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RESCCUE

SUSTAINABLE MANAGEMENT OF BIODIVERSITY AND ECOSYSTEM SERVICES IN KADAVU PROVINCE - DIAGNOSIS AND ACTION PLAN



The operator that is in charge of the implementation of the RESCCUE project in Fiji under the supervision of both SPC and the **University of the South Pacific** is a consortium of **four partners** :

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Overview of the objectives and components of RESCCUE projet :

The *Resilience of Ecosystems and Societies to Climate Change* (RESCCUE) project is a regional project implemented by the Secretariat of the Pacific Community.

The overall goal of RESCCUE is to contribute to increasing the resilience of Pacific Island Countries and Territories (PICTs) in the context of global changes. To this end RESCCUE aims at supporting adaptation to climate change (ACC) through integrated coastal management (ICM), resorting especially to economic analysis and economic and financial mechanisms.

The RESCCUE project operates both at the regional level and in one to two pilot sites in four countries and territories: New Caledonia, Vanuatu, Fiji and French Polynesia.

RESCCUE is funded primarily by the *French Development Agency* (AFD) and the *French Global Environment Facility* (FFEM) for a duration of five years (01/01/2014 to 31/12/2018). The total project budget is 13 million Euros, including 6.5 million Euros from AFD/FFEM and about the same in co-funding.

RESCCUE Project sites in Fiji are RaProvince and Kadavu province. Ra has about 95 communities and Kadavu 73 communities. The following are the RESCCUE components that will be implemented in these two sites.

It is structured around five components:

Component 1: Integrated coastal management – supporting ICM implementation through ICM plans, ICM committees, and management activities concerning both terrestrial and marine ecosystems, capacity building and income generating activities.

Component 2: Economic analysis – using economic analysis to support coastal management and policy decisions.

Component 3: Economic and financial mechanisms – setting up economic and financial mechanisms to generate additional and sustainable funding for ICM: review of options (payment for ecosystem services, taxes, user fees, trust funds, quota markets, offsets, labels...); feasibility studies; implementation; monitoring.

Component 4: Capitalization, communication, dissemination of project outcomes in the Pacific – going beyond pilot sites activities in order to have impacts at the regional level, by fostering experience sharing between sites, cross-sectoral expertise, and communication and dissemination of the project outcomes.

Component 5: Project management – implementing and coordinating the project, by providing technical assistance, organizing local and regional steering committees, conducting audits and evaluations (mi-term and ex-post), etc.

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Executive summary

In terms of wealth *Ravitaki* has the highest estimated median wealth at F\$5,260.00/ yr and *Yale* has the lowest estimated median wealth at F\$2,158.75/ year

There were only three villages which had more than 40% of individuals with formal work wages: *Drue*, *Naivakarauniniu*, and *Narikoso*.

In 13 villages, no more than 10% of individuals in the sample were self-employed: *Cevai*, *Daku*, *Jioma*, *Kabariki*, *Kadavu*, *Lawaki*, *Levuka*, *Nabouwalu*, *Nalotu*, *Narikoso*, *Solodamu*, *Soso*, and *Tavuki*

Growing yaqona is the main commercial activity for most households in all the villages in the eight surveyed districts. There are relatively small shares of individuals working for wages or in self-employment which are indicative of the limited opportunities for income generation outside of leveraging natural resources.

Muani and Matanuku have the highest proportions that catch and/or glean fish for commercial purposes at 73% and 70%, respectively.

Risks related to the economic & social livelihood:

- Dependence on yaqona;
- Little income diversification;
- Fisheries are available as an alternative source of income, but the status of fisheries is not very clear given there has been poor fisheries stock time series data collected in the past.

Risks related to the biophysical environment:

- Migration to the coast has facilitated transport, but has increased vulnerability to coastal disasters and impacts of climate change such as sea-level rise;
- Erosion and subsequent environmental issues associated with developing a road network;
- Indiscriminate burning is a major threat to biodiversity.

Of the 34 villages surveyed, 22 indicated that poaching using scuba in marine protected area specifically the “no-take zone” is a challenge facing the village and of these 22 villages, 19 believe it is getting worse.

Key opportunities for RESCCUE

1. *Marine Protected Areas (LMMA) specifically “no-take” zones*

- Legal protection for the humphead wrasse (*Cheilinus undulates*), and how to fast track it.
- Dedicated boat for policing of “no-take zone” in the respective LMMA
- Clarify implication of the surfing decree in LMMA and how it supersede customary fishing rights and opens it up to poaching

2. *Erosion*

- Planting of coconuts to provide more income and also some coastal protection
- Other coastal vegetation such as *Barringtonia asiatica*
- Awareness raising
- Use of water
- Livestock control
- Benefits of a health forest
- Trees by water ways (benefits and also challenges with water use) – could be food trees – need to consider their water needs so don’t compete with water supply

3. *Coastal protection*

- Replanting of mangroves
- Mapping to identify where to relocate houses (if relocation is necessary)
- Erosion protection from road construction
- Applications of appropriate ecosystem based management measures to complement engineering infrastructure erosion protection measures such as gabion and geo container) to reduce soil loss and damage caused by the road.

1. Demographics and education

The estimated mean age of individuals in Kadavu is 29, with a 95% confidence interval of (27.91, 30.02) and the estimated median age is 27. Three individuals in sampled households are older than 85. The age distribution in Kadavu, demonstrated in Figure 2, is positively skewed: of the 1,576 individuals comprising surveyed households, approximately 36% are under the age of 15 whereas only 9% are over the age of 60.

