Socioeconomic Factors that Affect the Sustainable Use of Natural Resources in Rural Communities in Fiji

WCS

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CONTENTS

EXECUTIVE SUMMARY

Local communities in the Pacific have a high dependence on their natural resources for food and livelihoods. Managing small-scale fisheries resources through locally-managed marine areas (LMMAs) is an approach that has been scaled up to cover seventy-eight percent of inshore community fishing grounds in Fiji. A LMMA is an example of the regulation of common-pool resources to prevent the "tragedy of the commons", whereby resources are depleted when the self-interest of users are not managed. There are various factors that influence the ability of local communities to self-organize and self-regulate including dependence on the exploited natural resources, livelihood diversity, leadership, social capital, participation in natural resource management, monitoring and enforcement.

Socioeconomic surveys were conducted in 14 different villages across 6 districts and 4 provinces in Fiji, between February to April 2015 to examine the socioeconomic factors that affect the sustainable use of natural resources in rural communities in Fiji. The results of this study highlighted two factors that affect the vulnerability local communities: income diversity and dependence of natural resources. There was generally a relatively low diversity of income sources at household level with almost half of the households interviewed depending on a single economic activity.

Local communities were highly dependent on natural resource-based livelihood activities, with fisheries and agriculture playing a complementary role in terms of food and livelihoods – meaning coastal villages where fishing was not a primary income source relied on fishing for subsistence, and agriculture for livelihoods, and conversely, coastal villages where fishing was a primary income source relied on agriculture for food. This dependency of local communities on their natural resources as sources of income and subsistence can have implications on their vulnerability to natural hazards such as cyclones or droughts, and future climate change scenarios.

The ability of communities to act collectively to solve problems can be as or more important than a lower dependence upon natural resources in supporting community resilience. Trust can also enhance cooperation and reduce the transaction costs in natural resource management. In communities where trust is high, individuals spend less time monitoring others since they trust that others will act as expected. The survey respondents in Fiji had generally high levels of participation in the social life of their villages. Most respondents trusted people from their own village, and placed a high level of trust in religious leaders. These results, together with a high dependence on fishing could indicate a strong potential for collective action in the management of natural resources, especially in villages where fishing is a major economic activity. This seemed to be supported by the existence of fishing rules in virtually all villages surveyed. However, key informant interviews suggested very low compliance levels in some of the villages.

The limited compliance can affect the availability of fish and the viability of fishing livelihoods in the medium and long-terms. This could be a result of limited trust in external agents and the possibility of enforcement, as well as the perceived lack of participation in natural resource management. First, the level of trust on people from other villages (who

may poach on the natural resources in neighbouring villages) and on fish wardens and police (who are supposed to enforce natural resource use rules) was relatively low, varying between villages. Implementing management actions that depend on collective action in the villages where trust is low might require additional investment in mediating negotiations and reinforcing social bonds between different groups.

The study found levels of participation in the decision-making regarding natural resource management were relatively low, especially in villages where fishing is an important economic activity. Most respondents perceived changes in the marine environment and attributed such changes mainly to human actions, but felt powerless to change fishing rules, which suggests that collective action for resource management in the villages might have lower levels of participation. This could be linked to both the hierarchical system of natural resource management traditionally in place and limited levels of trust on village leaders. Traditional hierarchical systems and customary rules have played a significant role in maintaining sustainable fisheries in Fiji. When supported by strong leadership, trust, and information flow through social networks, these traditional systems have the potential to lead to socio-ecological systems that are more robust to change.

Community and religious leaders endorsing the Kubulau District Ecosystem-Based Management Plan. ©Stacy Jupiter/WCS

1. INTRODUCTION

Historically, Pacific Island communities used a variety of tools to protect or control coastal and marine resource use (Johannes 1978, 2002). Government and non-government organisations (NGOs) working on natural resource management have eagerly embraced this local willingness to implement resource management and to revitalize customary management practice through locally-managed marine areas (LMMAs) in the Western Pacific. In Fiji and the tropical western Pacific, there are many ecological, socioeconomic, and cultural objectives associated with the establishment of LMMAs that are achieved through the use of a variety of management tools, including spatial and seasonal closures, access and effort regulation, and gear and species restrictions (Cohen and Foale 2013; Jupiter et al. 2014).

Managing small-scale fisheries resources through LMMAs is an example of regulation of common-pool resources to prevent the tragedy of the commons (Hardin 1968), whereby resources are depleted when the self-interest of users are left unchecked. It is in the interest of local community groups to self-organize and make investments in designing and enforcing rules in order to ensure the availability of resources on which they depend for livelihood and well-being outcomes (Ostrom 1990). There are various factors that influence the ability of local communities to self-organize and self-regulate. These include dependence on the exploited natural resources, livelihood diversity, leadership, social capital, participation in natural resource management, monitoring and enforcement (Ostrom 2009; Gutierrez et al. 2011; Cinner et al. 2013; Cox et al. 2016). Social-ecological systems are also embedded in broader social, economic and political contexts that may also affect and be affected by related ecosystems.

To understand how these characteristics vary across rural communities in Fiji, the Wildlife Conservation Society (WCS) undertook household and key informant surveys in 14 villages spread across the Vatu-i-Ra Seascape, between the islands of Viti Levu and Vanua Levu. These communities are part of the Fiji LMMA network and have some dependency on fisheries resources for livelihoods and well-being. This report provides a broad overview of the results of questionnaires focused on characterising the socioeconomic and governance conditions in these 14 communities to enable an assessment of where there are strong enabling conditions for successful community-based fisheries management and where there are weaknesses that may need to be addressed.

WCS has also collected ecological data from the fisheries management areas adjacent to the communities surveyed, in order to assess ecological outcomes of community-based fisheries management (Jupiter et al. 2017). During socioeconomic surveys, WCS also asked respondents about economic status and diet diversity in order to assess livelihood and well-being outcomes. Responses from the surveys are reported here, although a broader analysis of whether economic status and diet diversity has been influenced by changes in resource availability through management is beyond the scope of this report.

This report is part of a broader project aimed at **assessing the social, ecological, and institutional characteristics that influence the social and ecological success of LMMAs**.

2. METHODOLOGY

Socioeconomic surveys were conducted in 14 different villages across 6 districts and 4 provinces in Fiji between February to April 2015 (Table 1, Fig. 1). Villages were selected based on whether there was a history of implementing *tabu* areas (i.e. periodically harvested fisheries closures), and where WCS had matching coral reef survey data (see Jupiter et al. 2017). We did two types of data collection at each of the villages:

(i)   Household survey: The main part of data collection was through a household survey, which was designed to gather data on factors that influence the ability of local communities to self-organize and self-regulate in natural resource management (Ostrom 2009; Gutierrez et al. 2011; Cinner et al. 2013; Cox et al. 2016). Where possible the questions were the same as (or as similar to) those asked by WCS in previous socioeconomic surveys in 2009 (WCS, unpublished data). Within each village, as many households were surveyed as possible over a 6–15 hour period by a team of trained interviewers. Each interview took approximately 60 minutes, generally in the homes of the respondents. All surveys were done in the *iTaukei* language.

(ii)   Compliance survey: a compliance survey was done through telephone discussions with key informants to understand the overall level of management effectiveness of LMMAs by examining the level of compliance with management rules. WCS has long-standing relationships with the majority of communities, and participants were selected based on their knowledge of their *tabu* areas, and included community leaders and local fishers.

To maintain confidentiality of respondents, personal identifiers were removed from the database for data analysis and replaced by a code. All data were aggregated at the village or district level. District level was selected for those questions that were particularly sensitive, such as those relating to trust. However, such data aggregation does not assume that villages are representative of the whole district.

All questionnaires were reviewed and received approval through the WCS Institutional Review Board.

Navatu Village in Bua Province (left) and Nabukadra Village in Ra Province (right) ©Stacy Jupiter/WCS
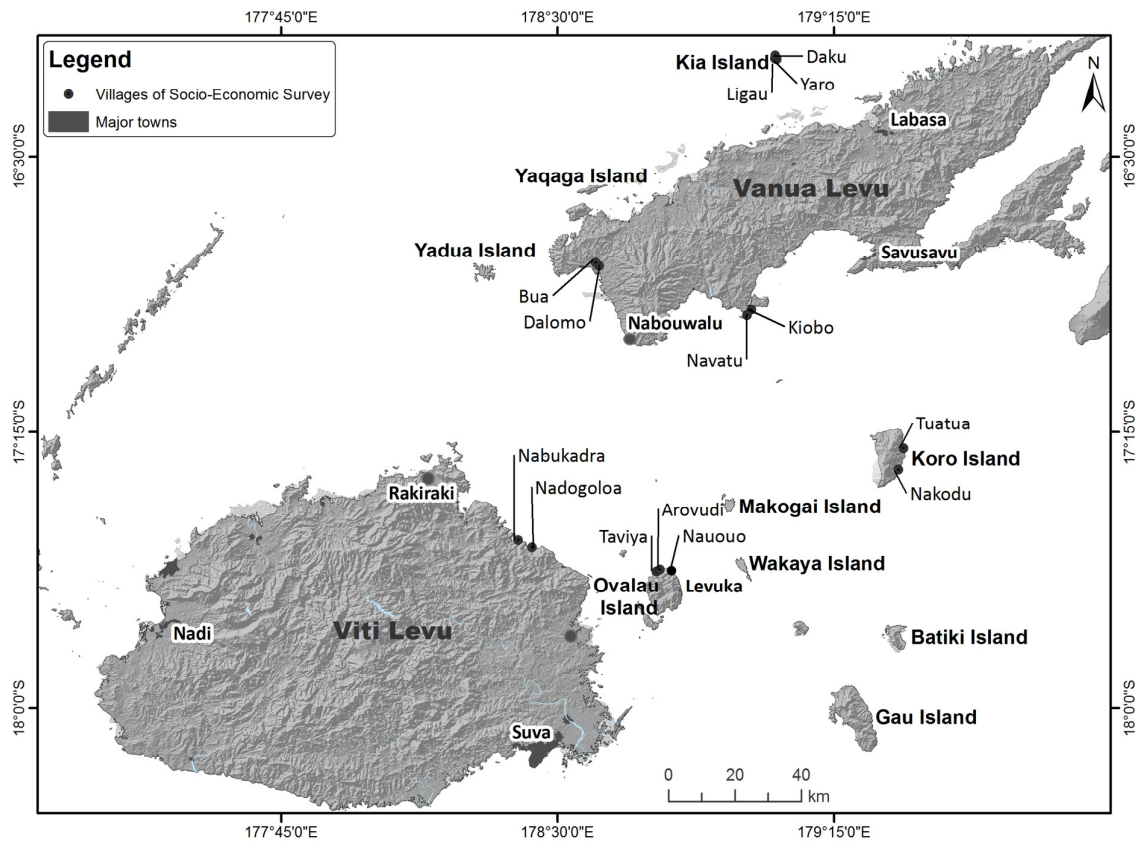
Figure 1. Villages (black circles) in Fiji where socioeconomic surveys were conducted in 2015.

Margaret Fox (WCS) piloting the household survey in Vatukalo Village on Ovalau Island. ©Stacy Jupiter/WCS

3. RESULTS AND DISCUSSION

3.1 General demographics

In total, 220 household representatives were interviewed. Although not everyone (especially children or the elderly) was interviewed, the survey covered between 27% and 99% of the population of the villages that were part of the study (Table 1). More men (58%) than women (42%) were interviewed. The population surveyed was relatively young, with almost half aged less than 20 years (Fig. 2). Most adults had a secondary education, though not all finished through to Form 6, while 21% to 39% of respondents or members of their household over 20 years of age had only some level of primary school education (Fig. 3). Only 3% of respondents went to university, with the highest numbers coming from Levuka District. The majority of respondents were Methodist (88%), and the remaining 22% were Apostle, Assemblies of God, Catholics, Church of God, Later Day Saints or Seventh Day Adventists.

Table 1. Total population of the villages where socioeconomic surveys were conducted, the number of households interviewed per village, and the percentage of the total population covered by the survey (including all household members) in parenthesis. Source: Provincial Offices

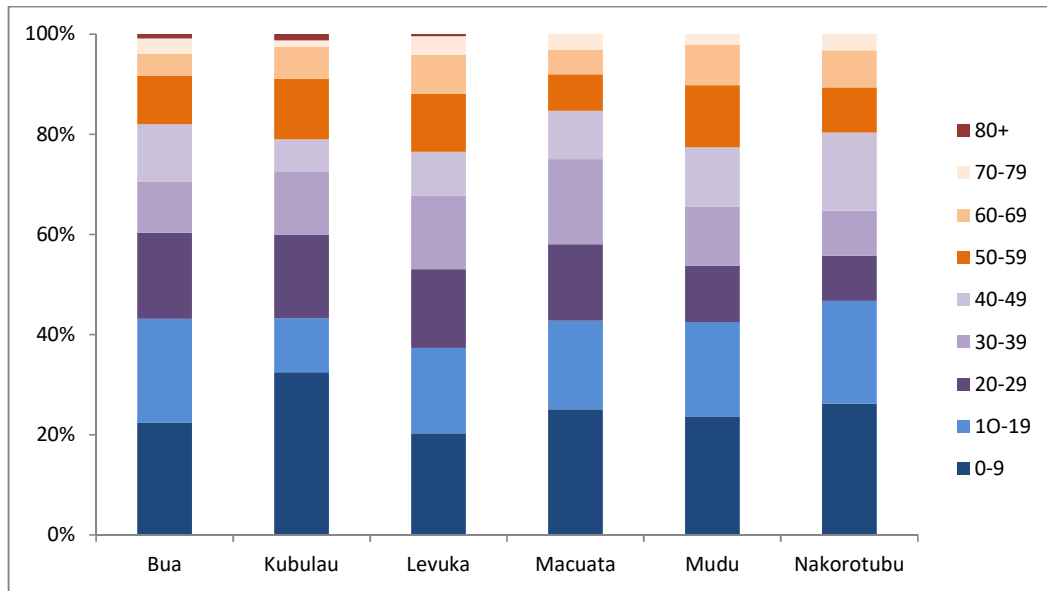| Province	District	Village	Total Population	# Households interviewed	Population covered by survey
Bua	Kubulau	Kiobo	68	11	63 (93%)
		Navatu	110	17	94 (85%)
	Bua	Bua	296	29	177 (60%)
		Dalomo	72	11	51 (71%)
Macuata	Macuata	Daku	44	8	38 (86%)
		Yaro	60	10	50 (83%)
		Ligau	44	8	38 (86%)
Lomaiviti	Levuka	Taviya	238	25	101 (42%)
		Arovudi	175	16	55 (31%)
		Nauouo	109	12	62 (57%)
	Mudu	Tuatua	320	18	85 (27%)
		Nakodu	380	24	103 (27%)
Ra	Nakorotubu	Nabukadra	51	13	46 (90%)
		Nadogoloa	85	18	84 (99%)
Total			**2052**	**220**	**1047 (51%)**

