampling strategy where one interview respondent identifies another person or agency that is important to interview.

[8] Community based organisations or groups are too numerous to include all in the data collection process. However a sample of three community-based organisations (or local non-government organisations) were included as they were identified as qualifying for membership of SILMMA and were observed to participate in national information exchange and learning fora.

information on implementation and effectiveness of conservation and management and; (4) intentions and approaches to scaling-up conservation and management engagements in Solomon Islands (results of (4) not presented here).

To gather quantitative social network data, interview respondents were handed a table containing the names of agencies identified as being involved in marine resource management and conservation in Solomon Islands (n.b. the table included blank rows so that new agencies could be added). This did not include donor agencies and we excluded relationships to donors where the relationship was described as financial support only. Donor agencies were only included if they were present in a capacity to directly implement a marine resource management or conservation project. Respondents were asked to characterize (as either strong = 2, present = 1 or absent = 0) two relations of their agency with each other agency in the list: (1) collaboration to implement marine resource management or conservation and; (2) receiving new ideas and influential information regarding marine resource conservation and management. Finally respondents were asked to identify, independent of agency affiliation, the individuals (from both within and outside Solomon islands) that they personally considered as critical to supporting their efforts in marine resource management in Solomon Islands.

Two network structures were analysed: (1) collaboration and; (2) receiving influential information for management implementation i.e. corresponding with the two relations detailed above. Agency was used as the node. A third network was analysed using individuals as nodes; i.e. people considered critical to supporting management initiatives. Where there were multiple responses from one agency we used the highest strength of relationship reported (i.e. if one person from an agency said the relationship was 'present' and another person from the same agency said the relationship was 'strong', 'strong' was used. The UCINET software package version 6.288 was used for analysis (Borgatti, Everett et al. 2002). Firstly, correlation analysis was conducted between the collaboration and receiving information networks. As these networks were significantly and positively correlated, only the analysis and presentation of information exchange networks is presented within this report. Firstly 'macro' or 'whole-of-network' analysis of the structure of the social network was conducted by calculating measures of 'reciprocity' and 'density' of relationships only between those agencies that were interviewed (i.e. those that have been identified as members of SILMMA). Density is calculated here as the number of ties or relationships between agencies divided by the total number of relationships possible (i.e. if every agency was collaborating or sharing information with every other agency). Reciprocity is the number of relationships that are reciprocated (Hanneman and Riddle 2005). The 'hybrid' based method was used to determine the reciprocity in the network as a whole.

Secondly the network was examined more closely by analysing the ways that individual agencies and people are connected. Using UCINET, three centrality measures were calculated: a) in-degree (the number of links/relationships running to the node i.e. the number of relationships that node receives from other nodes); b) out-degree (the number of links/relationships running from the node i.e. the number of relationships that node has identified to other nodes) and; c) betweenness (how often a node is on the shortest path between other nodes in the network). To examine the relations between agency type (i.e. national government agency, local NGO, international NGO, university), we grouped the network by agency type.

Using Netdraw in UCINET (Borgatti 2002), we created cartographic visual representations or graphs of the all networks. We conducted analysis twice, setting two different levels at which the matrices were dichotomised: firstly to absent (0) or present (>0); and secondly to weak/absent (<1) or strong (>1).

3.2 Networking at Local Scales - Case Study Methodology

Three embedded case studies were conducted in the regions of Jorio (Vella Lavella Island, Western Province), Sandfly (Ngella Island, Central Province) and Langalanga (Malaita, Malaita Province) (Figure 1). Case study site are the focus of engagement of two different management and conservation support agencies who are members of the formal network SILMMA. All 'sites' represent regions that contain multiple villages. Within regions, at least one village has a history of direct engagement with the support agency. The investigation used semi-structured interviews conducted in at least three villages in each region. In each village interviews were conducted in Solomon Island Pijin with at least three key

informants; both men and women who are members and/or leaders of a reef owning clan or are members of a formal reef management committee and all were fishers. Additionally, informal interviews were conducted with agency staff specifically about engagement with their site. Interviews prompted discussion of perceptions of the origins of information that influenced uptake and design of adaptive co-management of coastal ecosystems in their village of residence.

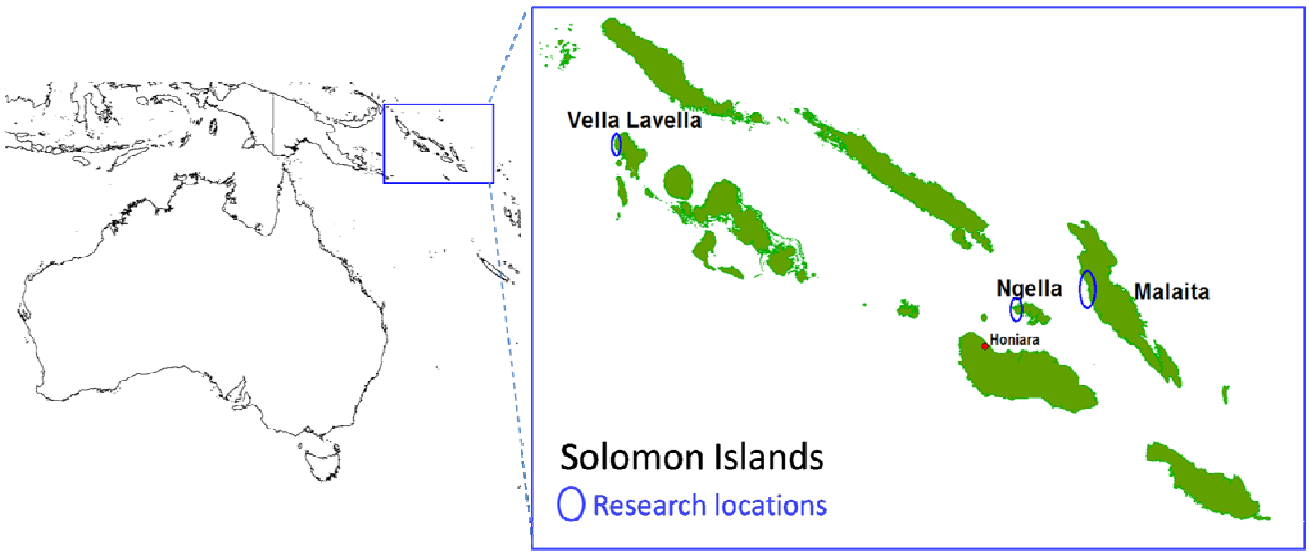


Figure 1. Study region and case study site locations.

Results and Discussion

4.1 Network members; different approaches to marine resource management & conservation

Patterns of collaboration and information sharing may be influenced by similarities or differences between network members. Agencies involved in implementing marine resource management in Solomon Islands were identified and characterised as a first stage of this research. Interviews and a literature review identified 43 agencies directly and indirectly involved in implementing and supporting marine resource management and conservation in Solomon Islands. Agencies included four national non-government organisations (NGOs), seven universities, four regional organisations, nine provincial governments, six international NGOs, four national government agencies, two development agencies and three private enterprises. Local NGOs or community based organisations are numerous in Solomon Islands; a sample of three were included in this analysis as they were identified as being active in national information exchange fora. Including all local or community based organisation was beyond the scope of this study, however may be a useful direction for future research.

Priorities of the SILMMA group of agencies (10 agencies detailed in Table 2) were somewhat disparate, but the dominant primary objective was habitat and biodiversity conservation followed by fisheries management (Figure 1). Individuals from the same agency displayed differing perceptions of their agencies priorities.