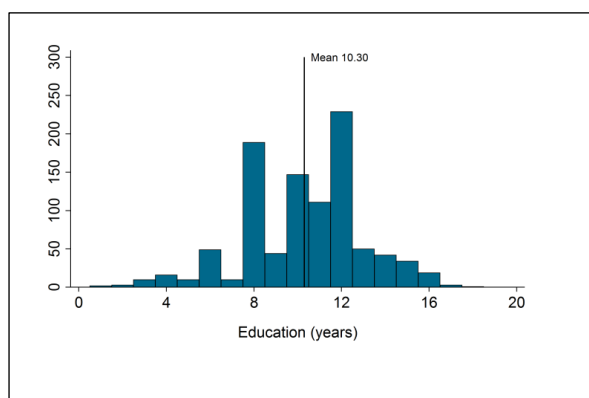


Figure 1 Education profile of Kadavu province

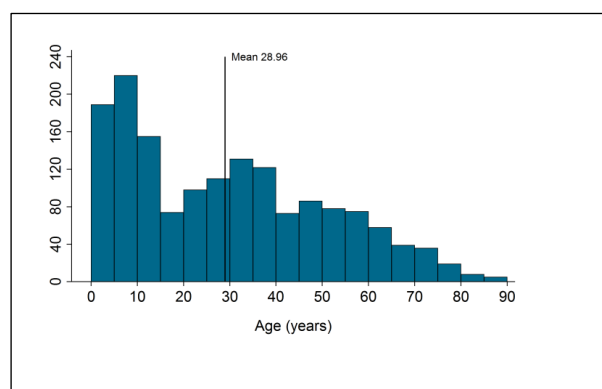


Figure 2 Age profile of Kadavu province

The estimated mean education level of individuals over the age of 18 in Kadavu is 10.3 years with a confidence interval of (10.13, 10.48). The estimated median education level is 11 years. Every individual in the sample has at least one year of education. The education distribution in Kadavu, demonstrated in Figure 3, demonstrates strong bimodality at 8 years and 12 years. Eight years of education was compulsory for all individuals until 2009 (IBE 2011), with a complete secondary education terminating after 12 years of education. The large drop after 12 years indicates that relatively few individuals have gone on to tertiary education.

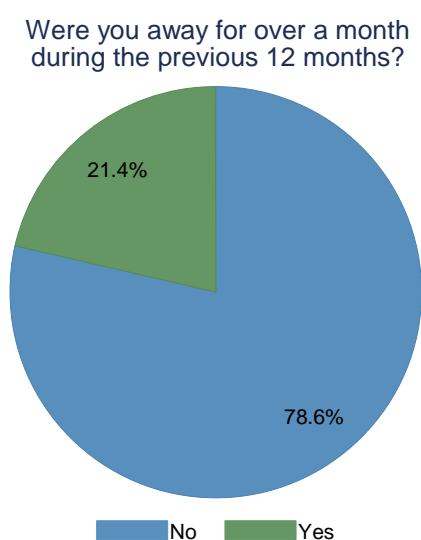


Figure 3 Proportion of individuals away from the household for over a month

A significant proportion of the sample (21.4%) report having been away from the village for over a month during the previous 12 months (Figure 4). Among them, a significant majority of 69.3% report Viti Levu as their destination (Figure 5) while 13.1% were in another village in the same district.