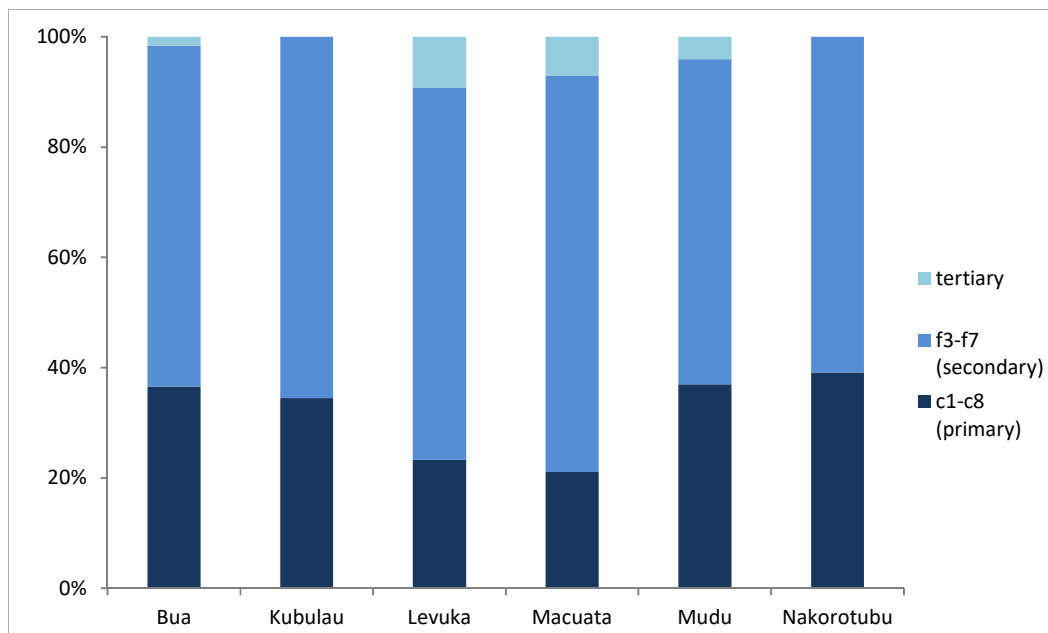Figure 2. Age range of members of households interviewed per district.

Figure 3. Level of education of adults (over 20 years old) in the households interviewed per district.
f=form, c=class

3.2 Livelihoods

The livelihood activities (i.e. the sources of income and subsistence) of households can provide information on the dependence of households on fisheries (i.e. the fraction of households that derive at least some part of their regular income from fisheries), or other sources (e.g. agriculture, wage labour) in each community. In general, it is expected that high levels of resource dependence would increase incentives for communities to invest in managing their LMMA (Ayers and Kittinger 2014; Cinner et al. 2016), but it could also lead to more intense and frequent harvesting to meet local needs (Acheson 2006; Cinner et al. 2012). The livelihood activities can also inform two important aspects related to communities' vulnerability to shocks and stressors. First, households with many livelihood sources (represented here by household income sources) tend to be less vulnerable to shocks (FAO and ILO 2009; Cinner et al. 2013). Second, the dependency of local communities on their natural resources as sources of income and subsistence can have implications on their vulnerability to natural hazards such as cyclones or droughts. Households that are highly dependent on natural resources tend to be more vulnerable to natural hazards (Cinner et al. 2013).

Livelihoods in rural communities in Fiji. Using dried pandanas leaves (voivoi) to weave mats on Koro Island (left, ©Sahar Kirmani/WCS), and spearfishing for food on outer reefs of Ovalau Island (right, @Sangeeta Mangubhai/WCS).

3.2.1 Livelihood diversity

Respondents were asked to list the income sources of their household. In terms of diversity of income sources, a higher proportion of households had only one (34%) or two (35%) sources of income, 28% had between three and four, and 2% had between five and six income sources. The villages with the lowest number of income sources per household were from the districts of Macuata (Daku and Ligau villages) and Levuka (Taviya and Nauouo villages), which had only one or two sources of income (Fig. 4). Daku and Ligau villages are on Kia Island and due to their isolation have few income opportunities. In contrast, communities in Levuka District have more opportunities to be involved in salary employment, due to their proximity to Levuka town. Conversely, the villages with relatively higher number of household income sources were in the districts of Bua (Bua and Dalomo) and Mudu (Tuatua and Nakodu).

Even households with many (five to six) sources of income indicated that most of it was generated by only one or two sources. This means that these households relied mostly on one or two income sources, with the remaining sources providing only supplementary or opportunistic support. Seventy percent of respondents ranked both the contribution of sources of income of their households and stated the proportion of income supplied by each source. Of these, over 40% of these respondents had a single activity providing 100% of the household's income, while the other 60% of respondents had over 60% of their household incomes provided by up to two livelihood activities (Fig. 5). Among those households with a single activity providing 100% of the household income, 21% of them had fishing and 10% had farming as their only source of income. This suggests a low variety of income sources and a strong reliance on few sources in most households surveyed.

Additionally, often several of the income sources listed by 'income diverse' households (i.e., five to six income sources in Fig. 4) had several responses that belonged to the same type of activity. For example, a household would list 'planting *yaqona*' and 'planting *dalo*' as different activities, but these are both farming-related. Therefore, these households tend to be more vulnerable to extreme weather events (e.g. cyclones or droughts) since such events can negatively affect a large proportion of their income and subsistence sources.

Figure 4. Number of income sources in the households interviewed per village.

Figure 5. Percentage of household income obtained from one (in yellow) or two sources (shades of blue).

We asked respondents to rank their income sources, and 183 (83%) respondents answered this question. Very few respondents from Tuatua village answered this question; hence we excluded the data for this village. Figure 6 shows the most important sources of income (i.e. ranked 1) for each household. Overall, fishing (36%, includes collecting and selling sea cucumbers), farming (34%, including crops, copra and animal husbandry) and informal economic activities (14% including weaving, small businesses, vehicle hire, SCUBA diving, lumberjack, carpentry) were the most important sources of household income for the local communities surveyed.

There were notable differences between individual villages. For example, fishing was the dominant source of income in the villages of Daku, Yaru and Ligau, as well as Navatu, possibly due to the limited arable land available in these areas (Fig. 6). Conversely, in Taviya, Arovudi and Nakodu, farming was much more important than fishing as an income source. In Kiobo, Bua, Nabukadra and Nadogoloa villages the proportion of fishing and farming was similar. Dalomo had a higher proportion of households dependent on informal economic activities or pensions, social welfare and remittances. In Nauouo Village there was a much higher proportion of households dependent on salaried employment, possibly due to its proximity with the Pacific Fishing Company's (PAFCO) tuna factory in the main town of Levuka.
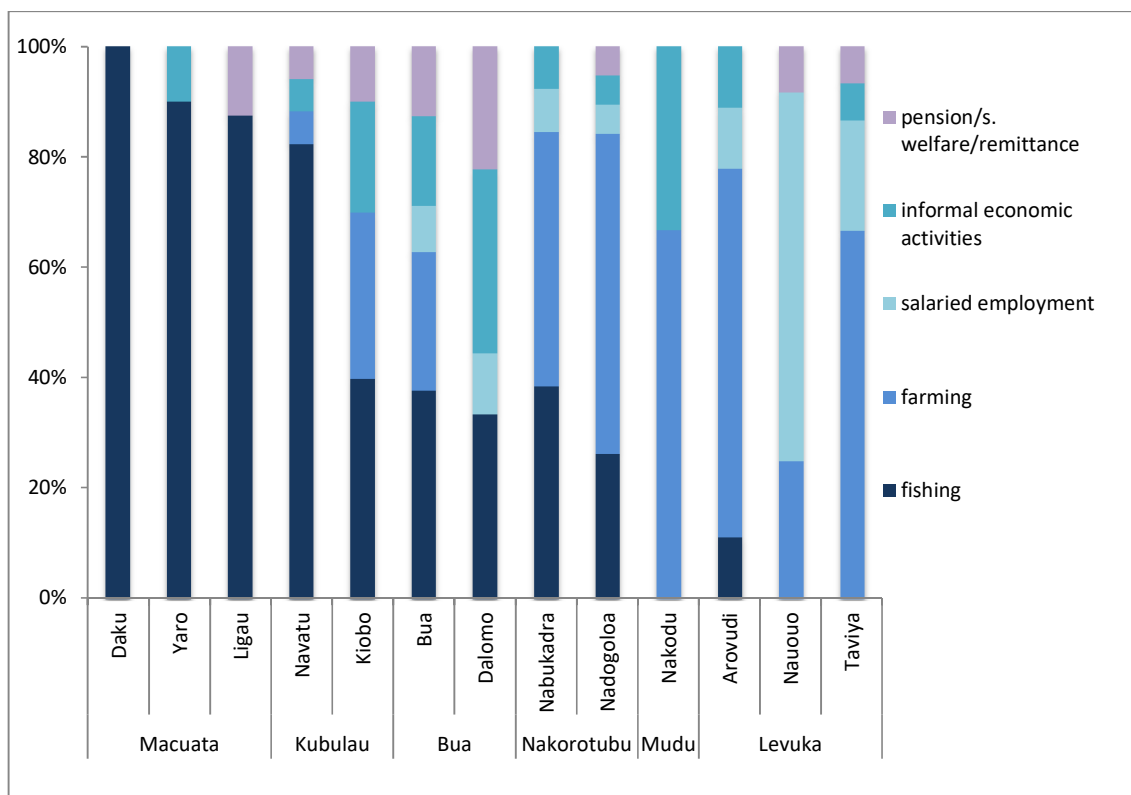

Figure 6. Main sources of income in the households surveyed. Villages are listed by district and level of dependence on fishing.

3.2.2 Dependence on fisheries

The relative proportion of households that sell their fish for income between the villages surveyed (Fig. 7) is similar to the relative proportion of households that have fishing as their main source of income (Fig. 6) for the villages of Yaru, Daku, Ligau (Macuata District) and Navatu (Kubulau District). These villages also have a high proportion of households that have fishing as their only source of income (Fig. 8), highlighting their dependence on marine ecosystems.

Conversely, villages in the Levuka and Mudu districts have low dependence on fisheries as a source of income, notably Nauouo with no respondents fishing for income. These results are not surprising given Mudu District (Koro Island) is relatively far from markets, with only one boat per week to and from Suva. Communities in Levuka District, as discussed earlier have more employment opportunities through Levuka town and therefore less dependent on fishing for household income. Kiobo (Kubulau District) and the villages from Bua and Nakorotubu districts have over 50% of households fishing for income, but their dependence on fisheries is lower since they have alternative income sources such as farming, small businesses and handicraft making

Households were asked to estimate what proportion of their average catch was sold, consumed (subsistence) or traded/given away. The results highlight the importance of fish not only for income but also in the diet of rural communities in Fiji. All villages retained a certain percentage of fish for household consumption, with the highest percentages of the catch consumed in Nauouo, Bua and Taviya villages (Fig. 9).

In contrast, fisheries are an important source of income for households in Macuata District, with the majority of their catch being sold (Figs. 6–9). Two middlemen have been based in Yaro and Ligau villages in Macuata District prior to 2010, buying fish and invertebrates from local communities to sell in Labasa Town. They mostly sold to Gold Hold, a large seafood export company based in Labasa Town. Interestingly, villages where most households depend on fishing for income tended to consume most of their crops for their own subsistence, and vice versa (Figs. 9 and 10). Bua, Kiobo and Nabukadra villages are exceptions since there are similar proportions of households that depend on farming and fishing for income.

Figure 7. Proportion of households that fish for income in the villages surveyed.

Figure 8. Proportion of households that: have fishing as the only source of income ("only fish"); depend on fishing and other livelihood activity for income ("fish and other"); and have their income generated only by activities other than fishing in the villages surveyed ("only other").

Figure 9. The average percentage of fish consumed (subsistence), sold or traded/ given away in the villages surveyed.

Local fishers from Natokalau Village in Kubulau District in Bua Province using local rafts (bilibili) to access inshore coral reefs. ©Sangeeta Mangubhai/WCS

3.2.3 Agriculture

Given the role of farming or agriculture in rural Fiji, households were asked to list and rank the crops they grew. Table 2 shows the items ranked as the most important (i.e. ranked # 1) in the villages surveyed. Overall, cassava (39%) and *dalo,* a popular root crop (38%) were most often ranked as the main crop cultivated by the households interviewed, followed by *bele*, a highly nutritious Fijian spinach (7%). Respondents were also asked to estimate what proportion of crops they consumed, sold or bartered/gave away. Overall, 72% of crops were grown for subsistence, 19% were sold and 9% bartered or given away. Half of the villages surveyed sold less than 10% of their crops and the other half sold between 19–44% (Fig. 10). Up to 21% of crops were bartered or given away as gifts, especially in Daku, Ligau and Dalomo.

Table 2. Fruits and vegetables that communities ranked as the most important (#1) to eat or sell per village surveyed. The columns display th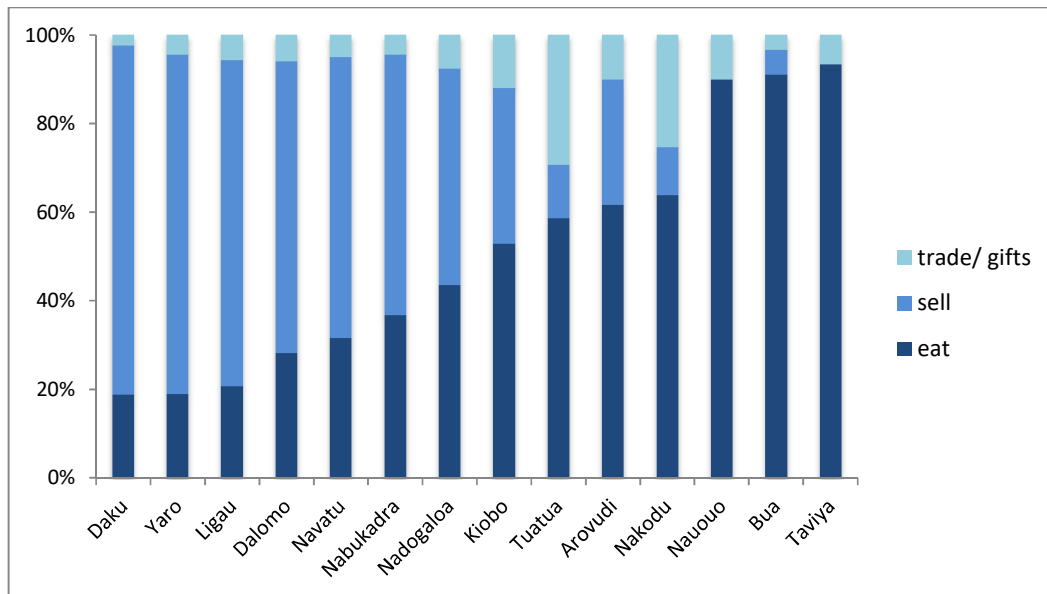e three most cited items per village and the percentage of respondents that ranked each vegetable as #1. * the type of root crop was not specified.