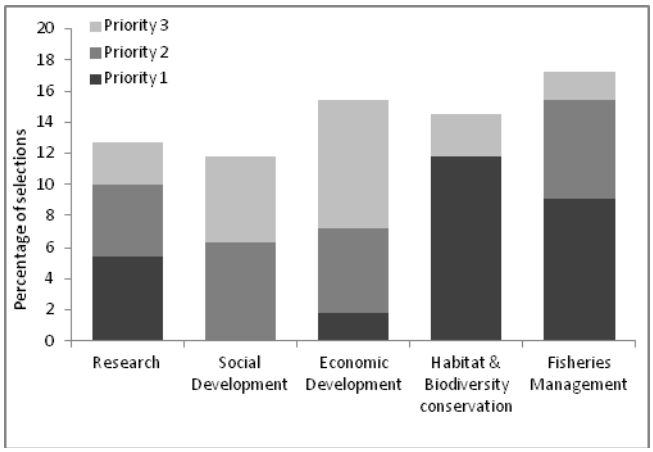


Figure 2. First, second and third priorities of the SILMMA group of agencies

Respondents described the origin of marine resource rules-in-use at sites that they support . Rules-in-use were predominantly 'best described' as being a hybrid of 'traditional and contemporary resource use controls ' (Figure 3). Rules were also considered to be reinforced traditional rules and contemporary rules that were derived locally.

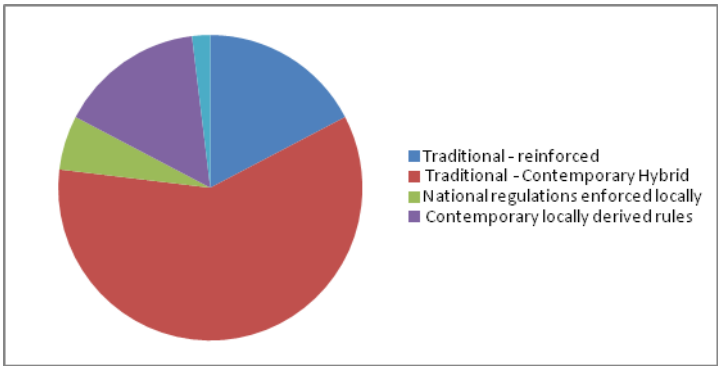


Figure 3. The source or basis of marine resource use rules employed at SILMMA agency supported sites.

There was consensus (17 agrees/strongly agree, 1 neither agree nor disagree and 5 no responses) that within their approaches to marine resource conservation and management 'local traditions and knowledge form the basis of design of marine and fisheries resource use rules' employed at their sites of engagement. There varied between strong agreement to strong disagreement (12 agree/strongly agree, 4 disagrees/strongly disagree, 2 neither agree nor disagree and 5 no responses) that 'contemporary marine resource and fisheries management science forms the basis of design of resource use rules' employed at sites of engagement. These results show that although there is consensus about the significance of grass roots knowledge in rule formation, there are conflicting views about the applicability of contemporary scientific knowledge in adaptive co-management of marine resource in Solomon Islands. There may therefore be limits to the types of information and learning that are universally valued across the network.

8 agencies described the marine resource conservation and management instruments utilised at the sites or LMMAs they support. 25 sites were described by respondents from 8 agencies. On average each site employed 4 instruments for marine resource management and conservation. 80% of sites described (by 7 agencies) employed non-permanent area closures and notably there was only one agency that did not employ non-permanent area closures accounting for the 5 sites that agency supports. A common tool, such as non-permanent area closures in this case, may suggest a high priority opportunity for national scale learning, particularly when considering the global dearth of information regarding the multi-species fisheries management implications of this tool (Cinner, Marnane et al. 2006; Bartlett, Manua et al. 2009).

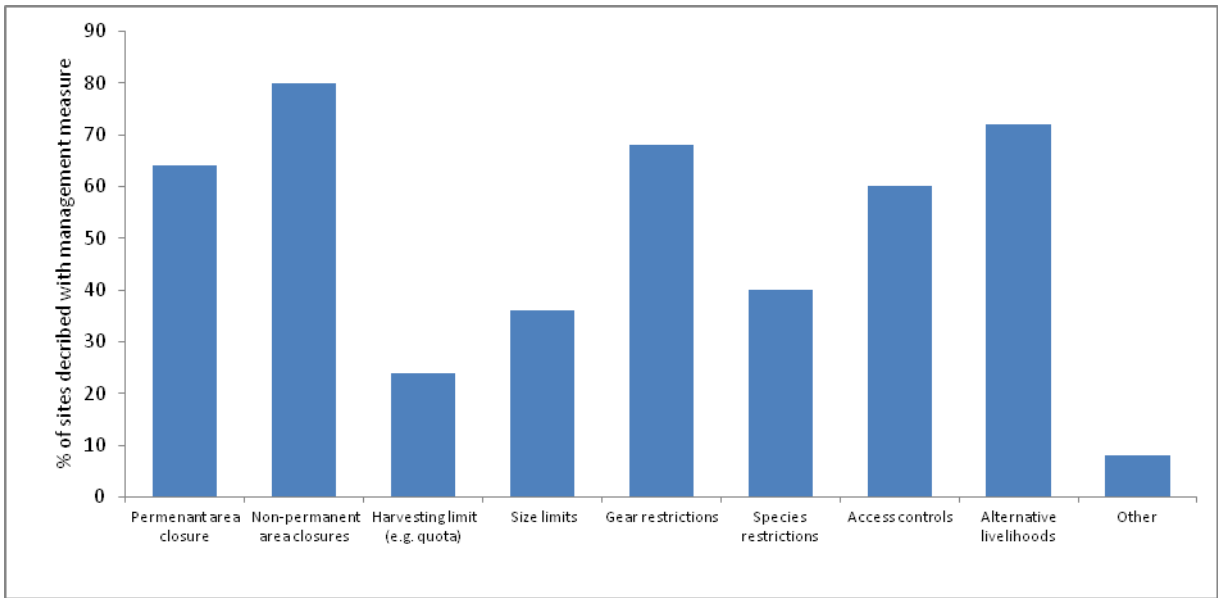


Figure 4. Percentage of described (i.e. sample only) SILMMA agency supported sites that employ different marine resource management and conservation tools.

4.2 Information Exchange Practices

Managing marine resources for conservation or fisheries benefits is a complex task that spans from local to provincial to national to international scales. It would be both difficult and unlikely for any agency to hold full knowledge and influence needed to manage the marine systems of Solomon Islands (Berkes 2009). A recent 'capacity needs assessment' identified that most SILMMA representatives had some expertise in most areas of LMMA establishment and management, and that for each area of expertise one representative felt they could act as a trainer (Environment Consultants Fiji 2010). This illustrates that the network has the potential or the opportunity to share and mobilise capacity that largely may already exist within country.

To gain an understanding of how information and knowledge currently moves between SILMMA member agencies, this research examined the use of information exchange mechanisms. Note that later sections of this report will address the movement of information and knowledge between scales (local, provincial, national and international).

Respondents were asked from where they predominately receive information about successful or less successful approaches (best or better practice) to marine resource management and conservation. Learning about best or better practice from within Solomon Islands was greater than learning from international sources i.e. one's own or other organisation operating outside of Solomon Islands (Figure 5). This evidence supports that there may be a general perception amongst SILMMA that *international experiences do not provide much guidance to the particular context of Solomon Islands for meeting the challenges of integrated or ecosystem management, climate change adaptation and resilience in line with the countries sustainable development goals* (Govan, Schwarz et al. 2011). The most predominant means of agencies obtaining information was via 'learning by doing' at sites and learning within their own organisation in Solomon Islands. Notably inter-agency networking would not be required for the site or agency generating knowledge to benefit from this learning.