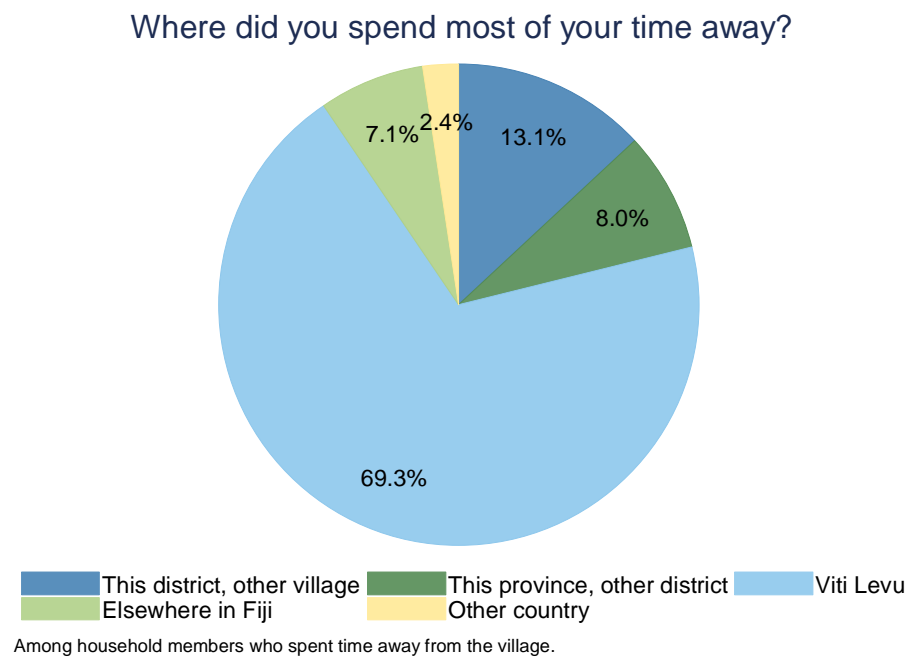


Figure 4 Proportion of individuals away at various locations

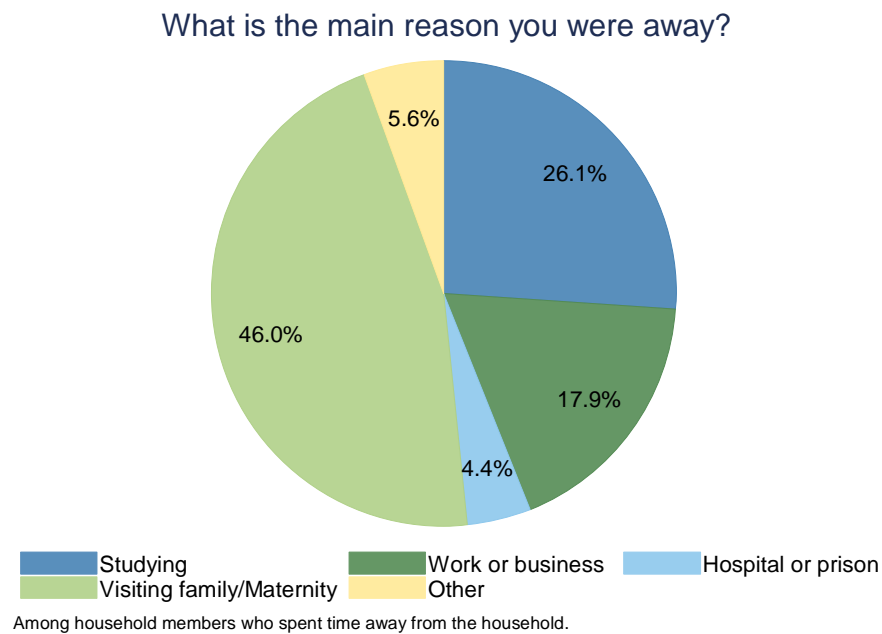


Figure 5 Proportion of individuals away for specific reasons

Figure 5 indicates the reason that people report household members being away for extended periods in the previous year. The majority of individuals report being away for either visiting family or maternity reasons. The categories “studying” and “work or business” had similar proportions at 26.1% and 17.9%, respectively.

2. Wealth

To estimate household wealth, enumerators asked about household assets, including the age and condition at the time of purchase. Information on cash assets was also collected. Figure 6 shows the distribution of estimated household wealth across the nine districts. There is little absolute difference in estimated wealth across districts; *Ravitaki* has the highest estimated median wealth at \$5,260.00 and Yale has the lowest estimated median wealth at \$2,158.75. Overall, more than 70% of households report estimated wealth below \$6,500 and only 4% of households in the sample report estimated wealth greater than \$45,000 (Figure 7).