Villages	Main crop 1	Main crop 2	Main crop 2
Bua	Cassava (86%)	*Dalo* (14%)	Yam (3%)
Dalomo	*Dalo* (91%)	*Bele* (9%)	-
Kiobo	*Kava* (55%)	Cassava (27%)	*Dalo* (9%)
Navatu	Cassava (65%)	*Kava* (18%)	Plantain (6%)
Daku	Cassava (100%)	-	-
Yaro	Cassava (90%)	Root crop* (10%)	-
Ligau	Cassava (78%)	*Bele* (11%)	Breadfruit (11%)
Nauouo	*Dalo* (89%)	Tomatoes (11%)	-
Taviya	*Dalo* (55%)	Eggplant (18%)	Cassava (9%)
Arovudi	*Dalo* (86%)	Cassava (14%)	
Nakodu	*Dalo* (88%)	*Bele* (8%)	Eggplant (4%)
Nabukadra	*Dalo* (55%)	Cassava (36%)	*Bele* (9%)
Nadogoloa	*Dalo* (37%)	*Bele* (26%)	Cabbage (16%)
Overall	Cassava (39%)	*Dalo* (38%)	*Bele* (7%)

Figure 10. The average percentage of crops consumed (subsistence), sold or bartered/ given away per household in the villages surveyed.

3.2.4 Expenditures on food

Respondents were asked to list and rank their households' sources of expenditure. Of the 147 respondents who cited 'food' or 'groceries', 90% ranked these items first, 6% ranked second and 4% ranked them third as a source of expenditure. Respondents were also asked what proportion of their household income was spent on items such as groceries, cooking fuel, transport, etc.. The information from Arovudi, Taviya and Tuatua villages were excluded from the analysis due to the low rates of response. We divided the proportions into quarters; the first quarter starting at 10% because no respondent spent less than that on food and/or groceries. Of the 116 respondents who answered this question, most spent between 26 to 50% (59% of respondents) or 51 to 75% (26% of respondents) on food or groceries, respectively. The households surveyed in Daku, Bua and Nabukadra villages spent a higher proportion of their income on food and/or groceries than other villages (Fig. 11).

Figure 11. Percentage of household income spent on food or groceries in the villages surveyed.

LIVELIHOODS: KEY POINTS

- Most households in the villages surveyed had a relatively low diversity of income sources and were highly dependent on only a few livelihood activities.
- Most income and subsistence activities are related to natural resource use (i.e. farming, fishing, weaving and copra).
- Households depend heavily on fishing for incomes were in Daku, Yaro and Ligau villages (Macuata District) and Navatu (Kubulau District). Convers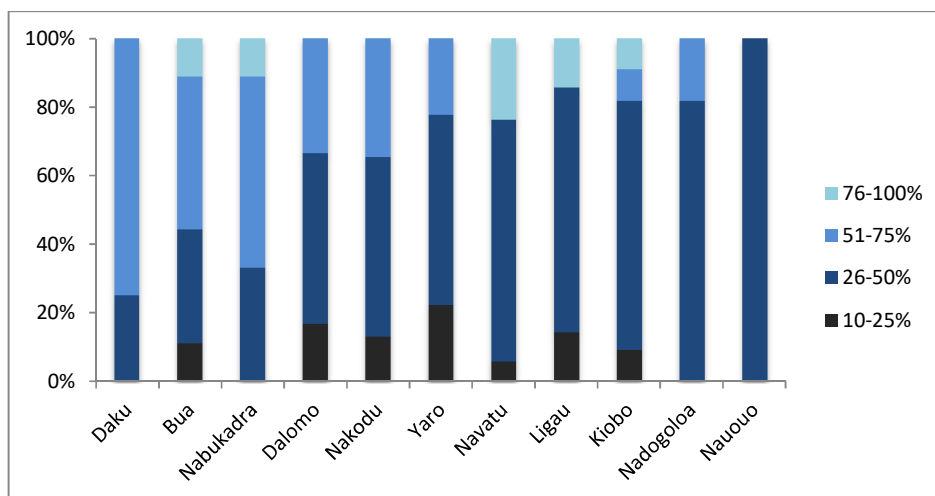ely, Bua and the villages in the Levuka and Mudu districts had low dependency on fisheries as source of income but relied on it for subsistence.
- Farming and fishing seemed to play a complementary role in terms of food and livelihoods. Coastal villages where fishing was not a primary income source relied on fishing for subsistence, and agriculture for livelihoods. Conversely, coastal village where fishing was a primary income source relied on agriculture for food.

The high dependence on fisheries as a source of income in the villages surveyed in Macuata District and Navatu village (Kubulau District) suggests that these communities should have incentives to invest time and effort in managing their LMMA. However, the residents of the villages on Kia Island in Macuata District have largely given up on marine management due to concerns that the benefits from their investment may be appropriated by their paramount chief who has authority to open their *tabu* area for harvesting (Jupiter et al. 2017).

These results also emphasise the significant dependence of households on natural resources as sources of income and their vulnerability to shocks and stressors (e.g. natural hazards or market changes) (FAO and ILO 2009; Cinner et al. 2013).

Kiobo Village in Kubulau District, Bua Province (left, Chris Roelfsema). Nauouo Village on Ovalau Island, Lomaiviti Province (right, ©Stacy Jupiter/WCS)

3.3 Participation and trust

Social capital, meaning the existence and strength of social bonds and norms within a community, has been associated with enhanced management of natural resources, including fisheries (Pretty and Smith 2004, Nenadovic and Epstein 2016). This survey focused on two components of social capital, 'social cohesion' and 'leadership'. Participation and trust are related to social cohesion. In theory, high levels of participation in the community's social and political life and trust contribute to better cooperation, conflict resolution and collaboration with external partners (Gutierrez et al. 2011). Trust can also enhance cooperation and reduce the transaction costs in natural resource management. In communities where trust is high, individuals spend less time monitoring others since they trust that others will act as expected (Pretty and Smith 2004). Trust in leaders can also indicate strong leadership, which was identified by a global study of co-management regimes as the most important attribute contributing to the achievement of environmental and social outcomes in fisheries co-management (Gutierrez et al. 2011). However, other studies did not find a relationship between trust in leaders and management outcomes for small-scale fisheries (Cinner et al. 2012).

A series of questions were asked to determine if household respondents were engaged in their villages' social and political life, and whether they tended to participate in decision-making, with respondents simply answering "yes" or "no" to each question. Overall, most respondents were engaged in community events, organisations, and general decisions. When asked whether they had participated in any community events (outside their family) such as feasts and celebrations in the previous year, 83% of respondents answered "yes". Rates of participation were particularly high in the Macuata, Bua and Kubulau districts (Table 3). Engagement in community organisations was high, with 77% respondents being part of at least one community organisation, and some individuals involved in up to seven different committees. However, levels of engagement differed between districts. Bua and Kubulau presented high rates of engagement (66.8%), but Mudu (especially Nakodu village) and Nakorotubu (especially Nadogoloa village) had rates of engagement in community organisations close to 50% (Table 3).

When asked "*If there is a decision to be made in your community, are you involved?*", 84% of respondents answered "yes". Many contributed through participation in village meetings, on committees, through the *Bose Vanua* (chiefs council)*,* or by holding senior positions in the village, amongst others. However, it was noted that 32 out of 185 (17.3%) "yes" respondents stated they were engaged only passively, and did not speak at village meetings. There was a slightly larger percentage of women (14%) who said they were not involved in community decisions than men (7%), but this was not significant.

In terms of involvement in resource management decisions, only 42% of respondents said "yes". Their involvement was largely through attendance of village meetings, participation in the *Bose Vanua*, or participation in committees (e.g. resource management, *yaubula*, village development). The districts with higher rates of participation were Mudu (57%) and Nakorubutu (52%). The lowest participation rates were in Macuata (69%), especially in Daku and Yaro, (two villages where fishing was the dominant economic activity); and in Kubulau (64%), especially in Navatu, another fishing village.

Overall, the results show that people were generally engaged in their community. However, fewer respondents felt they were involved in resource management decision-making. This is most likely due to the governance structures in Fijian society, where chiefs, chiefly families or specific committee representatives are largely involved in decision making, and where cultural barriers to express opinions openly still exist.

Table 3. The percentage of respondents that had participated in: community events in the previous year; community organisations; community general decisions; and natural resource management decisions in their communities, per district.

Questions/ answers	Macuata	Mudu	Levuka	Nakorotubu	Bua	Kubulau	Total
Community events							
Yes	100	86	60	81	93	89	83
No	0	14	15	16	0	11	10
No answer	0	0	25	3	7	0	7
Community organisations							
Yes	73	52	62	39	93	89	77
No	27	45	13	55	7	11	26
No answer	0	3	25	6	0	0	7
Community decisions							
Yes	100	93	72	84	83	82	84
No	0	7	13	16	17	18	12
No answer	0	0	15	0	0	0	4
Resource decisions							
Yes	31	57	34	52	40	36	42
No	69	43	36	48	60	64	51
No answer	0	0	30	0	0	0	7

Kiobo Village in Kubulau District, Bua Province. Community workshop for natural resource management. ©Stacy Jupiter/WCS
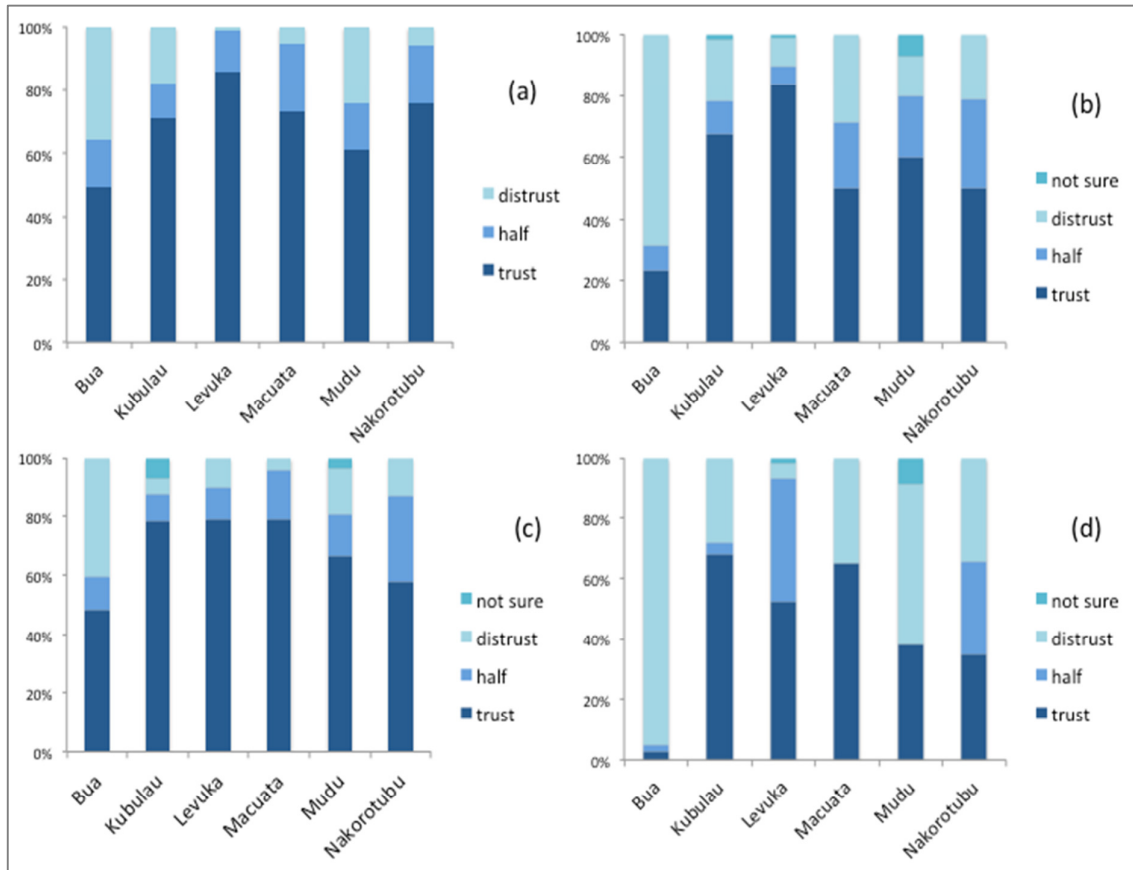
Figure 12. Respondents' levels of trust in (a) people from their own village, including traditional and religious leaders; (b) police and fish wardens; (c) government and NGOs; and (d) people from other villages. Responses are aggregated to district level.

Respondents were also asked a series of questions on trust. They were presented with various actors (e.g. people in their village, government officials, NGO staff) and asked how much they trusted them on a five-point scale: not at all; distrust more than trust; half-half; trust more than distrust; entirely trust; or don't know. For the analysis we simplified these into four categories: distrust, half-half, trust and not sure. To maintain the confidentiality of respondents and avoid the disclosure of sensitive information, the results were aggregated to district level. Additionally, the following groups of actors presented to respondents were merged: people in the village, village leaders and religious leaders; fish wardens and police; government and NGO staff; and people from other villages (Fig. 12).

Respondents' trust in people from their own village was high, with 70% trusting, 15% 'half' trusting, and 15% not trusting each other. Levels of trust in religious leaders were particularly high among this group of actors. The general levels of trust were higher in Nakorotubu and Macuata districts, and lower in Bua District (Fig. 12a). This information suggests that implementing management actions that depend on collective action in the villages in Bua might require additional investment in mediating negotiations and reinforcing social bonds between different groups.