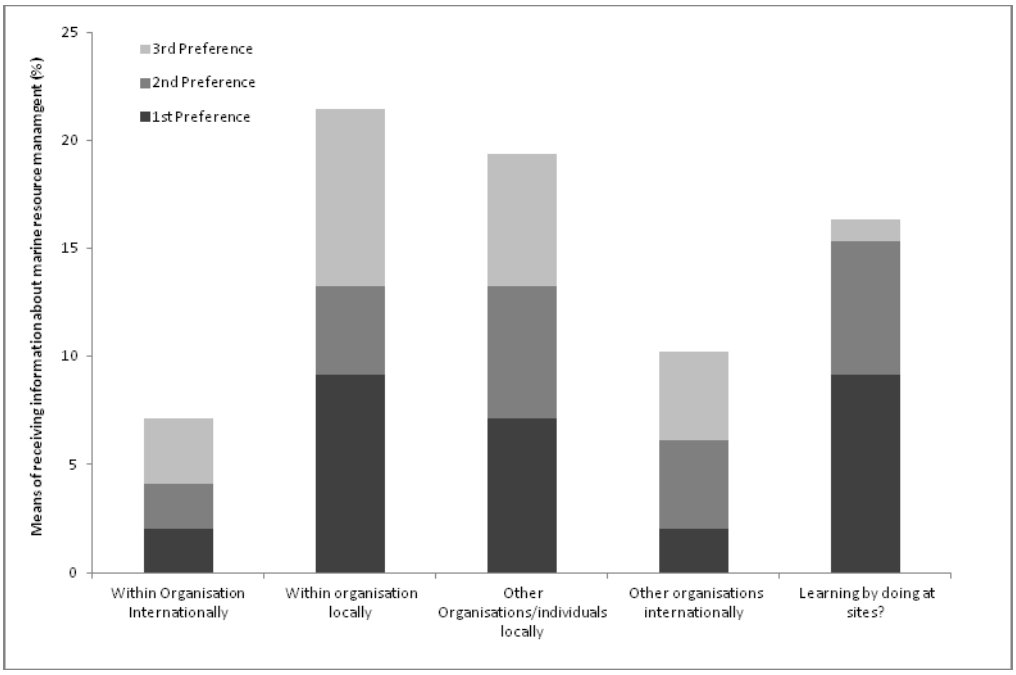


Figure 5. Sources of receiving information about best or better practice in marine resource management and conservation.

Respondents were asked through which form or mechanisms do they predominantly receive (Figure 6a) and provide (Figure 6b) information about successful or less successful (i.e. best or better practice) approaches to marine resource management. Meetings and workshops were cited as the predominant mechanisms of information exchange, whereas scientific publications and websites are more rarely utilised and scientific journals were very rarely utilised. The preference for information transfer through workshops, meetings and informal communication demonstrates the importance of maintaining sound social relationships between agencies. By comparison, social relationships would perhaps be less important in purely academic spheres as information exchange is driven through scientific publications obtained via electronic database systems.

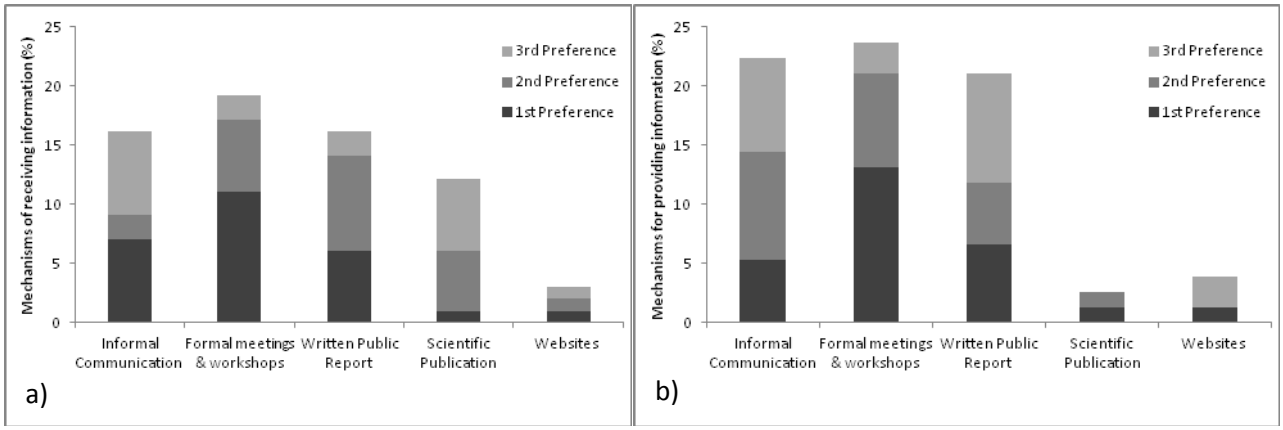


Figure 6. Forms or mechanisms of information exchange about best or better practice in marine resource management and conservation is predominantly a) received and b) provided.

9 information exchange fora that were relevant to the SILMMA network had been pre-identified; seven fora were CD/DVD or online databases and two meeting categorised as 'SILMMA meetings' or 'other meetings'. Databases were chosen as filling several criteria; specialise in disseminating information about the Pacific region or Solomon Islands specifically, comprise of a component of marine resource and management information and contain freely available reports and grey literature. Respondents were asked to describe their usage of each forum to receive information for supporting their marine resource management and conservation activities: use was categorised as 1. regularly rely on to get information; 2. sometimes use to get information; 3. unaware of, or; 4. aware of but do not use. The most relied upon fora were both formal SILMMA network meetings and other stakeholder meetings and one database (Figure 7). Responses indicated of nine existing information sharing channels, six (all CD/DVD or online databases) are largely not utilised by network members.

Qualitative responses indicate that SILMMA members felt that there were not sufficient structures and systems (such as databases, email lists etc.) to share lessons learned in marine resource management or that existing structures and systems needed to be strengthened to perform adequately. Notably 'maintaining a library and database' is a goal outlined by SILMMA in the strategic plan (Solomon Islands Locally Managed Marine Area Network 2009). It would be advisable to determine reasons why existing databases are under-utilised or insufficient before proceeding with a new database. Most respondents felt that there were currently sufficient opportunities (such as meetings or workshops etc.) to share lessons learned in marine resource management, however that they needed supporting and improving.