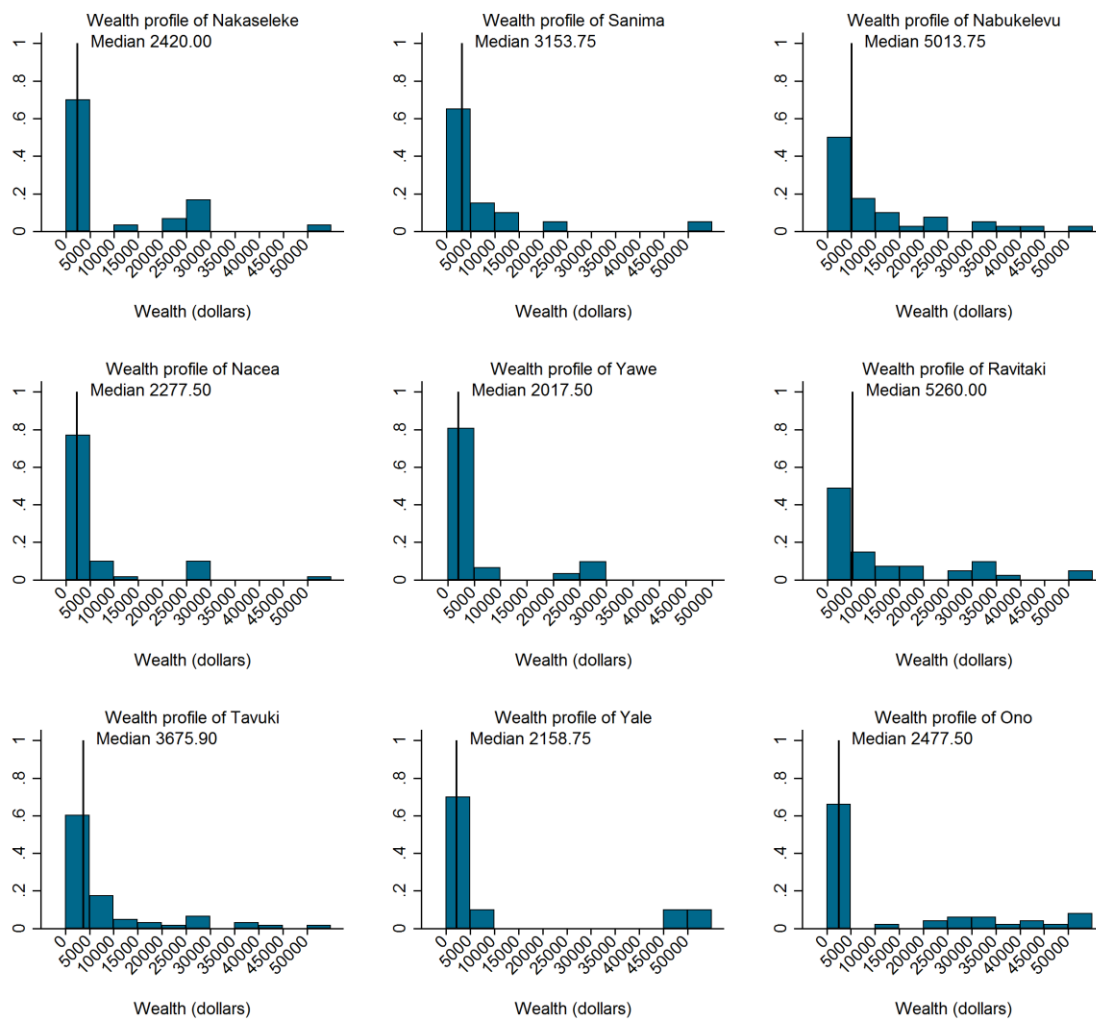


Figure 6 Wealth profile of each district

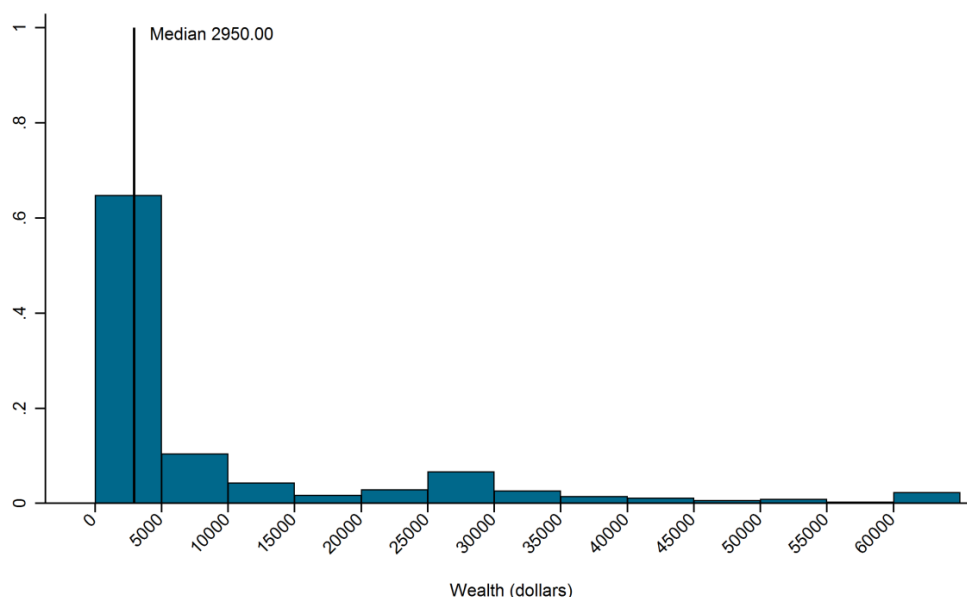


Figure 7 Wealth profile of Kadavu province

3. Livelihoods and consumption

WAGE WORK

The proportion of individuals who work for wages and the proportion of individuals who are self-employed (excluding cropping, raising livestock, and fishing) vary from village to village, as shown in Figure 8. In only three villages did more than 40% of individuals in the sample work for wages: *Drue*, *Naivakarauniniu*, and *Narikoso*. In contrast, 10% of the sampled individuals worked for wages in nine villages: *Levuka*, *Kadavu*, *Jioma*, *Matanuku*, *Nabouwalu*, *Nacamoto*, *Nasegai*, *Soso*, and *Vabea*. In only one village, *Nasau*, were over 30% of the individuals in the sample self-employed. In 13 villages, no more than 10% of individuals in the sample were self-employed: *Cevai*, *Daku*, *Jioma*, *Kabariki*, *Kadavu*, *Lawaki*, *Levuka*, *Nabouwalu*, *Nalotu*, *Narikoso*, *Solodamu*, *Soso*, and *Tavuki*. In general, more villages have a greater proportion of individuals who work for wages than individuals who are self-employed, although *Matanuku*, *Muani*, *Nabouwalu*, *Nacamoto*, *Nakaugasele*, *Nasau*, *Nasegai*, *Rakiraki*, *Ravitaki*, and *Vabea* are exceptions.

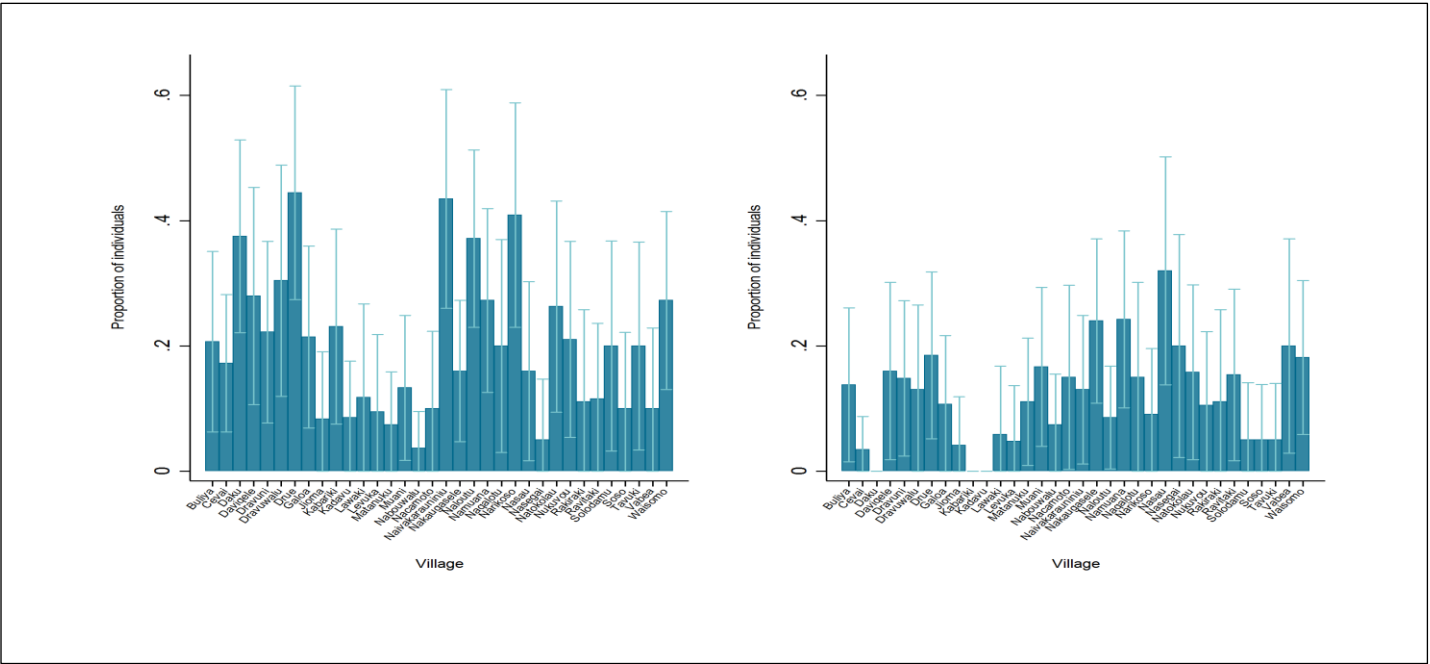


Figure 8 Proportion of individuals in self-employment& individuals working for wages

Figure 9 shows the proportions of each category of labor for all individuals who work for wages in Kadavu province. Of the individuals in the sample who work for wages, over 70% either raise crops and/or livestock in exchange for wages, work in the tourism industry, have a paid village position, or work in construction. The remaining individuals are spread across all other categories of wage work.