Trust in fish wardens and police was relatively lower, with 57% of respondents trusting, 15% 'half' trusting, and 27% not trusting them. Levels of trust were highest in Levuka and lowest in Bua District (Fig. 12b). The general levels of trust were similar between police and fish wardens. The main difference was that people in Bua (and Macuata to a lesser extent) had a higher level of confidence in fish wardens (and lower in the police), while people from Nakorotubu suggested the opposite. The data that fisheries enforcement actions in villages within the Macuata District could benefit from the inclusion of fish wardens, but enforcement by police seems more acceptable than use of community wardens. Additionally, enforcement actions in Bua might require alternative approaches given the low levels of trust in enforcement agencies.

Respondents generally had high levels of trust in government and NGOs with 68% of respondents trusting, 15% 'half' trusting, and 16% not trusting. The level of trust was higher for NGOs (73% of 'trust' answers) than for government staff (62% of 'trust' answers). Levels of trust were higher in Kubulau, Levuka and Macuata, and lower in Bua and Nakorotubu (Fig. 12c), suggesting that external organisations might require higher investments in building trust when working in the villages surveyed in the latter districts. The lowest levels of trust were in relation to 'people from other villages', with 41% of respondents trusting, 16% 'half' trusting, and 40% not trusting them. Levels of trust were the lowest in Bua and Mudu districts (Fig. 12d).

SOCIAL CAPITAL: KEY POINTS

Levels of participation in the social life of the villages surveyed were high, especially in Macuata, Bua and Kubulau districts. However, levels of participation in the decision-making regarding natural resource management were relatively low, especially in villages where fishing is an important economic activity such as Daku, Yaro and Navatu. This is likely due to the traditional hierarchical decision-making structures in these villages.

In general, levels of trust were highest between people from the same village and local leaders, followed by external partners (government and NGOs), police and fish wardens, and then people from other villages. Confidentiality issues and cultural particularities prevented an in-depth analysis of trust in village leaders (associated with strong leadership). We note however that most *iTaukei* are unlikely to respond that they do not trust their leaders; thus observed responses of half-half indicate that there is probably considerable distrust.

3.4 Fisheries and management

This section provides an overview of fisheries and fisheries management in the villages surveyed. It starts with a general description of the fishing gears used in the villages and their access to ice, middlemen and fish markets. Access to markets (facilitated by access to ice and middlemen) can have a negative effect on the state of reef fishery resource (Cinner et al. 2012) since market demand may drive the overexploitation of resources. However, improved market governance and the use of sustainable harvest certifications can reduce such impacts while enhancing resource users' economic return (Cinner et al. 2012). Additionally, selling fish to middlemen is often associated with lower economic return (as opposed to fishers who sell directly to markets).

Next, the fishing rules in the communities, motivations behind resource protection and respondents' satisfaction with the achievement of management objectives are described. Monitoring and enforcement of rules can have an important impact on compliance and therefore maintenance of marine resources (Jupiter et al. 2017), though perceived compliance may decrease when there are more than two rules in place, as the complexity of regulations can hinder compliance (Cinner and Hutchery 2014). Respondents were also asked about their perceptions of changes in marine resources and whether humans contribute to such changes (human agency). Acknowledgement that humans affect their environment and that management actions can address environmental issues may be linked with a higher likelihood of communities using collective action to manage natural resources (Cinner et al. 2012).

3.4.1 General overview

In this section we describe the general features of fishing activities in the villages surveyed. This study included focus groups and interviews with key informants in all villages surveyed but Arovudi. They provided a range of information that was used to characterize fishing in each village (Table 4). Yaro and Navatu had the highest numbers of fishing boats and licenses, respectively. Key informants confirmed that Nakodu had no commercial fishing activity. This is consistent with Figure 6, which shows no income sources associated with fishing in this village. Most villages had access to at least one middleman but no access to markets, which suggests that the economic return of fishing might be low in most of these villages and dependent on their ability to negotiate prices with middlemen.

The study found that 163 (74%) of the households surveyed reported using at least one type of fishing gear. The villages with the highest proportion (100%) of households that used at least one type of fishing gear were Daku, Dalomo and Navatu. In contrast, the villages with the highest proportion of houses that did not report any gear were Taviya and Arovudi, with less that 40% of households reporting the use of any fishing gears (Fig. 13).

Table 4. Features of fishing in the villages surveyed, including the number of boats, fishing licences, whether the village has access to ice, whether there are middlemen and what they buy (fish and/or invertebrates), whether fishers can sell their catch in a market and where the market is. *The data from Bua and Dalomo are presented together since the two villages are adjacent to each other. Empty cells mean no data were collected. No data were collected for Nadogoloa. invert. = invertebrates. N/A=not applicable and applies to villages that do not sell fish to markets.

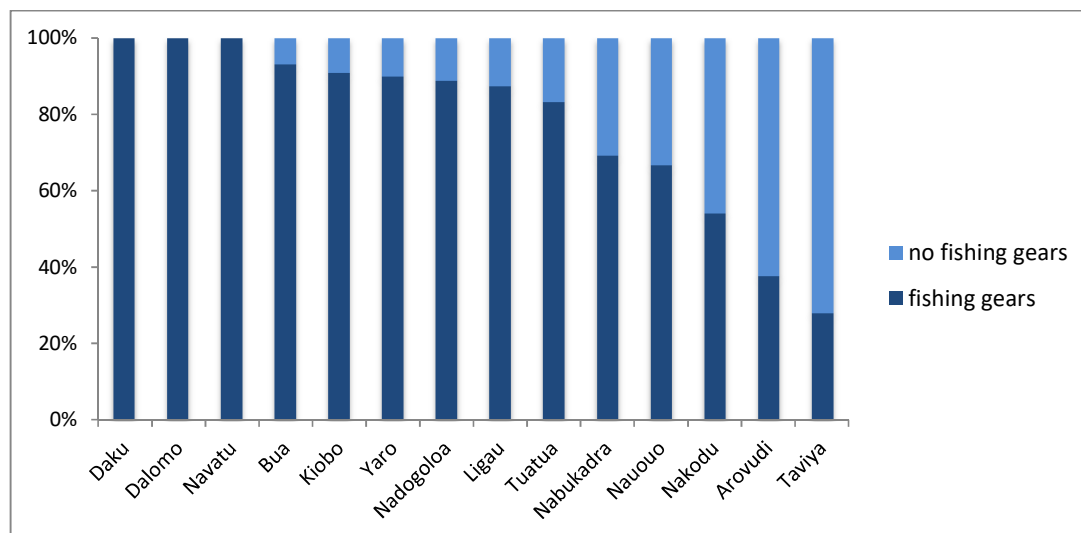| Villages	Fishing boats	Fishing licenses	Ice access	Middleman	Market	Where
Bua/ Dalomo*	12	-	Yes	Fish, invert.	–	–
Kiobo	1	4–5	Yes	Fish, invert.	Yes	Savusavu
Navatu	4	15	Yes	Fish, invert.	No	N/A
Daku	1	3	Yes	Fish, invert.	No	N/A
Yaro	16	10	Yes	Fish, invert.	Yes	Labasa
Ligau	3	3	Yes	Fish, invert.	Yes	Labasa
Nauouo	0	1	Yes	Invert.	No	N/A
Taviya	2	2	Yes	Fish, invert.	No	N/A
Tuatua	1	1	No	No	No	N/A
Nakodu	0	0	No	No	No	N/A
Nabukadra	2	1	Yes	Fish, invert.	Yes	Suva, Korovou

Figure 13. Percentage of households that reported using at least one fishing gear and with no fishing gear in the villages surveyed.

Respondents were asked to list and rank the fishing gear used in their households. The villages with the highest diversity of gear types were Bua (up to 8 types of gear per household) and the adjacent village of Dalomo (up to 7 types per household). Villages with a high percentage of households using only one or two types of gears included Daku, Yaro (two villages where fishing is an important source of income) and Taviya (Fig. 14). A higher diversity of fishing gears can be associated with a higher diversity of marine and coastal ecosystems available for fishers or villages with a higher population or access to greater income. Some of the villages where fishing was a major economic and subsistence activity had a relatively lower gear diversity, suggesting specialisation in a few more lucrative species.
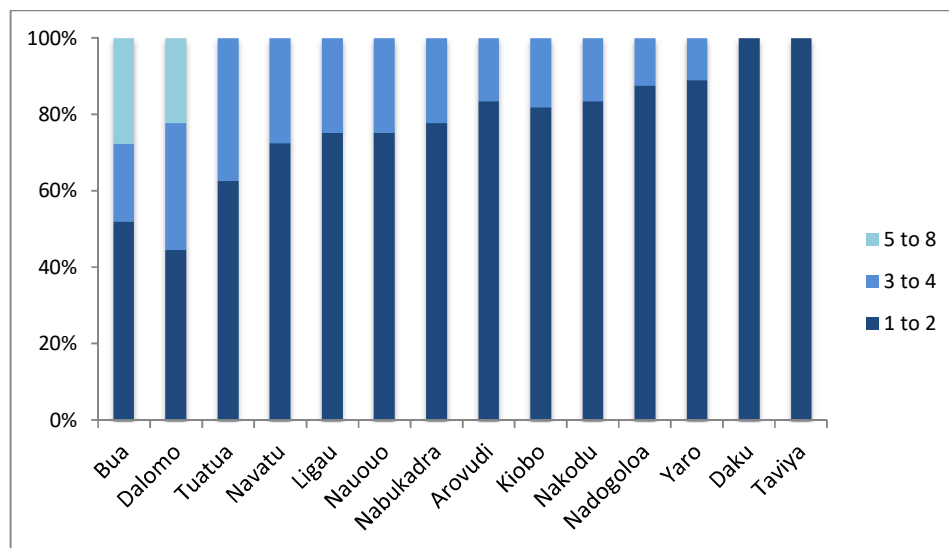

Figure 14. Percentage of households using a low (1 to 2), medium (3 to 4) or high (5 to 8) number of fishing gears in the villages surveyed.

Respondents were asked "*What gear do you or fishing members of your household fish with on most days?*", to which they responded by listing up to three gears. The respondents from Tuatua, Ligau, Nakodu and Yaro did not answer to this question. Overall, the most commonly used fishing gears were handline (46%), speargun (29%) and handnet (9%). In most villages handline was the main fishing gear used, with the exception of Navatu, Dalomo and Daku where at least 50% of households mostly used spearguns (Fig. 15). These results are consistent with recent surveys conducted on fishing gear impacts and losses from Tropical Cyclone Winston (Chaston Radway et al. 2016). The least used gears had less than 3% occurrence and were included in the category 'others' in Figure 17. They included gleaning (only cited in Navatu village), SCUBA gear (only cited in Arovudi) and 'net' (only cited in Bua).

The respondents from fishing households were asked whether there had been any changes in their main fishing gear over the past 10 years. Overall, in 66% of households there had been no change, 13% of respondents did not answer, and in 20% of the households there was a change in main fishing gear. The villages with the highest rate of gear change were

Ligau (86% of households) and Yaro (44%). Those who had changed gear were using, at the time of the survey, a speargun (47%), handline (43%), or handnet (10%).
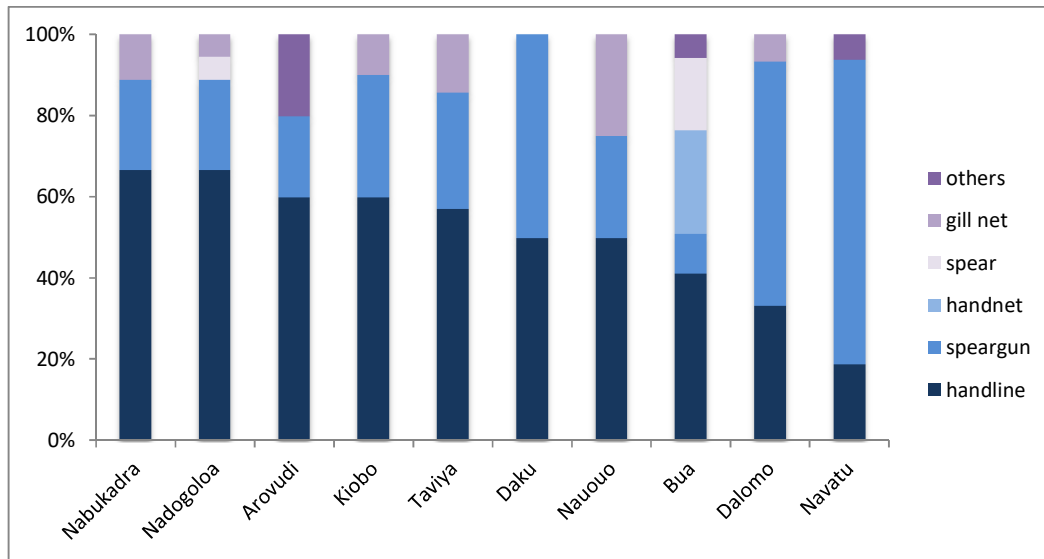

Figure 15. Percentage of the fishing gear considered as the most important in the households surveyed, per village. Respondents from Tuatua, Ligau, Nakodu and Yaro villages did not answer these questions.