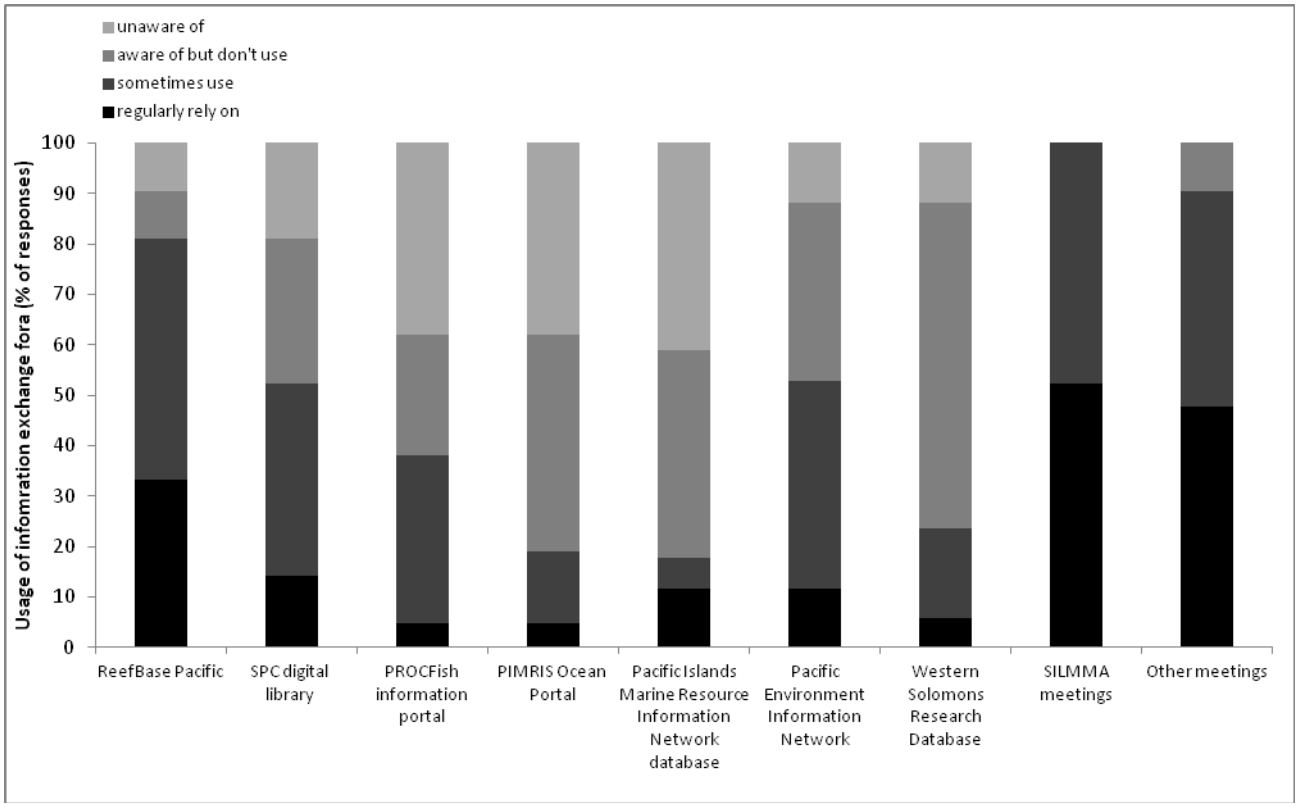


Figure 7. Use of established information sharing fora.

4.3 Patterns of Information Exchange

Quantitative social network data allows detailed examination of the relationships between agencies and individuals. Interview respondents were asked to note where a relationship with another agency was absent, present or strong for receiving new ideas and influential information regarding marine resource conservation and management. In a social network diagram (e.g. Figures 7, 8, 9 and 10) an actor (organization or person) is represented by a symbol and a relationship is represented by a line. Names of the organization and people are not presented in network diagrams in this report as the specifics of those relationships are considered useful to SILMMA specifically.

Social network analysis suggests that certain SILMMA agencies are more effective at sharing information than other agencies. The larger symbols, in Figure 8 for example, show those agencies that are the greatest providers of information to SILMMA members i.e. a large number of agencies have identified that agency as an important source of information. Some non-SILMMA agencies (i.e. circles) are as important for providing information about marine resource management as some SILMMA members (i.e. squares). So although these agencies are not formal network members they are clearly important players in marine resource management in Solomon Islands. The diagram shows agencies grouped by type of organisation. One government agency, one local NGO, several universities, international NGOs and regional organisations account for the key providers of information for supporting marine resource management activities in Solomon Islands.

One particular SILMMA member agency is outstandingly important for connecting agencies that would otherwise only distantly connected or completely disconnected (Figure 10). This type of agency is exceptionally important for two reasons; firstly it forms a natural focal point for information distribution, and secondly if somehow it were to be reduced in effectiveness or removed from the network, many agencies would become further or completely removed from information sharing and learning opportunities.

The density is the number of existing relationships between agencies compared to the number of possible relationships that can exist i.e. if all agencies were perfectly connected to all others. The density of information sharing relationships is 64% i.e. 64% of all the possible information sharing linkages that could exist between SILMMA member agencies currently do exist. The density of 'strong' information sharing relationships between SILMMA members is 28%. SILMMA members identify 'strong' relationships with more non-SILMMA agencies than SILMMA agencies (Figure 8). Notably all, but one, SILMMA agencies were considered to hold a strong relationship for information provision by at least two other SILMMA member agencies. Strong relationships can also be indicated by reciprocated relationships i.e. where both agencies receive information from each other. Reciprocity can be measured as the number of relationships that are reciprocated relative to an 'ideal' situation where all relationships would be reciprocated. Note that due to the nature of sampling (i.e. we did not interview non-SILMMA agencies to ask their relationship with SILMMA agencies) reciprocated ties only appear between SILMMA member agencies (but this does not mean that relationships to non-SILMMA members are unreciprocated). Of all the SILMMA member agencies that share information only 57% result in mutual exchange. In other words, agencies that are providing information to other agencies perceive that they do not receive information back from that agency in 43% of cases.

Social network research suggests that strong ties within a group such as SILMMA increase the likelihood that group members can influence and learn from one another, as well as share resources and trust (Newman and Dale 2005; Bodin, Crona et al. 2006). However if there are only ties between agencies in the 'core' network then there may be redundancy in the information and opportunities they are sharing (Reed, Graves et al. 2009). Weak ties and bridging ties i.e. to agents outside of the core group facilitate access to new information, innovations and opportunities. In a practical sense, supporting and encouraging strong relationships within SILMMA may lead to collective action and consensus within the group. However relationships, even if they are weak, to external agencies can provide access to new information and opportunities that can become critical if situations change and the network members need to adapt to a set of new conditions or environmental change (Crona and Bodin 2006). Additionally as agencies tackle demands of ecosystem-based management and multi-sectoral approaches, connections to networks of other expertise become vital (Govan, Schwarz et al. 2011). In Solomon Islands, at least within the government, routine mechanisms for coordinating between sectors have been absent or ineffective (Lane 2006).

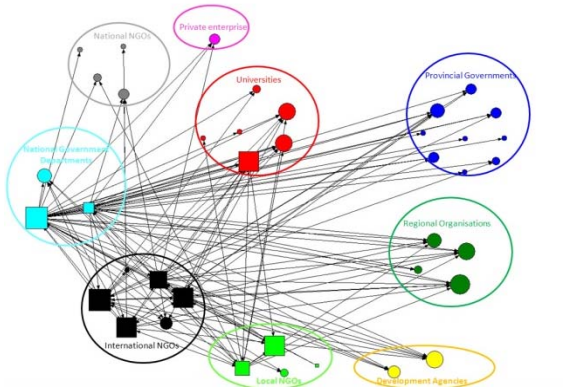


Figure 8. Social network graph showing **all information sharing relationships** amongst agencies. Symbols represent agencies; square symbols represent SILMMA members, circular symbols are non-SILMMA members. Agencies are grouped, coloured and labelled by type of organisation. **Size of symbol represents the number of connections** (lines) to that agency (i.e. in-degree centrality). Lines represent relationships present between agencies for receiving information that supports or influences marine resource management and conservation actions of another. Direction of the arrow points towards the supplier of information (ie. we receive information from them).