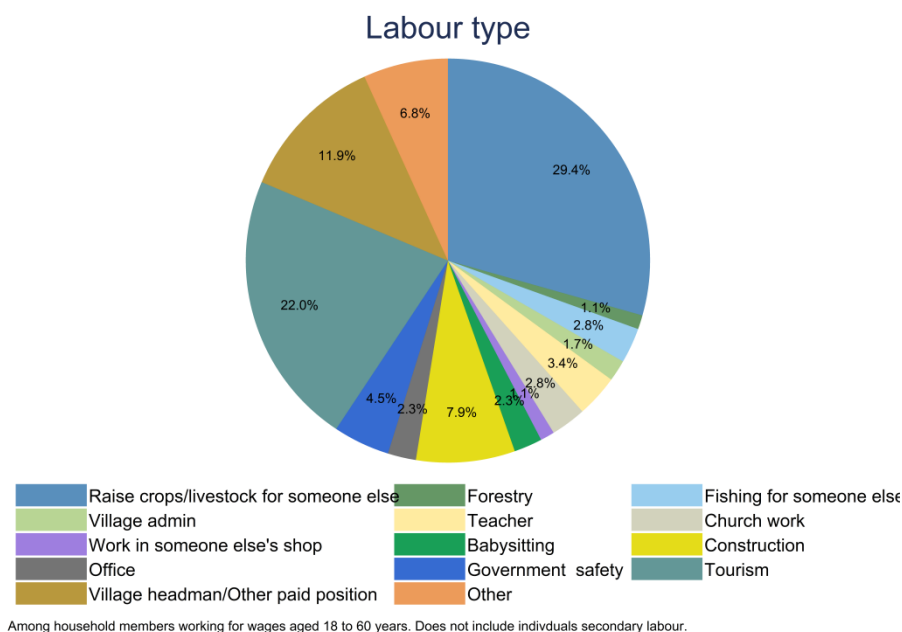


Figure 9 Proportion of individuals in different labor types

Figure 10 shows the distributions of various types of self-employment. Of the individuals in the sample who are self-employed, 50% own shops. Handicraft work occupies the next highest proportion at 32.6%. The "other" category includes individuals who work as mechanics, selling fuel, or selling food. The shares of self-employed individuals who operate sea transport businesses or exist as middlemen are each 2.3%.

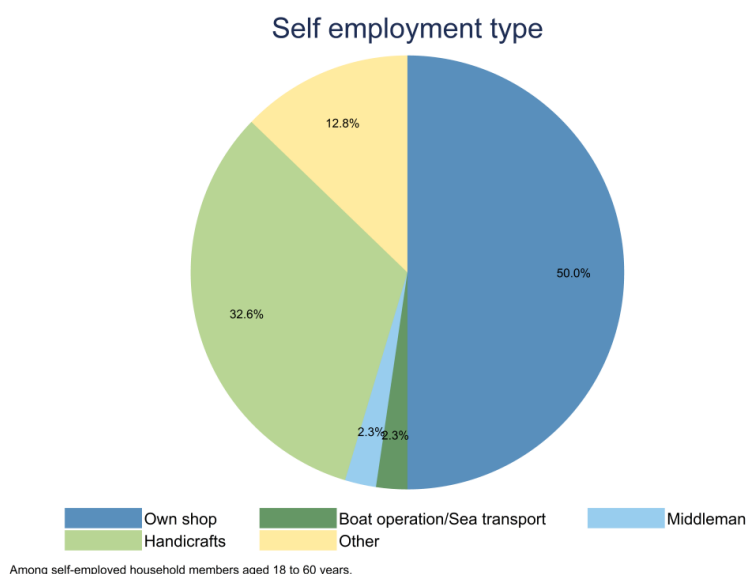


Figure 10 Proportion of individuals in different self-employment types

The distribution of yearly wages in Kadavu province is similar to the distribution of wealth, albeit less extreme (Figure 11). The estimated median yearly wage for Kadavu province is \$5,888. Approximately 79% of all individuals who work for wages earn \$10,000 or less per year and only about 5% earn over \$20,000 per year.