3.4.2 Rules and motivations

Respondents were asked questions regarding the types of fishing rules present in their communities. They could list more than one type of rule so Figure 16 portrays the percentages of responses, not respondents. Too few respondents from Arovudi answered this question, and therefore this village was excluded from the analysis. The most common type of rule was to totally or partially restricted access to certain areas (e.g. *tabus*). Closed areas were present in all of the 12 villages but Taviya, whose respondents did not list any fishing rules. Species and gear restrictions were present in eight villages. The species most commonly cited as banned from fishing and eating were marine turtles, followed by the humphead wrasse (known locally as *varivoce*). Respondents tended to be more aware of gear restrictions (31%), *tabus* (30%) and species restriction (16%) than of other types of rules in most villages (Fig. 20), and were cited by a higher proportion of respondents. Also, although *tabu* areas were generally seen as rules developed locally or traditionally, species restrictions were seen as developed by external organisations.
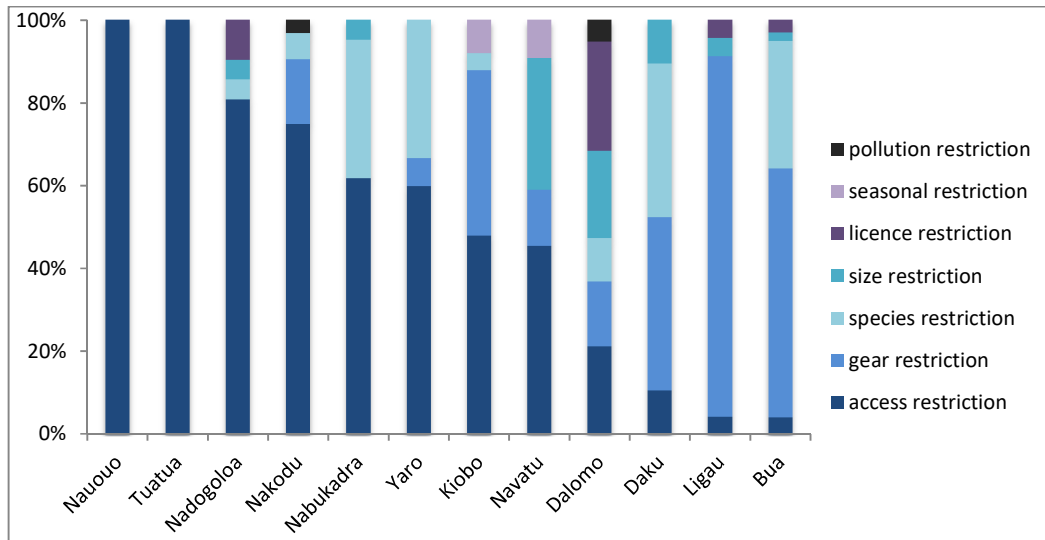
Figure 16. Percentages of responses associated with different types of fishing rules per village surveyed. Taviya was included in the analysis but excluded from this graphs because the respondents from this village did not list any fishing rules.

Respondents were asked who had initiated management in their shared customary fishing ground (*qoliqoli*), and could select from the following options: their community, the *Bose Vanua* or other agency. In the majority of villages management had been initiated by the *Bose Vanua*, with the exceptions of Kiobo and Navatu, where management had been started by the community, and in Ligau, where most respondents stated that management had been initiated by both the community and the *Bose Vanua* (86%) and some said it had been initiated only by the *Bose Vanua* (14%). Respondents were asked about the motivations to create the management rules in place in their community. They were given the list of options below and asked to rank the motivations that applied to their village:

- To have fish for the future;
- Making it easier to catch fish for food or to sell;
- Protect species and habitats;
- Earn money;
- Keep up traditional Fijian practice;
- Keep people from outside of the community from fishing; and
- Improve how the community works together.

The motivation most commonly ranked first was "to have fish for the future" (75%), followed by "protect species and habitats" (8%) and "making it easier to catch fish for food or to sell" (8%) (Fig. 17). In Kiobo, a higher proportion of respondents ranked "protecting species and habitats" first; in Arovudi and Yaro "making the fish easier to catch" was cited as a primary motivation for many respondents; and the same was true for "earning money" in Navatu and "improving how the community works together" in Tuatua.

When asked whether the objectives listed above were being met, most respondents responded ''yes'' (51%); 28% considered that the objectives they listed had been partially

met; and 21% considered that they were not being met. The level of respondents' satisfaction with the objectives they ranked per village is depicted in Figure 18, and each respondent could refer to more than one objective. The level of satisfaction (i.e. percentage of "yes") was highest in Ligau, Navatu, Bua and Kiobo. Conversely, the lowest satisfaction rates (i.e., percentages of "no") were in Daku, Nadogoloa, and Arovudi.
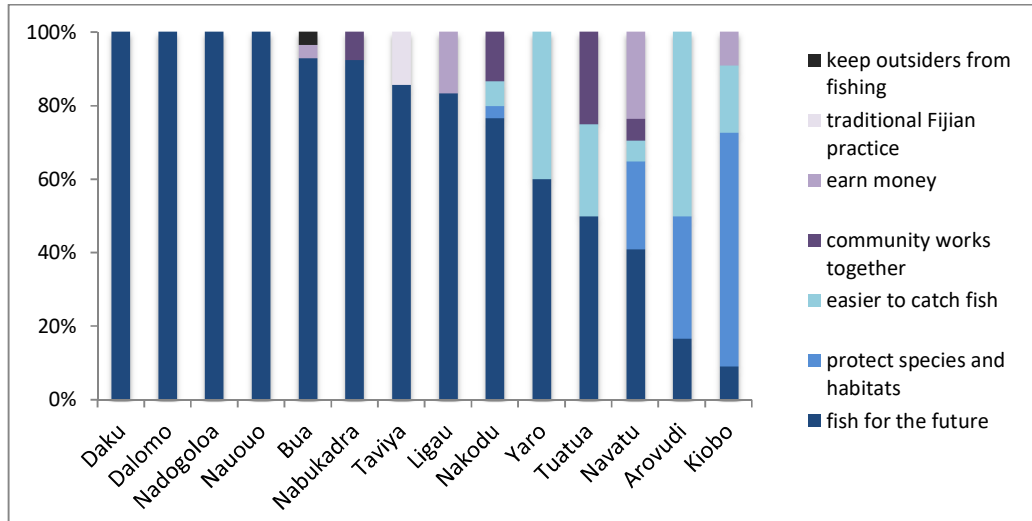

Figure 17. Motivations to create the management rules ranked #1 by respondents in the villages surveyed.
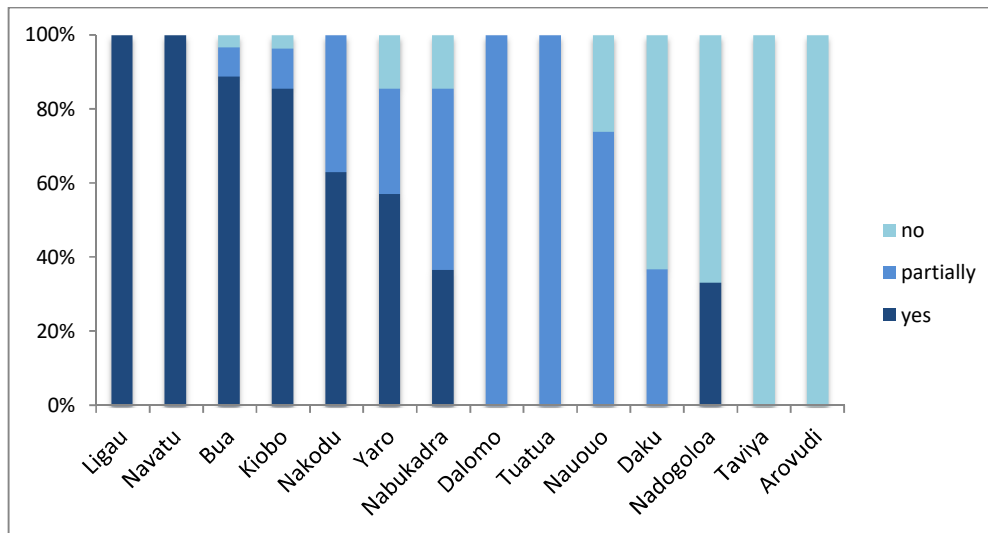

Figure 18. Percentages of levels of satisfaction with the accomplishments of fisheries management objectives in the villages surveyed.

3.4.3 Monitoring and enforcement

Monitoring of rules via fish wardens was present in all villages but in Nauouo (Jupiter et al. 2017). To gain a better understanding of the level of compliance with fishing management rules and peoples attitude towards it in the villages surveyed, respondents were asked several questions regarding perceived compliance and their reactions to people breaking the fishing management rules in their village. First, when respondents listed the fishing management actions in their village they were also asked whether people break such rules, and given a choice between 'no', 'just a few', 'most' or 'everyone'. Arovudi and Tuatua were excluded from this analysis because less than 50% respondents answered this question, and Taviya was excluded because there were no fishing rules in place.

In general, most respondents believed that no one broke the rules (39%), closely followed by 'just a few' people (38%), 'most' (22%), and 'everyone' (1%). Figure 19a depicts the perceived levels of compliance per village surveyed, including all types of fishing management rules in place. There were noteworthy differences between villages: Nakodu and Navatu were perceived to have generally good levels of compliance, whereas Yaro, Nauouo, Daku and Dalomo had lower perceived levels of compliance.

Respondents were then asked if they had seen people breaking those rules, with respondents able to answer for more than one type of rule in their village. Overall, respondents had not seen anyone breaking most rules (57%). The patterns of compliance per village are similar to those presented in Figure 19a with the exception of Yaro which had the highest perceived levels of non-compliance but very few people admitted to actually seeing others breaking the rules (Fig. 19b). These data are not very surprising, since compliance is a delicate issue and although the interviews were confidential people tend to be reluctant to provide detailed information about others breaking the rules especially in villages where fishing is an important economic activity such as in Yaro village.

Table 5 presents the perceived levels of compliance for the main types of fishing management rules: access (*tabus* and MPAs), gear, size and species restrictions per village surveyed. The table highlights cases where there is particularly high (blue) or low level of perceived compliance (pink). The type of rule that has the lowest levels of perceived compliance in most villages is access rules (*tabus* and MPAs). The table also presents the information from focus groups with key informants, who were asked to assess the levels of compliance in their village *tabu* using the following scale:

- Very bad (people are constantly fishing inside the *tabu*)
- Bad (people are often fishing inside the *tabu*)
- OK (people occasionally fish inside the *tabu*)
- Good (people are infrequently fishing inside the *tabu*)
- Total compliance

If the key informants perceived a "very bad", "bad" or "OK" level of compliance they were also asked whether villagers, outsiders or both broke the rules. The perceptions of household respondents generally agreed with the data provided by key informants

regarding the levels of perceived compliance in the *tabu* areas except in Navatu, where key informants associated a total level of perceived compliance with the *tabu* but some respondents perceived that a few people still fished in that area (Table 5). Daku, Yaro and Ligau, villages where fishing is a major source of income, had the lowest levels of perceived compliance.

Last, respondents were asked how they reacted when they saw people breaking the rules: participated, confronted them, reported to the chairman, reported to the fisheries officer, reported to the village official, reported to the person affected by the rule (owner), told friends or did nothing. Respondents could select more than one action. Arovudi, Kiobo, Nakodu, Navatu, Taviya and Tuatua were excluded from the analysis since they had less than 50% of responses. The most common action was to report the offender to the village official (39%), followed by 'confront them' (21%) and report them to the fisheries officer (12%).
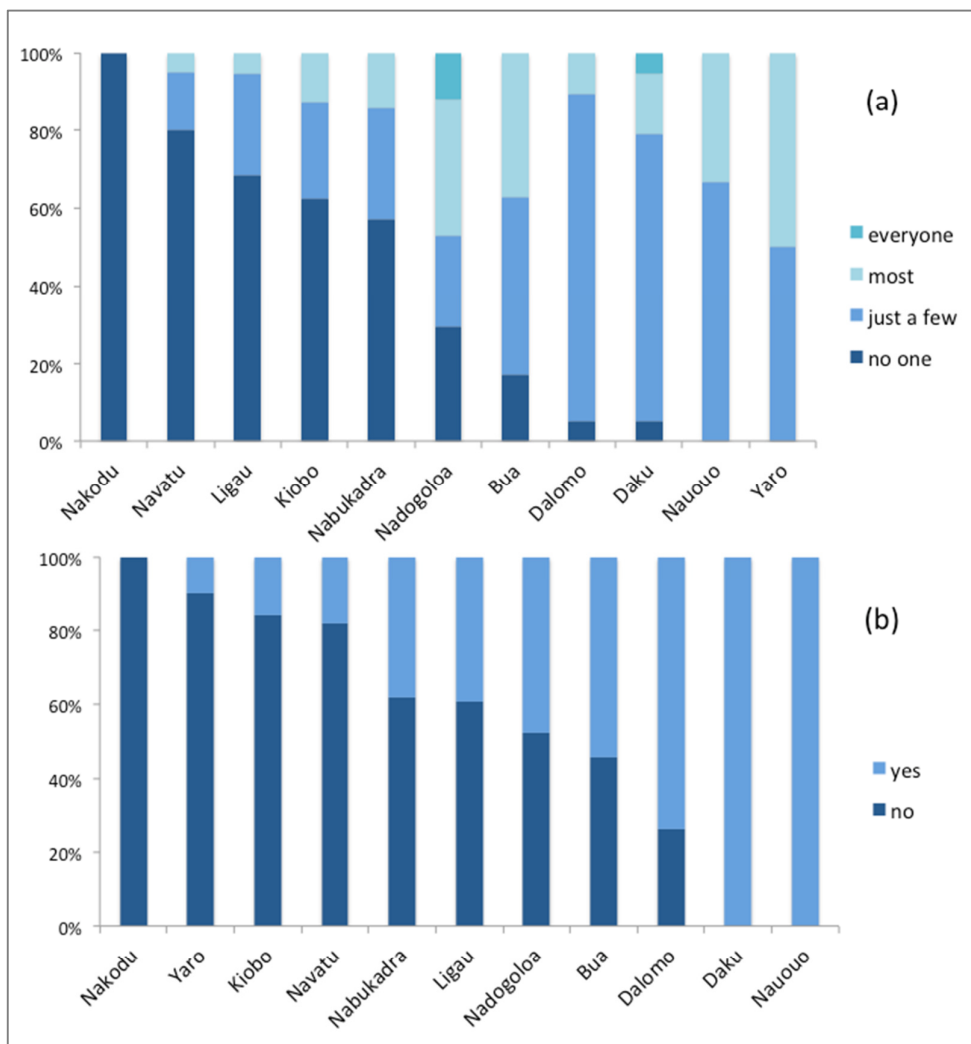

Figure 19. (a) Percentages of respondents that considered that no one, just a few people, most people or everyone broke fisheries management rules in their villages; (b) percentages of respondents who had or had not seen others breaking fishing management rules in the villages surveyed.

Table 5. Types of fishing management rules and percentages associated with the perceived levels of compliance, or 'who breaks the rule', associated with each type of rule by household survey respondents (no one, a few, most, everyone). Particularly high (green) and low (pink) levels of compliance are highlighted in each village. The right side of the table contains the perceived level of compliance (Compl. level) with *tabus* and whether villagers, outsiders or both break the rules. Results are presented by village surveyed, ordered according to districts.