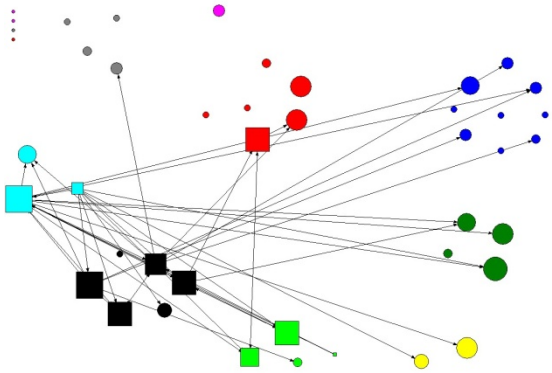


Figure 9. Social network graph showing **strong information sharing relationships** amongst agencies. Symbols represent agencies; square symbols represent SILMMA members, circular symbols are non-SILMMA members. Agencies are grouped and coloured by type of organisation. **Size of symbol represents the number of connections** (lines) to that agency (i.e. in-degree centrality). Lines represent strong relationships present between agencies for receiving information that supports or influences marine resource management and conservation actions of another. Direction of the arrow points towards the supplier of information (ie. we receive information from them).

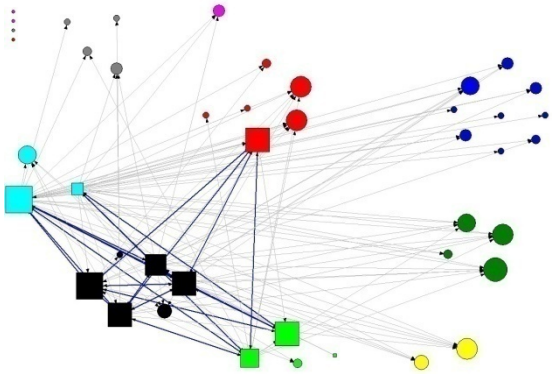


Figure 10. Social network graph showing **reciprocated information sharing relationships** amongst agencies. Symbols represent agencies; square symbols represent SILMMA members, circular symbols are non-SILMMA members. Agencies are grouped and coloured by type of organisation. **Size of symbol represents the number of connections** (lines) to that agency (i.e. in-degree centrality). Blue lines represent reciprocated relationships (grey = unreciprocated) present between agencies for receiving information that supports or influences marine resource management and conservation actions of another. Direction of the arrow points towards the supplier of information (ie. we receive information from them).

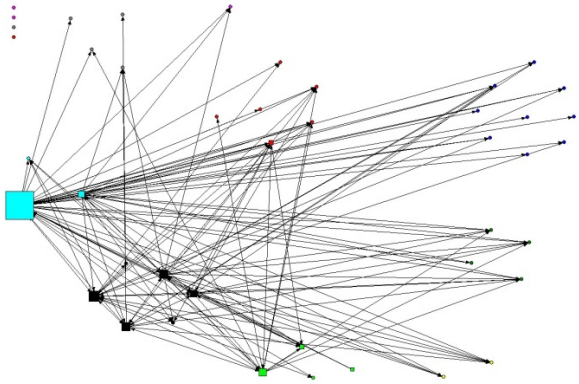
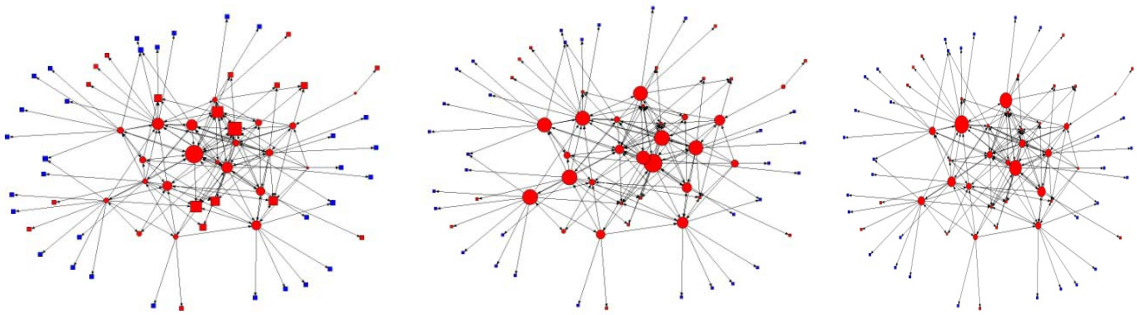


Figure 11. Social network graph showing **all information sharing amongst agencies**. Symbols represent agencies; square symbols represent SILMMA members, circular symbols are non-SILMMA members. Agencies are grouped and coloured by type of organisation. **Size of symbol represents the importance of that agency for connecting agencies that would otherwise be disconnected or distantly connected** (i.e. betweenness). Lines represent relationships present between agencies for receiving information that supports or influences marine resource management and conservation actions of another. Direction of the arrow points towards the supplier of information (ie. we receive information from them).

In the course of interviews, 72 people were identified as important or 'key' contacts for providing technical support and advice to marine resource management practitioners in Solomon Islands. 40 of these individuals belonged to agencies that were members of SILMMA (see red symbols in Figures 11a, b and c) and 23 of these individuals were interviewed (represented by circles and squares represent people who were not interviewed).

Most interviewed people were important contacts of other interviewees, however around three key SILMMA contacts were not interviewed (Figure 11a). Interviewees identified 8 people on average (ranging between 2 and 16 individuals) as being important personal contacts to provide them with support or advice for marine resource management and conservation. Figure 11b illustrates the size of interviewees personal networks (the larger the symbol size the higher the number of personal contacts), that is those people they consider important and available to them to call upon for advice and support for marine resource management and conservation.

Most person-to-person connections existed between individuals who were employed by SILMMA member agencies. The 33 non-SILMMA members (blue symbols in figures below) were generally identified by only one interviewee, demonstrating that support networks external to SILMMA are quite unique. This implies that if any person that is currently a SILMMA member is removed from the network (e.g. by changing jobs out of the sector or leaving the country) their contacts, and the collaborative and information opportunities associated with that contact, would no longer be available or accessible to the broader SILMMA network. Similarly, new SILMMA members would likely bring their own personal network of contacts. Certain individuals are key players in connecting individuals that would otherwise be distantly connected or completely disconnected (Figure 11c). If these people were to leave their position in the network (for example by getting a new unrelated job or leaving the country) then several sources of information and expertise (that they consider highly important) would become completely or further removed from the network of practitioners. Again connections outside of the formal network can facilitate access to new information and opportunities that can become critical if network members need to adapt to set of new conditions or environmental change (Crona and Bodin 2006).



a) In-degree b) Out-degree c) Betweenness

Figure 12. Social network graphs of individuals considered important by others for providing critical information and support for marine resource management (line points towards the person they value). Symbols represent individuals and the size of bubbles represents; a) In-degree; the number of people valuing that person i.e. in-degree, b) Out-degree; the number of people that SILMMA member relies upon i.e. out-degree and c) Betweenness; the importance of that person for connecting people that would otherwise be distantly connected or completely disconnected. Circles represent interviewees and squares represent additional individuals identified by interviewees. Individuals who belong to agencies that are members of SILMMA are represented by red symbols, blue symbols individuals who are not SILMMA members.