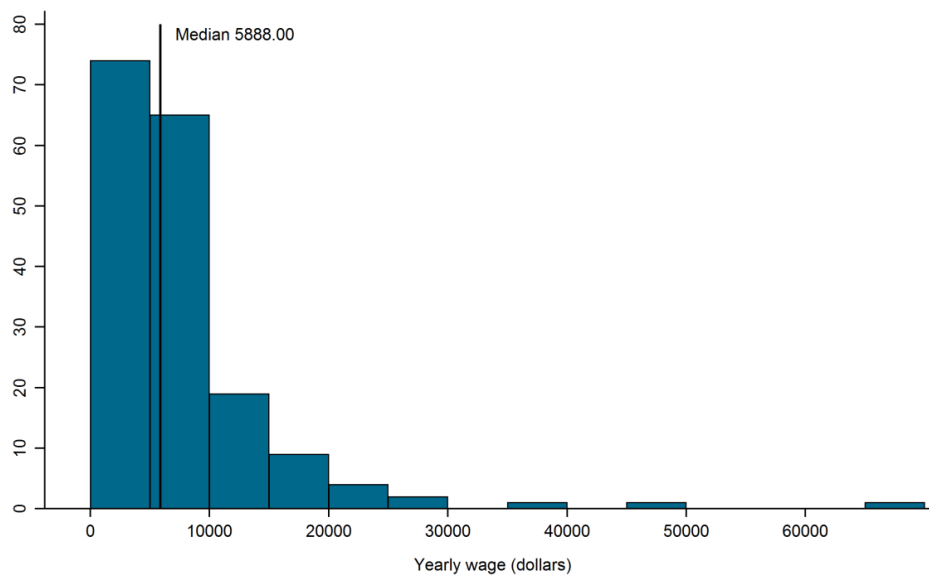


Figure 11 Yearly wage of individuals for the Kadavu province

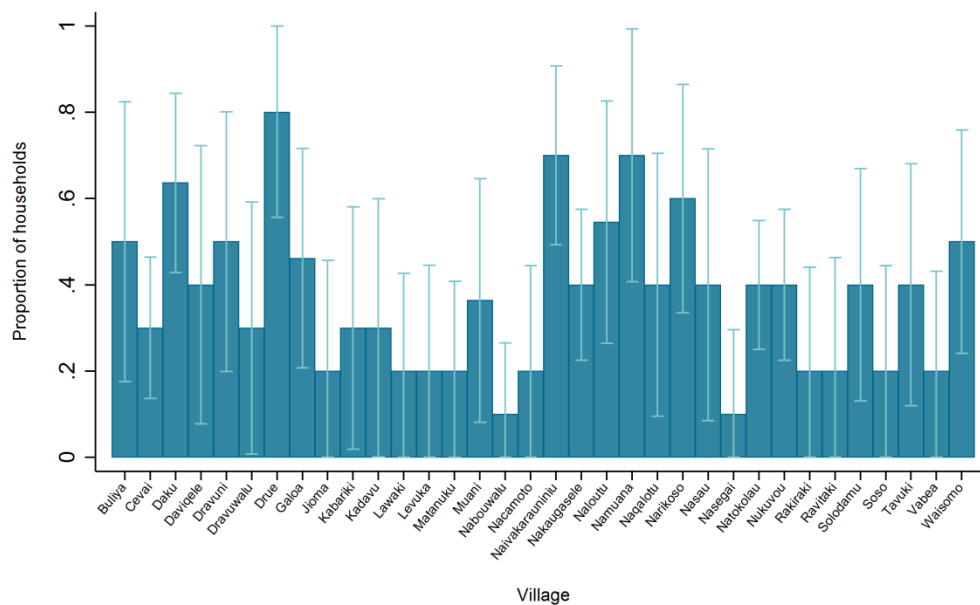


Figure 12 Proportion of households with at least one member working for wages

The relatively small shares of individuals working for wages or in self-employment are indicative of the limited opportunities for income generation outside of leveraging natural resources. Nevertheless, the proportion of households engaging in wage work is high in some villages. For example, in *Drue*, *Naivakarauniniu*, and *Namuana*, well over 60% of surveyed households include at least one member working for wages (Figure 12). Information provided by the villages' *turaga ni koro*, however, suggests that wage work contributes little to village wealth; only eight villages stated that wage work contributed any wealth to the village, with the average stated contribution of these eight villages being only 24% of total village wealth creation.

4. Agricultural production

Growing *yaqona* is the main commercial activity for most households (Figure 13). For most villages, at least 50% of all households in the sample grow *yaqona* for commercial purposes. Moreover, every household surveyed in four villages (*Nacamoto*, *Nalotu*, *Nasau*, and *Solodamu*) grows *yaqona* for commercial purposes. In contrast, only 20% and 30% of the surveyed households in Dravuni and Narikoso, respectively, grow *yaqona*. *Narikoso* has the third highest proportion of individuals working for wages, which may explain why the share of households growing *yaqona* for commercial purposes is comparatively low. In only one village – Buliya – do no households in the sample grow *yaqona* for commercial purposes as Buliya is located on a small islet with soil ill-suited for agriculture.

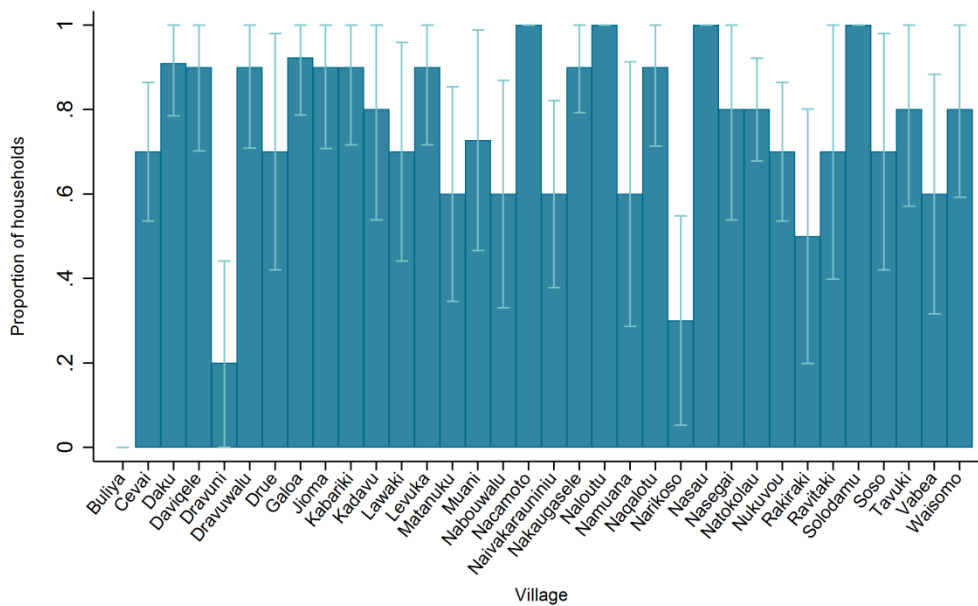


Figure 13 Proportion of households growing *yaqona* for commercial purposes

Yaqona plot sizes are modest, averaging between 0.25 acres and 2 acres (Figure 14). *Dravuni* has the largest average *yaqona* plot size at 2.25 acres, but only two households in the *Dravuni* sample grow *yaqona* for commercial purposes. *Narikoso* has the smallest average *yaqona* plot size at 0.3 acres; again, the number of households in *Narikoso* growing *yaqona* for commercial purposes is small.