	Type of restriction	Household respondents				Key informants	
		No one	A few	Most	Everyone	Compl. level	Who breaks rule
Kiobo	access	43%	36%	21%	0%	OK	Both
	gear	89%	11%	0%	0%		
	species	100%	0%	0%	0%		
Navatu	access	64%	27%	9%	0%	Total	N/A
	gear	100%	0%	0%	0%		
	size	100%	0%	0%	0%		
Bua	access	11%	37%	53%	0%	Bad	Outsiders
	gear	10%	39%	51%	0%		
	size	100%	0%	0%	0%		
	species	29%	61%	11%	0%		
Dalomo	access	0%	80%	20%	0%	Bad	Outsiders
	gear	50%	50%	0%	0%		
	size	0%	100%	0%	0%		
	species	0%	50%	50%	0%		
Daku	access	0%	43%	43%	14%	Very bad	Both
	gear	33%	67%	0%	0%		
	size	0%	100%	0%	0%		
	species	0%	100%	0%	0%		
Yaro	access	0%	33%	67%	0%	Very bad	Both
	gear	0%	100%	0%	0%		
	species	0%	100%	0%	0%		
Ligau	access	50%	33%	17%	0%	Very bad	Both
	gear	82%	18%	0%	0%		
	size	100%	0%	0%	0%		
Nauouo	access	0%	67%	33%	0%	Bad	Outsiders
Nakodu	access	100%	0%	0%	0%	Total	N/A
	gear	100%	0%	0%	0%		
	species	100%	0%	0%	0%		
Nabukadra	access	46%	38%	15%	0%	Bad	Outsiders
	size	100%	0%	0%	0%		
	species	71%	14%	14%	0%		
Nadogoloa	access	29%	24%	35%	12%	No answer	Outsiders

3.4.4 Human agency and changes in marine resources

A series of questions were asked regarding respondents' perceptions of changes in marine resources, the causes of those changes and how respondents would react to hypothetical changes. In order to elicit people's perceptions of changes in natural resources and ecosystems in the villages studied, respondents were also asked about such changes over the previous 10 years in their area. These included changes in: total catch, fish abundance and size; the size and abundance of invertebrates; and the condition of reefs, seagrass beds and mangroves. Overall, most respondents considered that the changes had been positive and the condition of resources had improved (Table 6). The percentages of 'increased', 'decreased', 'no change' and 'don't know' responses were very similar across all resources. However, the proportion of 'increased' and 'decreased' responses for the size and abundance of invertebrates was very similar; and a high proportion of respondents did not know if the condition of mangroves had changed (Table 6).

There were substantial differences in perceptions between the villages surveyed, but the patterns of perceived change were generally consistent among groups of villages. For example, in Nakodu, Nabukadra, Nauouo and Bua the majority of respondents considered that their catch had increased over the previous ten years (Fig. 20a). In general respondents from these villages were also optimistic regarding the changes in other resources presented in Table 5. Conversely, most respondents from Arovudi, Taviya, Daku, Nadogoloa and Ligau stated that their catch had decreased (Fig. 20a), and generally exhibited a similar pattern regarding other resources. In Navatu and Yaro almost half the respondents believed that there had been no changes to their resources.

Table 6. Respondents' perception of changes in natural resources in their area in the past 10 years.

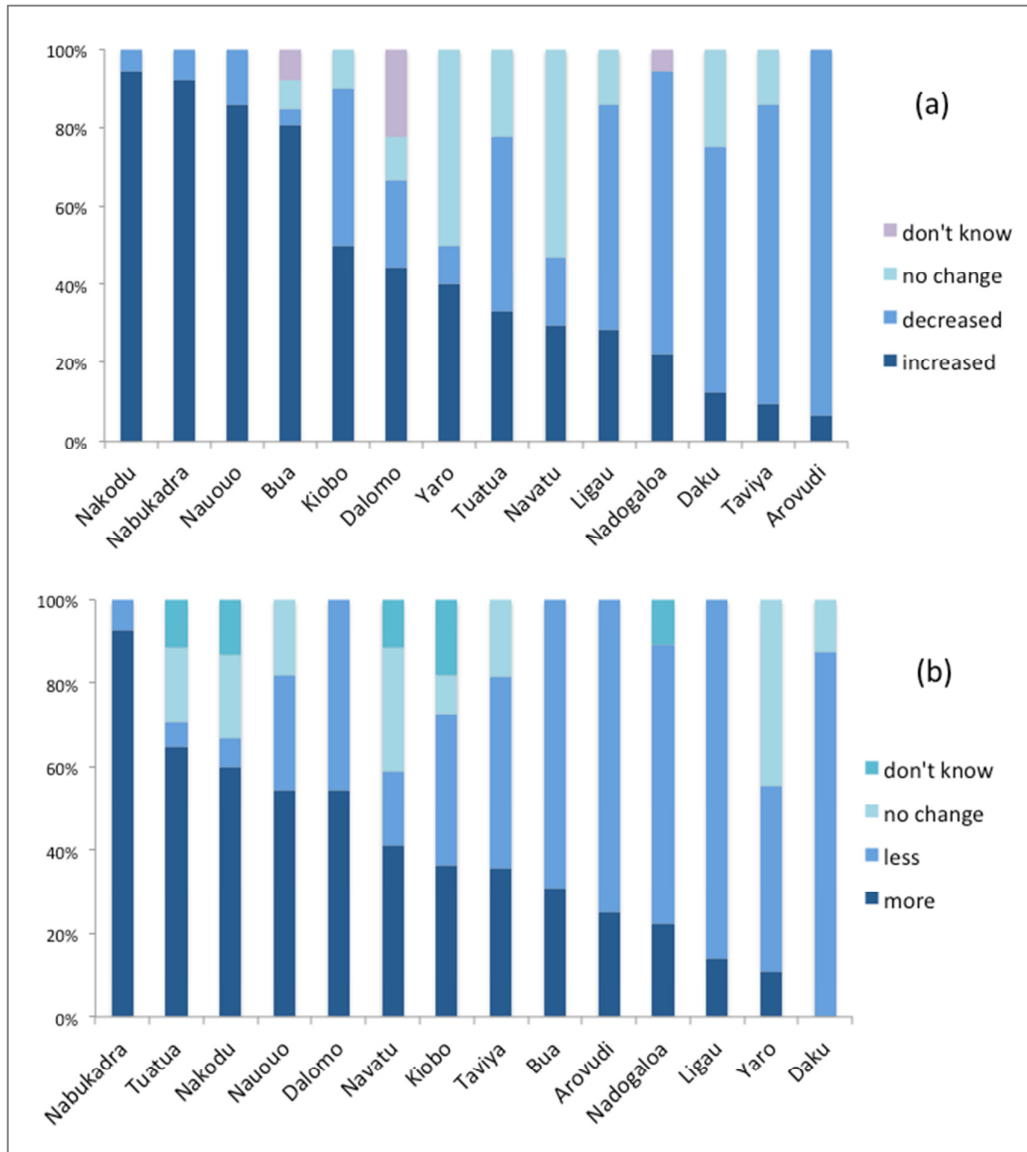| Resource	Increased	Decreased	No change	Don't know
Total catch	45%	38%	14%	2%
Fish abundance	49%	36%	13%	2%
Fish size	48%	38%	12%	2%
Invertebrate abundance	41%	38%	13%	7%
Invertebrate size	41%	39%	13%	7%
Reef condition	37%	34%	14%	14%
Seagrass condition	39%	26%	16%	17%
Mangrove condition	35%	19%	13%	32%

Figure 20. (a) The percentages of respondents that considered that their catch had increased, decreased, not changed in the previous 10 years, or did not know; (b) percentages of respondents that considered that the quantity of fish had decreased (less), increased (more) or not changed in the previous 5 years, or who did not know. Percentages are per village surveyed.

When asked whether there were more or less fish in the reef compared with 5 years before, 45% of respondents thought there was less fish, 37% thought there was more fish, 12% thought that there had been no changes, and 5% did not know. When excluding the answers of non-fishers these proportions remain very similar, with a slight decrease in the 'don't know' answers. The overall pattern between villages is similar to the perceived changes in catch presented in Table 5. The patterns between villages are also similar to the perceptions of catch: although a large majority of people in Daku and Ligau (two major fishing villages) considered that there were fewer as less fish, most people from Nabukadra, Nakodu and Tuatua thought that the amount of fish had actually increased (Fig. 20b).

Respondents from Yaro displayed a different pattern: 40% of respondents considered that their catch had increased in the past 10 years, but only 11% believed that there was more fish compared with 5 years before the survey and 44% thought there was less fish. This pattern makes sense considering that the increases in catch during the previous decade could have negatively affected the availability of fish.

When discussing the potential reasons for increases in catch, 82% of respondents referred to the effects of existing *tabus*; only 2% referred to other fisheries management strategies (changes in gear); 4% referred to environmental factors such as the weather; and 12% attributed changes to other causes. When discussing the causes of decreases in catch, 57% believed that these were result of overfishing or an increase in fishing pressure; 20% attributed changes to other fishing practice (e.g. increased use of destructive or more efficient fishing gears, or poaching); 5% thought that these were result of environmental factors; and 18% discussed other causes such as an increase in population or people littering the sea.

Respondents were asked about what could affect the number of fish on the reef and given four options: people, God, the environment (e.g. storms, weather, seasons) or other causes. The majority (68%) considered that people alone caused changes to fish on coral reefs; 17% attributed changes to environmental factors; 3% considered that changes were a direct result of God's will; 12% thought that both people and environmental factors affected the abundance of fish; and 2% attributed such changes to a combination of the factors. These proportions were similar in all villages, but in Ligau and Nakodu 100% of respondents cited 'people', and in Navatu and Nabukadra over 50% of respondents attributed changes primarily to environmental factors.

When asked about what could be done to increase the number of fish in the reef, almost all of the 163 respondents to this question (90%) mentioned some type of fisheries management action. Of those, 63% referred to the creation of either *tabus* or MPAs, and the other 23% suggested other fisheries management actions such as gear restrictions or better enforcement. The remaining 10% referred to educational or awareness raising actions, the creation of alternative sources of livelihoods and improving religious practices. The latter included actions such as "reconnect with God" and "protect God's creation". Only one person proposed "do nothing" as a solution. The information above suggests that, in general, respondents consider that peoples' actions and fishing practices can affect the number of fish. Additionally, in areas where they perceive a decline in fish, respondents could be open to discussing fisheries management actions to address such declines.

Lastly, the respondents from households where fishing was a source of income or subsistence were asked what they would do if there was a 50% decrease in fish catch for an entire year. Seven options were given to choose from: (i) keep fishing the same amount; (ii) fish harder; (iii) fish less; (iv) move locations; (v) change gear; (vi) leave the fishery; or (vii) other/unsure. Overall, most respondents said they would move locations (47%), leave the fishery (23%) or change gears (9%). In general, respondents in the villages where fishing is a major source of livelihood (Daku, Yaro, Ligau and Navatu) tended to be reluctant to fish less or leave the fishery, opting for strategies such as 'move locations', 'change gear' or 'fish

harder' (Fig. 21). Conversely, respondents from villages where fishing was only for subsistence (e.g. Nauouo, Nakodu and Taviya) were more likely to leave the fishery or fish less. This resistance to shifting livelihoods could reflect the lack of alternative sources of income in fishing villages, the strong dependence coastal villages have on fish as a major protein source, and/or the strong sense of identity that fishers tend to have associated with fishing.
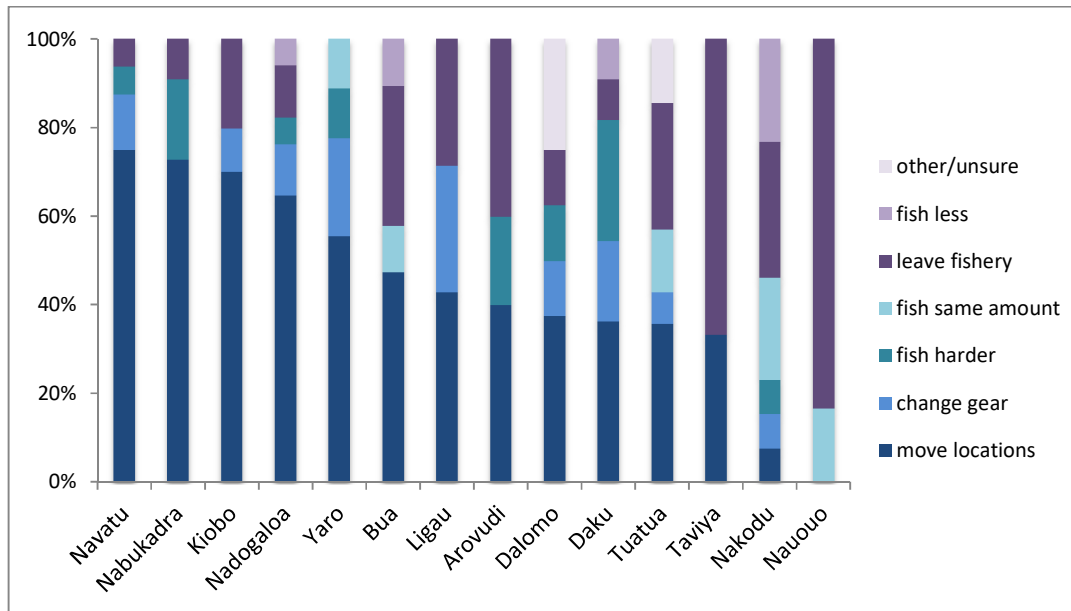

Figure 21. Percentages of respondents that would take different strategies in case their catch diminished by 50% over a year, per village surveyed.

However, the results of this hypothetical situation do not necessarily reflect the actual circumstances identified in this survey. Even though several respondents considered that there had been a decrease in the number of fish in the previous 5 years (Fig. 20b), this study found no evidence of fishers actually shifting livelihoods. When asked about work other than their current main occupation that they had in the past 5 years, only one respondent said he had stopped fishing, and he had only done so because he felt he was too old to fish. Therefore, the information on potential strategies presented above needs to be considered with caution and further investigated by resource owners and managers before being used to support management decisions.