4.4 Learning Lessons?

Sharing information and making information freely accessible to others does not necessarily result in the uptake or application of new knowledge. There are many complicated factors why adaptation or learning may not result from new and relevant information; some of these factors were raised in interviews and were discussed in focus groups (See Appendix 1). Most interviewees felt that agencies in Solomon Islands do respond and adapt to new marine resource management information from practitioners in other organizations. However they suggest that change can be slow or restricted. Some interviewees highlighted that applying new knowledge or adapting approaches to resource

management is impeded by commitments to donors, agency agendas or agencies commitment or familiarity with existing approaches or activities. Respondents identified that upon receiving new information about management successes or failures from another agency, an ability to learn and adapt was limited by institutional mandates or project design. Some interviewees suggested that adapting to new knowledge would mean impeding the momentum of management implementation within existing projects.

The value of adaptive co-management approaches is that adaptation can address site specific information and needs. Therefore a dominant space for learning is between communities and their partner agencies. The application of some knowledge generated and lessons learned will therefore be limited to specific sites and be of less value to cross site and organisation learning. However other lessons may be of relevance to other sites or nation-wide. Although 'learning by doing' at local sites is a dominant and important form of learning for SILMMA member agencies (Figure 5), it is possible that some learning is redundant and that lessons could have already been learned via information sharing and knowledge uptake in national fora. It seems likely that a more robust national level knowledge base can be developed via inter-agency learning which could result in improvements in marine resource management in Solomon Islands.

SILMMA network members feel that information shared through the network can impact both local and national scales of marine resource management. 90 % of respondents believed that information sharing between marine resource management organisations working in Solomon Islands promotes improvements in marine resource management applied at local levels. Respondents discussed examples of adaptation of rules-in-use at sites. In examples provided, where resource management rules had changed or adapted since their first implementation, changes were driven only by local processes as opposed to monitoring data or receiving new information or direction from the national network. Further research would be required to identify if and how information shared through the network had resulted in adaptation of existing actions or improved marine resource management approaches.

All respondents felt that information developed and provided by the network of marine resource management organisations can influence national or regional policies. Two thirds of respondents felt that information their agencies provided had influenced national or regional policies. Policies that had been influenced were the Solomon Islands Protected Areas Act 2010, CTI Solomon Islands Plan of Action and the National Inshore Fisheries Strategy.

4.5 Networking for Implementation of Adaptive Co-Management

Network members described their current level of collaboration in implementing marine resource management and conservation in Solomon Islands. Most respondents implement marine resource management and conservation in collaboration with another agency all or most of the time (Table 2). 14 respondents identified that they collaborated with one main partner most of the time; notably two of those main collaborative partners that they identified were not agencies included directly in the SILMMA network. Partner-community group collaborations were not the focus of this study (however were somewhat explored in case studies below), but due to the nature of adaptive co-management they were assumed to be present in every case.

Level of collaboration when implementing marine resource management or conservation	Number of responses
Around 1/4 projects/work are collaborative	6
Around half of projects/work are collaborative	1
3/4 of work/projects are collaborative	7
All projects/work collaborative	7

Table 3. Responses of 21 interviewees about their agencies level of collaboration with other agencies when implementing marine resource management or conservation.

The collaborative relationships of SILMMA member agencies were examined closely using social network analysis. The statistics and diagrams of collaborative relationships are not presented here in detail as similarities between information sharing and collaboration relationships and networks are high and statistically significant. The correlation between collaboration and information exchange indicates that where collaboration is strong, so is information exchange and where collaboration is weak so is information exchange.

4.5 Local Level Networking

Qualitative case studies were conducted at three sites in Solomon Islands to examine links to, and between, community level groups. Information about marine resource management is exchanged between villages in both informal and facilitated processes. To promote sharing of lessons many agencies facilitate 'look and learn' visits to villages or regions with established marine resource management regimes. These exchanges may involve community representatives that are from other LMMA sites or from communities were management is currently lacking. Look and learn visits involve observations and discussions about impacts of adaptive co-management of marine resources.

Case studies support that inter-village social networks facilitate information exchanges that promote and expand interest in adaptive co-management initiatives; this has been previously noted in Solomon Islands (Game, Lipsett-Moore et al. 2010). Further research would be required to determine if promotion and expansion of interest in management (via facilitated and informal inter-villages exchanges of information) actually result in increased uptake of management activities, particularly without the direct support of a partner. In some cases the engagement of external agents may be a critical to legitimise (or at least increase the perceived legitimacy of) management by linking local scales to higher level policy or to nest local institutions in higher scales (Ostrom 1990; Cudney-Bueno and Basurto 2009). Insights from diffusion of innovations theory highlight that while the spread of new ideas and knowledge can be facilitated by social relations, resultant adoption of new ideas is complicated by human behaviour and social conditions (Carrington, Scott et al. 2005). In focus group discussions community groups identified multiple types of support (technical and information) provided by their partner agency that they considered essential, and necessarily ongoing, for the success of marine resource management in their managed area. This implies that these community groups at least view initial and ongoing external agency support as critical to the success marine resource management in their areas.

Several limits to the sharing of lessons learned between sites were raised by SILMMA member agencies. Firstly the nature and quality of lessons taken from 'look and learn' were not known. Case studies explored this point and example lessons that respondents noted learning were quite general. The most common 'lesson' was that closing an area to fishing lead to more fish and invertebrates, healthier coral and tamer fish. The result being that observers then wanted these affects in their village area. Increased awareness of costs of management (i.e. loss of fishing ground, enforcement or time spent in management meetings for example) or specificities of resource use rules (such as effective reef closure durations, appropriate size limits or successful enforcement strategies etc), were not raised by case study respondents when discussing lessons learned. Further research would be required to understand the depth of learning occurring during site visits. The second limit discussed by SILMMA member agencies was that upon return to their home village, community 'look and learn' participants were failing to report back to their broader community. In response to these weaknesses SILMMA members felt that the 'look and learn' process may need to have a set goals, a formal agenda and reporting back processes to ensure that the information exchange opportunity is maximised.

4.6 Spanning Scales

Key to adaptive co-management of marine resource is that different governance levels are supporting and involved in decision making and implementation processes (Olsson, Folke et al. 2004). Emerging Solomon Islands natural resource management policies call for *multi-scale integrated policy and action between local, provincial and national levels* (Govan, Schwarz et al. 2011). Social networks can facilitate multi-level or multi-scale participation in forming policies that target more effective management of MPAs (Pajaro, Mulrennan et al. 2010). Social network analysis reveals that

there are currently information exchange connections between local, provincial national, national and international scales in Solomon Islands (Figure 13).

The capacity of local customary land and sea custodians to make informed and sound decisions about marine resource management can be undermined by; *(i) the absence of a mechanism that enables them to access advice (legal, financial, ecological) when making natural resource decisions, and (ii) poor vertical relations of governance which impede the flow of information and other assistance from government to community* (Lane 2006). Where local adaptive co-management had been established partner agencies (often NGOs) act as a bridges for information exchange between local levels, national governments and international fora. The connection of partner agencies to local scales is important for a number of reasons. Case studies revealed that individual agencies often exclusively channel information and technical support to villages or regions engaged in adaptive co-management. This is a powerful position to be in and depending on the quality of advice and information reaching local levels, can be a role that strengthens or weakens marine resource management.

Additionally the agency may be the only functional pathway for community level information, lessons learned and needs to reach national and international fora. Partner agencies often directly facilitate the representation of community groups or representatives in national and international fora, which otherwise may not be possible due to lack of capacity or resources (The Locally-Managed Marine Area Network 2009; Pajaro, Mulrennan et al. 2010). SILMMA core business is to facilitate community representation in its national meetings. The existence of these channels is evident; however the effectiveness of these channels would require further analysis.