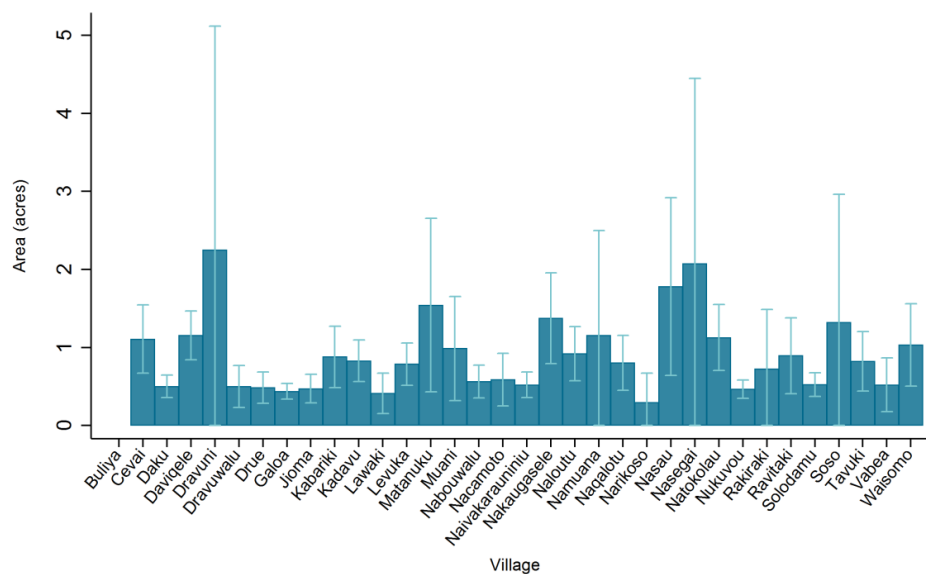


Figure 14 Average yaqona plot size

Kadavu households generally sell *yaqona* to a single market; primarily either within the village, elsewhere in Kadavu province, or in Viti Levu as indicated by Figure 15. Relatively few households sell *yaqona* to a wholesaler, surprising when considering that wholesalers pay approximately 10% more than the average price received in Viti Levu (Table 2).

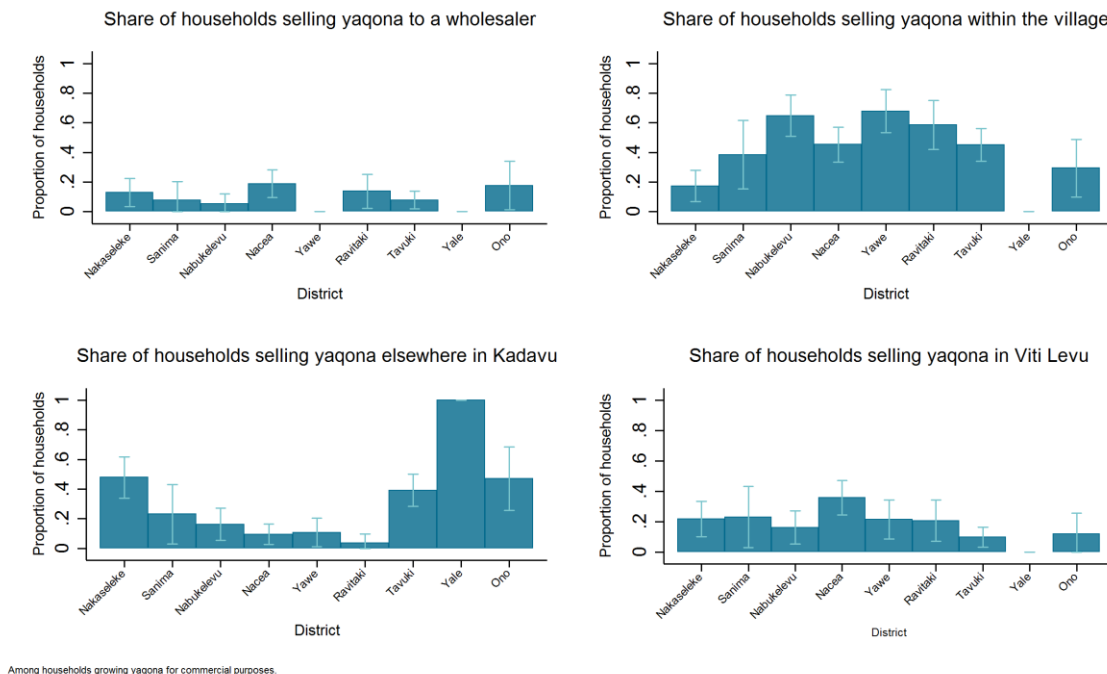


Figure 15 Proportions of households selling yaqona in various markets by district

Table 2. Average prices received for *yaqona* in each market

Market	Price per kilogram (FJD)
Wholesaler	\$49.96
Within the village	\$44.87
Elsewhere in Kadavu	\$44.16
Viti Levu	\$45.81

Information provided by the villages' *turaga ni koro* also suggests that agriculture contributes the most to village wealth; only two villages report that agriculture makes no contribution to village wealth while the 32 other villages surveyed report that the contribution of agriculture to village wealth is 74% of total village wealth, on average. The proportion of households growing crops other than *yaqona* for commercial purposes is small. Only cassava and taro are grown commercially by more than 10% of surveyed households (Figure 16), suggesting that *yaqona* squeezes out other commercial cropping. This lack of income diversity has serious implications for the financial resilience of individuals in Kadavu: the income streams of most households depend on agriculture, and any adverse impacts on *yaqona* prices can significantly reduce household incomes given the dominant role *yaqona* has in income generation.