Respondents were asked whether they could change fishing management rules in their villages, and the majority (74%) reported that they could not change the rules. Arovudi and Taviya were excluded from the analysis because there were too few respondents (<50%) that answered this question. A high proportion of respondents in Ligau, Yaro and Navatu felt that they could not change fishing management rules (Fig. 22). Fishing was a major economic activity in these three villages (Fig. 6); there was high satisfaction with management achievements (Fig. 18) and the community had major input in the development of fishing rules according to participants. Conversely, most respondents in Nauouo, Nabukadra and Nadogoloa thought that they could change such rules.
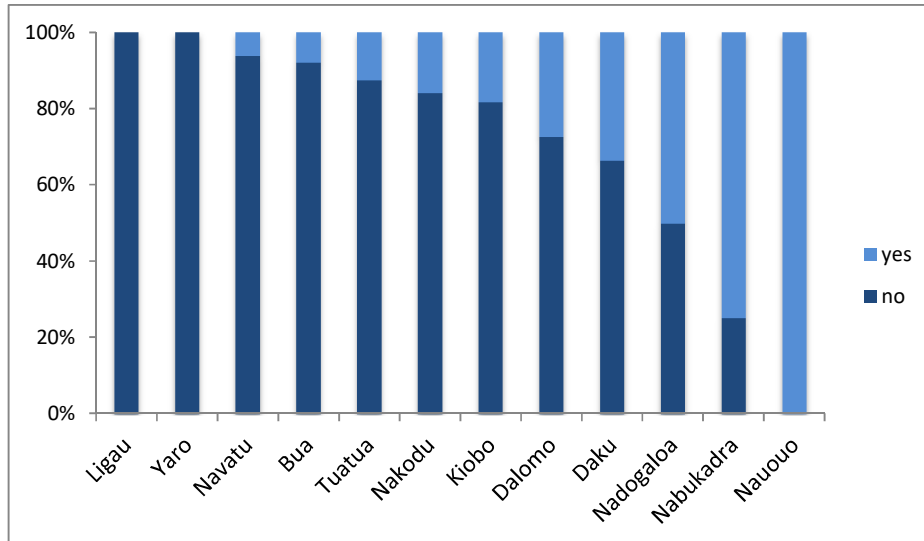
Figure 23. Percentages of respondents that thought they could or could not change fishing management rules in the villages surveyed.

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FISHERIES: KEY POINTS

Even though most villages did not have direct access to market, the presence of middlemen in all villages but Tuatua and Nakodu means that there is a market demand for fish in most villages and the economic return is lower than if sold directly to consumers.

All villages but Taviya had fishing rules, whose main aim was to protect marine resources ('to have fish for the future' and 'protecting species and habitats'), followed by 'making the fish easier to catch'. Perceived levels of compliance varied between villages and fishing rules, with lowest compliance in relation to access rules (e.g. *tabus* and MPAs).

Regarding human agency, most respondents perceived changes in the marine environment and attributed such changes mainly to human actions. However, respondents in the villages that rely mostly on fishing for their livelihoods believed that they do not have power to change fishing rules, which suggests that collective action for resource management in the villages might have lower levels of participation.

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3.5. Food security and diet diversity

Household food security can be defined as "the ability of families to access safe, sufficient and nutritious food" (Darling 2014). The appropriate management of fishing resources can lead to a higher availability of quality animal protein (e.g. fish and/or marine invertebrates), therefore enhancing food security. Ultimately, food security can be an indicator for livelihood and well-being outcomes associated with successful fisheries management; however, the inference of a causal relationship between fisheries management and food security is beyond the scope of this report, particularly as it may be affected by other external factors such as trade (Fabinyi et al. 2017).

The methodology described in Darling (2014) was adapted to measure: (i) the diversity of major food groups in households' diets; (ii) the consumption of whole and processed foods; and (iii) respondents' perception of their household's ability to have enough food and eat balanced meals.

Respondents were asked how often the statement "*I/we were worried that we might not have enough food for everyone in the household*" was true for their household in the last 12 months. Of those interviewed, 149 respondents (67.7%) answered this question. Less than 50% of respondents from Arovudi, Taviya, Tuatua and Nauouo answered this question so their responses were excluded from analysis. Overall, 62% of respondents had never worried about not having enough food, 37% sometimes worried and only 1% worried often. A higher proportion of households in Dalomo, Bua and Daku had sometimes worried about not having sufficient food, but the great majority of households in Kiobo, Nakodu, Navatu and Ligau did not have such concerns (Fig. 24). We note, however, that there are cultural sensitivities around divulging this type of information (Sterling et al. in press), thus the above results should be interpreted with caution.
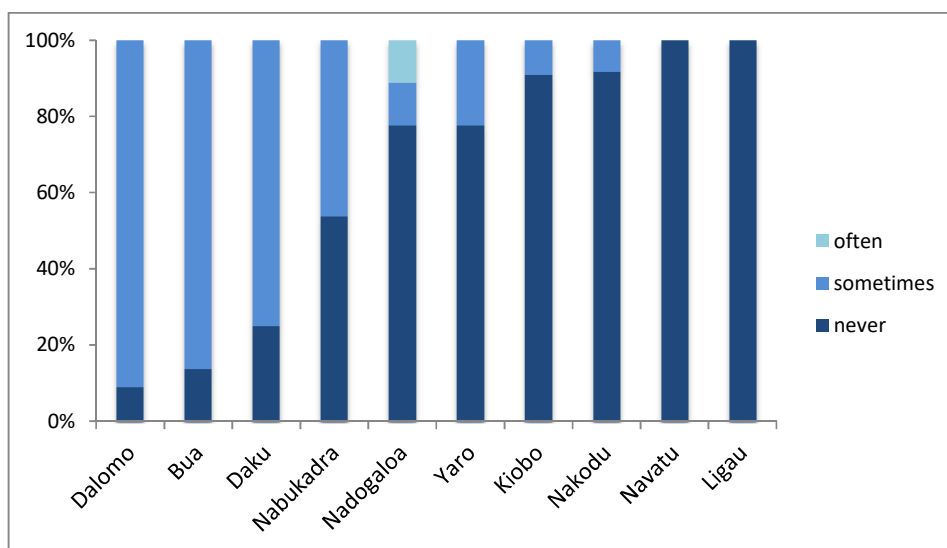

Figure 24. Percentage of houses that worried 'often', 'sometimes' or 'never' about not having sufficient food in the 12 months before the survey per village surveyed.

Consumption was assessed through a 24 hour recall of the food prepared by the family, from which we calculated a 7-point diet diversity score. The food prepared by the household was classified into 7 main food groups: (1) starchy staples (grain, roots or tubers); (2) legumes; (3) dairy; (4) meat, poultry, fish, or eggs; (5) vitamin A-rich fruits and vegetables; (6) other fruits and vegetables; and (7) foods made with oil, fat, or butter. The diet diversity score was a number from 0 (no food groups present in diet during the 24h diet recall) to 7 (all food groups present in diet).

The 24 hour recall method is suitable to provide a general overview of household food consumption in large scale surveys, but there are limitations intrinsic to this method; for example, the food consumed in a single day is seldom representative of a household dietary diversity due to day-to-day variation. We aimed to address such limitations by triangulating the recall method with questions on food diversity (i.e. ability to have balanced meals, below). There were also limitations associated with our data collection: the original methodology requires that the female head-of-household be interviewed because women are often the ones cooking, but over 50% of people surveyed were males.

Figure 25a presents the average number of food groups per household per village (in red), and the proportion of households with a low (1 or 2 groups), medium (3 to 4 groups) or high diversity score (5 to 6 groups). Two villages in the Macuata District (Yaro and Daku) had low averages and a high proportion of households eating only one or two food groups. On the other hand, the villages in the Nakorotubu (Nabukadra and Nadogoloa) and Bua districts (Bua and Dalomo) had higher averages and a larger proportion of households eating a higher diversity of food groups.

There were four noteworthy results regarding the consumption of specific food groups:

- *Legumes:* the great majority of households surveyed (87%) had not consumed any legumes in the previous 24 hours. The exceptions were Nadogoloa and Nakodu with around 30% of households having consumed one type of legume.

- *Vitamin A-rich fruits and vegetables*: 30% of households had not consumed any vitamin A rich fruits and vegetables, and 49% had consumed only one type. Daku (75%), Yaru (56%) and Navatu (53%) had the highest percentage of households that had not consumed any vitamin A rich fruits and vegetables in the 24 hours preceding the survey; in those villages, none of the households interviewed had consumed legumes in the 24 hours preceding the survey. This can be related to the fact that these villages had fishing as their main source of income (Fig. 6) and relied on farming mostly for subsistence (Fig. 7a).

- *Meat, poultry, fish and dairy:* most households had consumed at least one type of animal protein in the previous 24 hours, with the exception of 56% of households in Tuatua, 36% in Taviya and 29% in Nakodu. Additionally, less than half of households in these villages had consumed fresh fish and/or invertebrates in the previous 24 hours (Fig. 26). This may be related to the fact that both Taviya and Nakodu had farming as their main income source (Fig. 6) and relied on fishing mostly for subsistence (Fig. 7b). Conversely, villages where fishing was a major source of income had a higher

proportion of households where at least one portion of fresh fish and/or invertebrates was consumed in the previous 24 hours (Fig. 26).

- *Whole versus processed foods:* we estimated the proportion of whole and processed foods consumed by the households surveyed. Overall, 50% of the households consumed a much higher proportion of whole rather than processed foods (over 75% of whole foods), and less than 10% of households had a proportion of processed food over 50%.
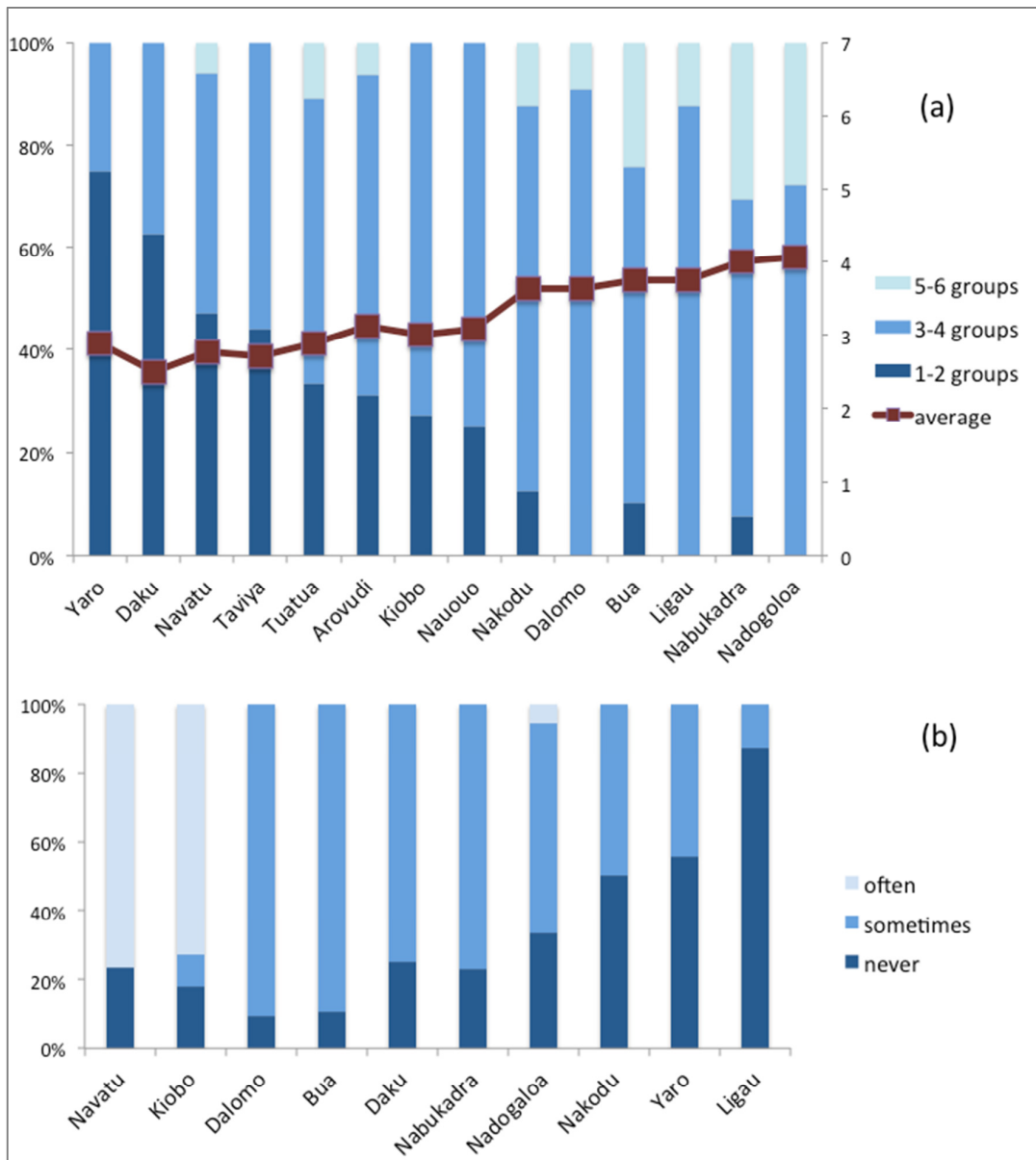

Figure 25. (a) Percentage of households with a low (1 or 2 groups), medium (3 to 4 groups) or high diet diversity score (5 to 6 groups) per village (left horizontal axis); and average diet diversity score per village (right horizontal axis). (b) Percentage of households that worried 'often', 'sometimes' or 'never' about not eating balanced meals in the previous 12 months per village surveyed.
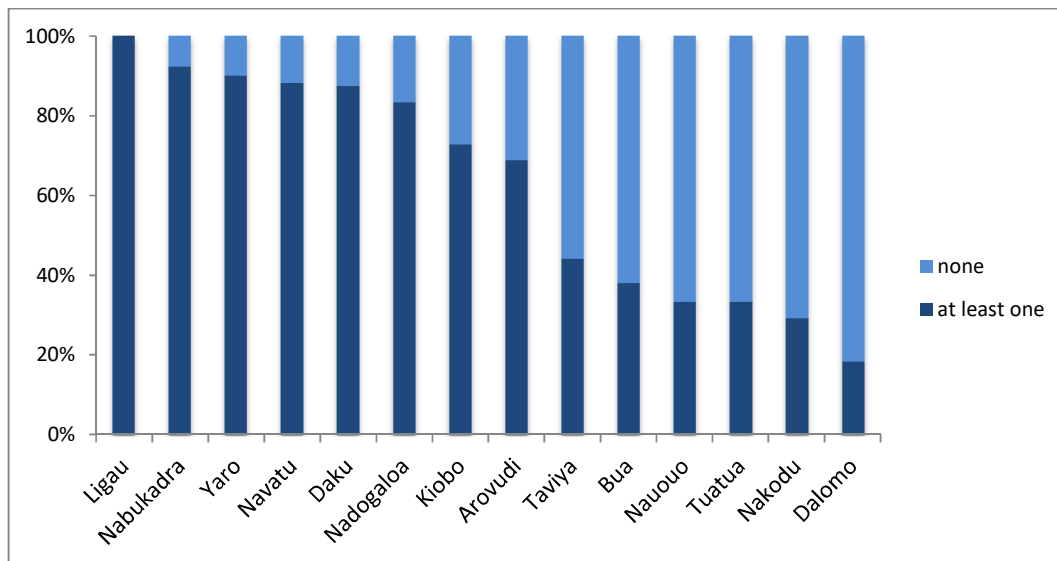
Figure 26. Percentage of households that had none or at least one portion of fresh fish and/or invertebrates present in the 24 hour recall. Results are per village surveyed.