Social networks can span local, provincial, national and international levels and facilitate both sharing and integration of information generated from various sources operating at different scales (Hahn, Olsson et al. 2006). At each scale (local, national, provincial and international) different agencies may hold information and expertise that aids or guides the implementation of effective management making connections between levels important for mobilizing and sharing knowledge and capacity. The importance of decentralised governance systems and particularly the role of Provincial governments for marine resource management are widely recognised (Lane 2006; McDonald 2006; Govan, Schwarz et al. 2011). At this stage it appears international NGOs, national government and local NGOs are better connected via the SILMMA network (for example see Figure 9 and Figure 10). National NGOs and provincial governments hold fewer information exchange connections to SILMMA members. The current lack of information flow from provincial governments implies a lack of capacity or knowledge regarding marine resource management; inferred from observing that relationships for information exchange naturally evolve with agencies that hold relevant and useful information even when they are not formally networked through SILMMA. It is noted that SILMMA *has not yet established itself in its role as an avenue for members (national government and NGOs) to liaise with national/provincial governments* and that facilitation of that connection is required (Environment Consultants Fiji 2010). However provincial governments have been observed to have *poorly defined roles and functions, inadequate funding, isolation and weak relationships with National Government* (Cox and Morrison 2004). While provincial governments may theoretically be in a good position to support local levels of marine resource management, low exchanges of information about marine resource management again highlight the need to transfer skills and knowledge to provincial fisheries officers (Govan, Schwarz et al. 2011), while also clarifying and adequately resourcing the role of provincial governments in natural resource management.

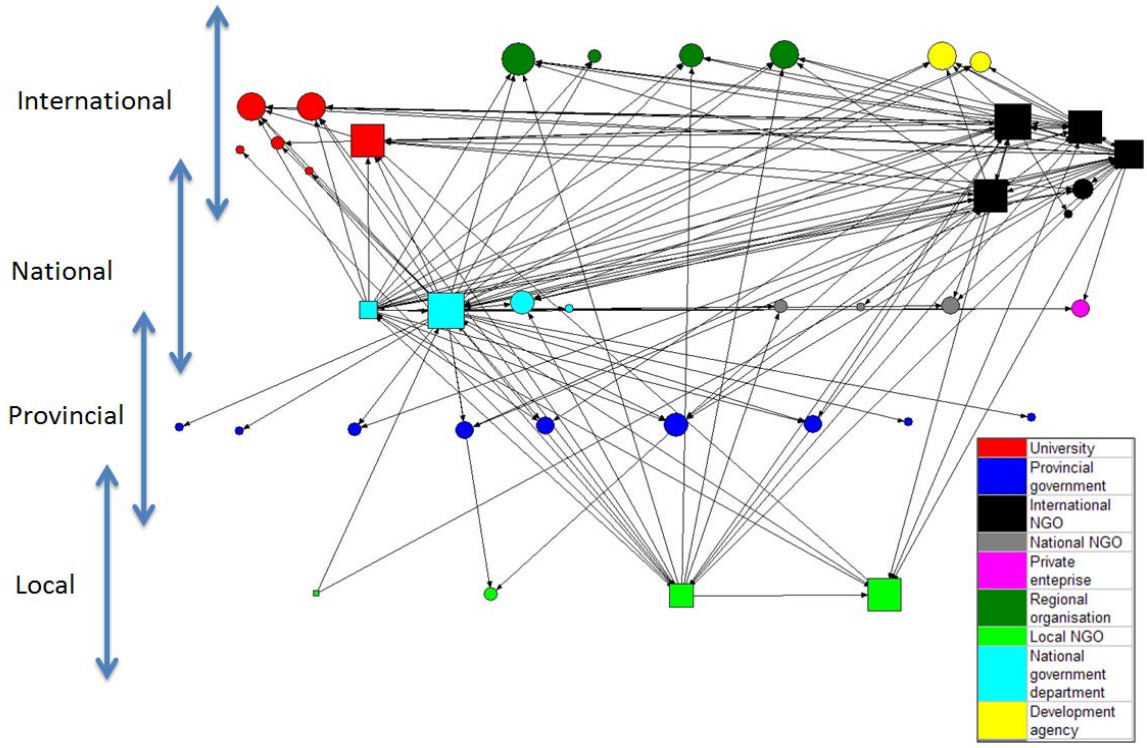


Figure 13. Agencies (defined by organisation type in colour and their broadest scale of focus or operations) that SILMMA members receive information from that supports and influences their approaches to marine resource management in Solomon Islands. Squares represent SILMMA member agencies and circles represent non-SILMMA members. Many 'international' agencies have country specific programmes and offices and could be represented on the national level or international level (as represented here). Local NGOs presented here are only a sample (i.e. there are many more) and therefore connections to the local level are under-represented in this diagram.

4.7 Research Limits and Future research

There are several limitations to the analyses presented here which highlight areas for future investigation. It is important to note that these analyses provide a snapshot of network connections in late 2010 and relationships between agencies and people are subject to change over time e.g. if a person who is highly active in facilitating information exchange or collaboration moves to another sector or another country. These analyses may however provide a useful baseline from which to measure improvements in information sharing between SILMMA agencies. It is likely that in addition to the relationships that interviewees recognised from the list of agencies presented, there are some additional relationships for information exchange that interviewees failed to recall. It is reasonable to conclude that there are more than 43 agencies and more than 72 people involved in generating information that supports marine resource management and conservation in Solomon Islands. A relationship being absent, present or strong is a subjective measure provided by respondents. The quality and content of information exchanges has not been determined by this report, however improving our understanding of information exchange would provide valuable insight into the limits and potentials to learning via the network. Several other areas of future research have been discussed through this report and highlighted in the recommendations.

Conclusion and Recommendations

Both formalised and extended informal social networks of agencies involved in establishing adaptive co-management are active in Solomon Islands. Pathways, mechanisms and opportunities for collaboration and exchange information are present and utilised. The formal SILMMA network is a key mechanism for sharing information between marine resource management practitioners operating at multiple scales. Evidence from SILMMA network members suggest that the formal SILMMA network facilitates information exchange beyond what would occur without a formal networking structure. However while network members place a lot of value on the potential functions of SILMMA to promote information exchange and learning between agencies and sites, many acknowledged that the network has not been functioning effectively to date.

- Review and action recommendations provided by the SILMMA network members to overcome barriers to information exchange and learning

- Recognise and support (via allocation of time and resources for networking) agencies and individuals that are lead facilitators of collaboration and information exchange

- Examine reasons why existing information sharing mechanisms and channels, particularly databases, are under-utilised or insufficient before proceeding with a new database. Consider utilising and strengthening existing mechanisms and channels

The value of adaptive co-management approaches is that adaptation can address site specific information and needs. Therefore a dominant and important space for learning is between communities and their partner agencies. It is therefore likely that the application of some knowledge generated and lessons learned may be limited to specific sites and be of less value to cross site and organisation learning. Although 'learning by doing' at local sites is a dominant and important form of learning for SILMMA member agencies, it is possible that some learning is redundant and that lessons could have already been learned via information sharing and knowledge uptake in more effective national fora. It seems likely that a more robust national level knowledge base can be developed via inter-agency learning which could result in improvements in marine resource management in Solomon Islands.

- While adaptive co-management emphasises adaptations to site specificities and 'learning-by-doing', recognise that there may be some redundancies in 'learning-by-doing' i.e. the same lesson may have already been learned elsewhere

- Focus in on key issues, approaches or themes for inter-agency or inter-site learning. Broad goals of 'information sharing' or 'learning' are important but may be awkward to implement and difficult to measure progress against

Agencies value improving collaborative and information sharing relationships and aim to utilise and to strengthen the existing SILMMA network. Strong bonds between agencies involved directly in implementing marine resource management (i.e. SILMMA network) indicate a network capable of committing to common goals and joint action. However the reality of moving forward a joint and coordinated agenda is a significant challenge. While improvements in collaboration and information sharing have been demonstrated to facilitate the emergence of adaptive co-management, there are also real barriers to improving these relations. Some barriers such as lack of time and resources to support networking activities, may be addressed through improved resourcing or project design. However some barriers may be intrinsically linked to the nature of adaptive co-management i.e. adapting to site specificities, project, donor and agency commitments and preference, disparate objectives and geographic distances.

- Recognize limits to networking and reflect these in common goals and commitments

Strengthening inter-SILMMA relations and establishing formal membership may strengthen the commitment to common goals and joint action. However relationships to agencies or people outside of the core network are critical for facilitating access new knowledge, resources and opportunities.

- Provide mechanisms so that new knowledge and information (i.e. agencies and individuals involved in generating knowledge or opportunities for marine resource management) have a mechanisms for interacting with either SILMMA as a network and/or those agencies or individuals that act as hubs for information exchange and collaboration

Evidence suggests that inter-village social networks facilitate information exchanges that promote and expand interest in adaptive co-management initiatives. Understanding and utilising intra and inter-village social networks may be critical to maximising the proliferation of management and the persistence of education and awareness about marine resource management. Further research would be required to determine if promotion and expansion of interest in management through inter-village exchanges of information leads to increased uptake of management activities, particularly without the direct support of a partner.

- Conduct ethnographic research into relationship between inter-village information exchange pathways and uptake of management and proliferation of education and awareness

- Conduct ethnographic research into the transfer and persistence of education and awareness messages via inter-village information exchange pathways

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Appendix 1. Limits to learning - partner agency focus group discussion

1. Factors preventing exchange of information and knowledge between SILMMA members?

1.1 (Lack of) availability of communication mediums
1.2 (Lack of) partner commitment (to information sharing), need a contact person
1.3 Lack of proper guidelines/mechanisms in place for sharing
1.4 Intellectual property rights for information
1.5 Individual organisations failing to look at the bigger picture, i.e. not working towards a common goals and not working as one under the SILMMA umbrella
1.6 The type of information asked for. This can also be related to intellectual property rights. For instance, raw data on household socio-economic surveys for example may not be able to be shared, but the written reports can be shared
1.7 (Lack of) procedures for sharing information, especially government procedures whereby government staff need permission from the Permanent Secretary before giving out statements
1.8 NGO partners have no/low trust towards government and how government institutions may use information
1.9 No proper storage of information so lack of trust for procedure for using the information and its safe storage
1.10 No clear direction where information is going and how it may be used and a goal and common purpose is lacking

2. What constrains learning when implementing management? (i.e. applying knowledge when it is received)

2.1 (No) clear goal and purpose of how to use the information; information is not always relevant
2.2 Difficult to grasp some of the (written) reports contents – main lessons learned should be made clearer type of information and relevance of information i.e. lots of reports may be shared but their relevance to others work may be minimal
2.3 Reliance on written reports limits its application
2.4 Lack of available time to apply information gained
2.5 Lack of adaptation to intake of new information. Restricted organizational procedures/no avenues for adaptation to the use of new information i.e. projects or organizations may not be able to adapt given the scope of their organization or project
2.6 No shared ownership of information, for instance each organisation prioritizing its own information above others
2.7 Focusing on implementation without taking the time to learn and document those lessons
2.8 Limited opportunities to pass on or use information
2.9 The form of the information package; short summary pages or lessons learned would be better as opposed to long reports where no one will have the time to read
2.10 Preferences for considering each organisations own information and for their geographical area of interest

3. How can SILMMA address these problems?

3.1 SILMMA partners to feed information into the database of information already existing
3.2 Secretariat needs to have the capacity to be able to store the information
3.3 Partners to be committed to seeking funding for SILMMA for its activities, and committed to the sharing of information and committing the time required to do that
3.4 SILMMA to facilitate workshops where 'lessons learned' are shared between members
3.5 SILMMA partners to develop the data-sharing protocol
3.6 Develop 'Learning themes' specific for a timeframe so that partners can focus learning in these areas and can report back to in the proposed lessons learned workshop (i.e. workshops can focus on that theme)

Appendix 2. Partner agency support - Community focus group discussion

Community group responses to focus group discussion questions; 1. What assistance and information was gained from engagement and working with partners to implement marine resource management? 2. Which of these require ongoing support from partners (and for e.g. which one off only)? 3. Which of these is ESSENTIAL (***) to the success of marine resource management?.

Community Group 1

What assistance and information was gained from engagement and working with partners to implement marine resource management?	Which of these require ongoing support from partners (and for e.g. which one off only)?	Which of these is ESSENTIAL (***) to the success of marine resource management?
Workshops/meetings	Ongoing	***
Office	Ongoing	***
Technical support; monitoring sites, capacity building, train local monitors, rangers, livelihoods	Ongoing	***
Research/Information feedback	Ongoing	***
Materials; FAD, radio, monitoring equipment, dive equipment	Ongoing	***
Look and Learn trips/trainings (national and international)	Ongoing	**
Establishment of local conservation		***

Community Group 2

What assistance and information was gained from engagement and working with partners to implement marine resource management?	Which of these require ongoing support from partners (and for e.g. which one off only)?	Which of these is ESSENTIAL (***) to the success of marine resource management?
Funding	Ongoing	***
Human Resources	Ongoing (localize exit plan)	***
Resource management training	Ongoing	***
Information Sources	Ongoing	***
Information/technology	Ongoing	***
Resource Centre	Ongoing	**
Exposures i.e. meetings and sharing	Ongoing	***
Transparency and accountability	Ongoing	***
Proper reporting	Ongoing	***
Prioritizing Work plan	Ongoing	***
Services	Ongoing	*

Appendix 3. Agencies' main goals of being a member of SILMMA.

For networking. Influence government and communities
To connect and share ideas
To coordinate national and regional actions, improve marine resource management, to influence policy and to influence local level activity
To achieve national CBD goals of management of percentage of reef to be protected
For Information sharing
Consult with what SILMMA has in place
To share lessons learned, to both give and receive
Give and get training, assistance and support
To spread community based resource management to other parts of the Solomon Islands, provide information on experiences and develop policy at the provincial level
To receive information and to understand what members are wanting at the national level i.e. what works and what doesn't work
For information sharing and to see if resource can be shared with partners
To share information, focal point to get information, learn from each other through information sharing
To provide baseline data and information to SILMMA members
To information, to network and to impart some knowledge to network and to share expertise
To share lessons with other practitioners (realistic expectation of the network). Can influence and be guided by national policy. Possibly in the future have a role of bringing communities together.
To network, share information and lessons learned. To give a stronger voice for policy engagement and advocacy
To share information, to provide and receive information and for learning by doing.
To assist resource owners and to access support
To receive more information to share our experiences and to look and learn from other communities.
To share scientific expertise in social and natural science.
To support capacity for communities and for networking for sharing ideas
To find funds and to receiving advice

Social networks to support learning for improved governance of coastal ecosystems in the Solomon Islands