Respondents were asked how often the statement "*I/we couldn't eat balanced meals*" was true for their household in the last 12 months. A total of 147 respondents (66.8%) answered to this question, and the data from Arovudi, Taviya, Tuatua and Nauouo were excluded from analysis given the low response rates. Overall, 31% of respondents had never worried that they could not eat balanced meals, 54% sometimes, and 15% often had. There were marked differences between villages: in Navatu and Kiobo (Kubulau district) a high proportion of respondents often worried that they could not eat balanced meals; Dalomo and Bua (in Bua district), Nabukadra and Nagolodoa (in Nakorotubu district), eating balanced meals was a sometimes a concern; and in Nakodu, Yaro and Ligau there was a relatively higher proportion of respondents that never had such concerns (Fig. 25b).

This information is somewhat in agreement with the data provided in Figure 25a. Navatu and Daku had a high number of households with low diet diversity scores as well as households often worrying about eating balanced meals, while the households of Ligau had higher diversity scores and were least concerned. However, even though places like Nabukadra, Nadogoloa, Dalomo and Bua had a high proportion of medium and high diet diversity scores, most respondents tended to express concerns about eating balanced meals sometimes or often. Such divergences can be explained by several factors.

First, Fijian villages tend to have a significant variation in food diversity over a week. The best, most diverse meals are on Sundays, and Mondays and Tuesdays can have a lower diversity. Consequently, the limitations of the 24 hour recall method in representing general household dietary diversity are exacerbated. Overall, the results of respondents' perceptions of eating balanced meals and their diet diversity based on the 24 hour recall presented above point out to hypotheses to be explored in future research. Future surveys that focus on nutrition and food security could use a more detailed version of the 24 hour

recall method developed by the US Department of Agriculture[1], which used multiple recalls and aims to interview the female head-of-household (at least for this section of the questionnaire) if feasible.

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FOOD SECURITY and DIET DIVERSITY: KEY POINTS

A higher proportion of households in Dalomo, Bua and Daku had sometimes worried about not having sufficient food, while the majority of households in Kiobo, Nakodu, Navatu and Ligau did not have such concerns.

Some fishing villages (Yaro and Daku) had a high proportion of households eating only one or two food groups. Nevertheless, villages where fishing is a major source of income had a high proportion of households where at least one portion of fresh fish and/or invertebrates was consumed in the 24 hours analysed in this research.

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Fish caught by local communities for consumption. ©Sangeeta Mangubhai/WCS

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[1] https://www.ars.usda.gov/northeast-area/beltsville-md/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/ampm-usda-automated-multiple-pass-method/

3.6. Economic status of households

A series of questions was asked relating to the economic situation of the households including changes in economic status and access to credit. Improvement in the economic status of households can be an important goal of fisheries management and is therefore an indicator for livelihood and well-being outcomes. However, similar to food security, the establishment of a causal relationship between fisheries management and economic status of households was beyond the scope of this report.

Respondents were asked whether the economic status of their household had changed over the past year, and if their situation was (i) much better, (ii) slightly better, (iii) neither worse nor better, (iv) slightly worse or (v) worse. For the analysis, (i) and (ii) were combined into "better", and (iv) and (v) into "worse". The majority of the 204 respondents (43%) who answered this question stated that their economic status had improved over the past year, 39% had no changes and 17% stated that their economic status was worse. The most significant perceptions of change were in the Macuata District, with Yaro and Ligau villages having the highest proportion of respondents perceiving economic improvement, and Daku had the highest proportion of respondents perceiving a worsening of their households' economic status (Fig. 27).
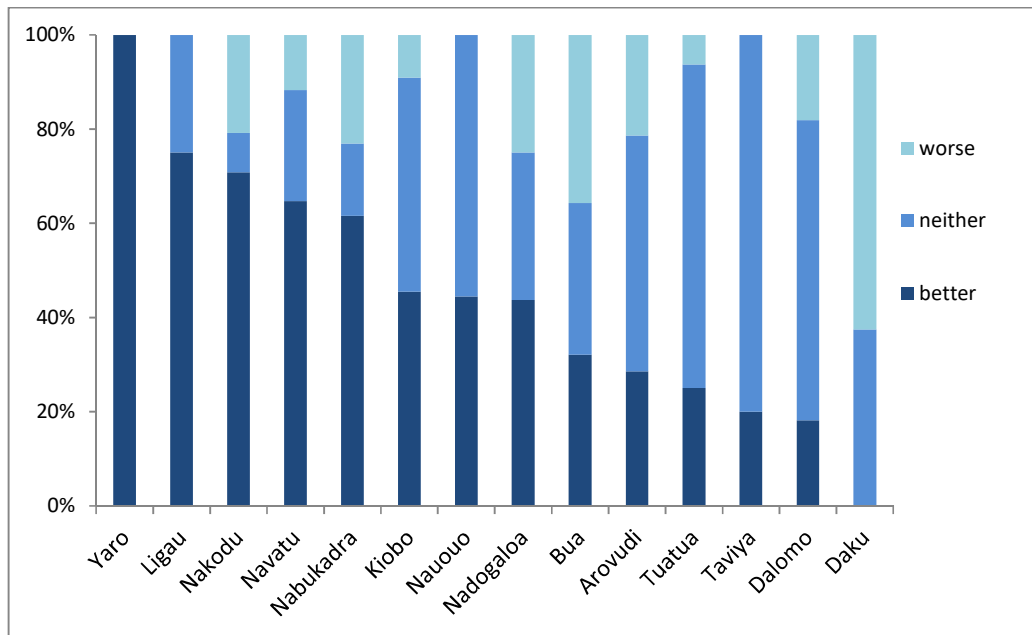

Figure 27: Percentage of respondents that perceived that the economic status of their households had improved, worsened or neither improved nor worsened in the past year, per village surveyed.

The majority of respondents had access to credit (65%), with the highest proportions recorded in villages in the Levuka District, followed by the villages of Navatu (82%), Nakodu (71%) then the villages in the Nabukadra District (69%) (Fig. 28). In contrast, the villages of Ligau (88%) and Yaro (70%) in Macuata province had the least access to credit.
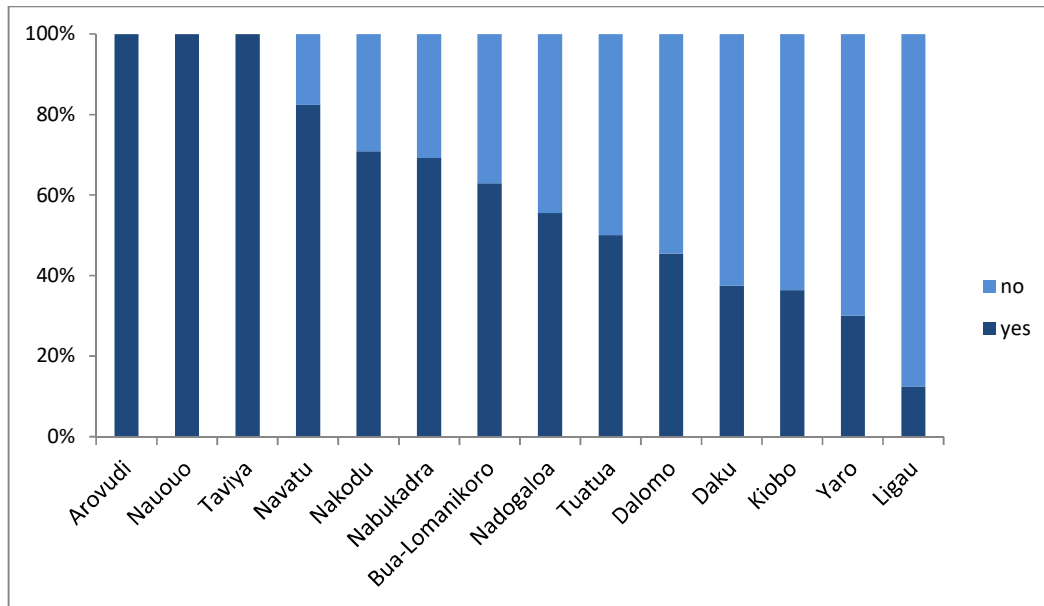

Figure 28. The percentage of respondents within villages with and without access to credit in the villages surveyed.

HOUSEHOLD ECONOMIC STATUS: KEY POINTS

The most significant perceptions of change in income had happened in the Macuata district where most villages rely on fishing for income. Yaro and Ligau villages had the highest proportion of respondents perceiving economic improvement, and Daku had the highest proportions of respondents perceiving a worsening of their households' economic status. Additionally, these villages had limited access to credit.

4. CONCLUSION

This study examined the socioeconomic factors that affect the sustainable use of natural resources in rural communities in Fiji, and included many of the indicators from the ecological-socioeconomic systems monitoring framework for coastal fisheries management that WCS is implementing in the Pacific, Indonesia, East Africa and Caribbean (Gurney and Darling 2017).

The results of this study highlighted two factors that affect the vulnerability of local communities: income diversity and dependence of natural resources (Metcalf et al. 2015). A diversified economy is generally deemed to increase the adaptive capacity of local communities to changes such as market fluctuations and natural hazards (Metcalf et al. 2015). Some of the Fijian villages that are part of this study showed a strong specialization towards fishing, with most households having fishing as the main economic activity. These included the villages in the Macuata district and Navatu Village. Other villages presented a more diverse livelihood portfolio that included farming, salaried employment and informal economic activities (Fig. 6). There was also a relatively low diversity of income sources at household level with almost half of the households interviewed depending on a single economic activity (Fig. 5). This contrasts with other coastal communities in developing countries with a more economic base; a study in Timor-Leste, for example, showed a much smaller percentage of households (0.4%) engaged in a single livelihood activity, conferring a higher adaptive capacity to those communities (Mills et al. 2017).

This study also revealed how dependent local communities were on natural resource-based livelihood activities. Fisheries and agriculture seemed to play a complementary role in terms of food and livelihoods – meaning coastal villages where fishing was not a primary income source relied on fishing for subsistence, and agriculture for livelihoods, and conversely, coastal villages where fishing was a primary income source relied on agriculture for food. Such patterns are common to other coastal communities in developing countries, where fisheries, agriculture and informal economic activities are important livelihood activities (Cinner and Bodin 2010, Mills et al. 2017). The literature generally supports that local communities' dependency on natural resources as sources of income and subsistence increase households' vulnerability to natural hazards or market changes (FAO and ILO 2009; Cinner et al. 2013). This was evident after Cyclone Winston in 2016, which caused wide-scale losses in agricultural produce (Government of Fiji 2016) and affected communities' ability to fish for both food and livelihoods (Chaston Radway et al. 2016). Even without major disturbances, households in three villages worried sometimes about not having sufficient food. These results emphasise the potential to foster higher livelihood diversity in the villages that were part of this study as a way to increase the adaptive capacity in these communities to natural hazards, which are expected to increase in frequency and intensity in Fiji due to global climate change (Mangubhai et al. in press).

The ability of communities to act collectively to solve problems (as expressed by several aspects of social capital) can be as or more important than a lower dependence upon natural resources in supporting community resilience (Smith et al. 2012). Trust can also enhance cooperation and reduce the transaction costs in natural resource management. In

communities where trust is high, individuals spend less time monitoring others since they trust that others will act as expected (Pretty and Smith 2004). The households surveyed in Fiji had generally high levels of participation in the social life of their villages. Most respondents trusted people from their own village, and placed a high level of trust in religious leaders. These results, together with a high dependence on fishing could indicate a strong potential for collective action in the management of natural resources, especially in villages where fishing is a major economic activity. This seemed to be supported by the existence of fishing rules in virtually all villages surveyed. Nevertheless, the key informant interviews suggested very low compliance levels, especially in Navatu Village and fishing villages in Macuata District.

The limited compliance can affect the availability of fish and the viability of fishing livelihoods in the medium and long-terms. This could be a result of limited trust in external agents and the possibility of enforcement, as well as the perceived lack of participation in natural resource management. First, the level of trust on people from other villages (who may poach on the natural resources in neighbouring villages) and on fish wardens and police (who are supposed to enforce natural resource use rules) was relatively low, varying between villages. Additionally, even though confidentiality issues and cultural particularities prevented an in-depth analysis of trust in village leaders, most *iTaukei* are unlikely to respond that they do not trust their leaders. Therefore, the observed responses of half-half indicate the potential distrust of local villagers on leaders. This information suggests that implementing management actions that depend on collective action in the villages where trust is low might require additional investment in mediating negotiations and reinforcing social bonds between different groups. Additionally, the data that fisheries enforcement actions in villages within the Macuata District could benefit from the inclusion of fish wardens, but enforcement by police seems more acceptable than use of community wardens. Moreover, enforcement actions in Bua might require alternative approaches given the low levels of trust in enforcement agencies.

Second, the levels of participation in the decision-making regarding natural resource management were relatively low, especially in villages where fishing is an important economic activity such as Daku, Yaro and Navatu. At the same time, most respondents perceived changes in the marine environment and attributed such changes mainly to human actions, but felt powerless to change fishing rules, which suggests that collective action for resource management in the villages might have lower levels of participation. This could be linked to both the hierarchical system of natural resource management traditionally in place and limited levels of trust on village leaders. For example, the residents of the villages on Kia Island in Macuata District have largely given up on marine management due to concerns that the benefits from their investment may be appropriated by their paramount chief who has authority to open their *tabu* area for harvesting (Jupiter et al. 2017). Traditional hierarchical systems and customary rules have played a significant role in maintaining sustainable fisheries in Fiji (Jupiter et al. 2014) and elsewhere (Cinner and Answani 2007). When supported by leadership, trust, monitoring capacity; information flow through social networks; and participatory arenas of collaborative learning, these traditional systems have the potential to lead to socio-ecological systems that are more robust to change (Olsson et al. 2004).

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