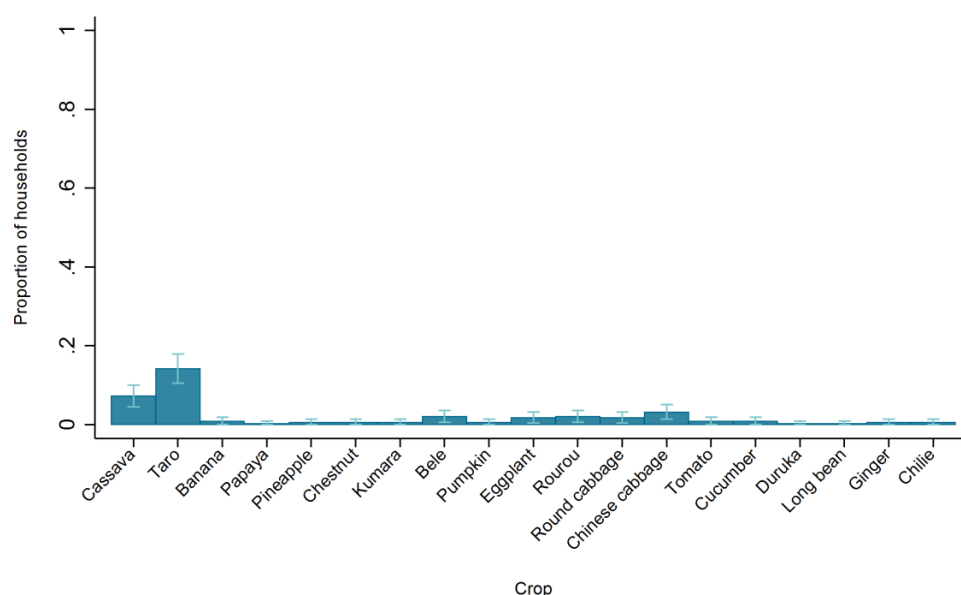


Figure 16 Proportion of households growing various crops other than *yaqona*, among households growing crops for commercial purposes

5. Fishing

The proportion of households that catch and/or glean fish for commercial purposes varies widely across villages (Figure 17). Muani and Matanuku have the highest proportions that catch and/or glean fish for commercial purposes at 73% and 70%, respectively. In contrast, none of the surveyed households in Kadavu, *Nacamoto*, *Nasegai*, *Solodamu*, or *Soso* catch and/or glean fish for commercial purposes. A number of factors potentially contribute to this

variation, including geographic location, relevant rules pertaining to locally marine managed areas, and other marine activity (e.g. tourism).

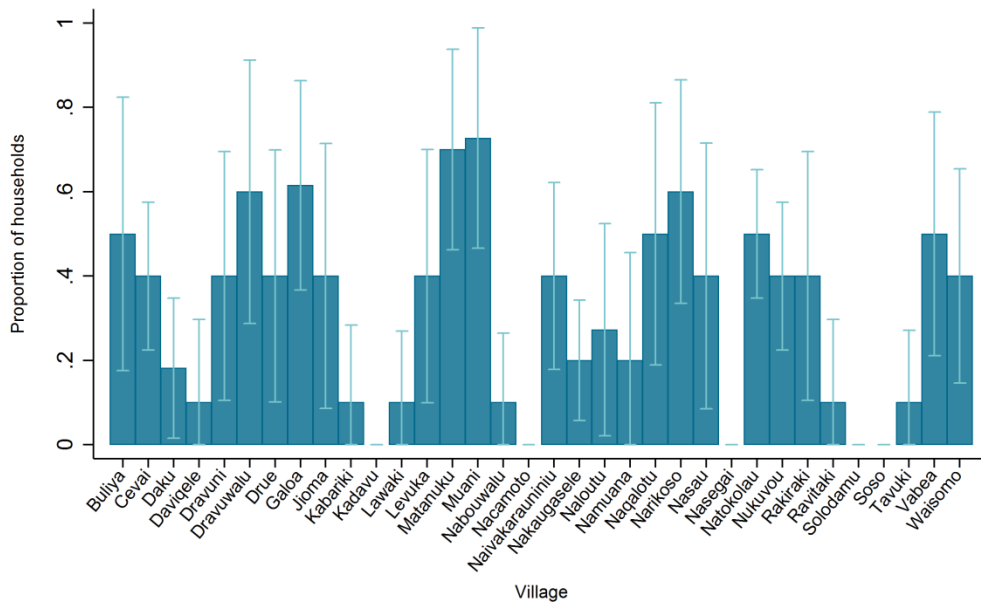


Figure 17 Proportion of households fishing for commercial purposes by village

Figure 18 indicates the share of households that catch specific species of fish among all households that catch and/or glean fish for commercial purposes. The species listed include the seven most popular species caught and sold by households during the previous 12 months. Approximately 67% of all households that catch and/or glean fish for commercial purposes catch emperors. Approximately 26% to 32% of households identify the remaining six species in Figure 21 as being among the 5 most important commercial species/genera.

Sea cucumbers are caught for sale in the largest quantities, with over 7100 sea cucumbers sold across all four markets. The quantity of emperors follows at over 6500 sold in all four markets. Figure 19 indicates that sea cucumbers and emperors occupy the majority of fish caught, with the next highest quantity at 2830 (*Ta*). The quantity of sea cucumbers caught is greater due to a few households; over 6500 sea cucumbers are caught by 15 households and 10 of these households, which are located in Ono district, account for 4110 of the sea cucumbers caught.

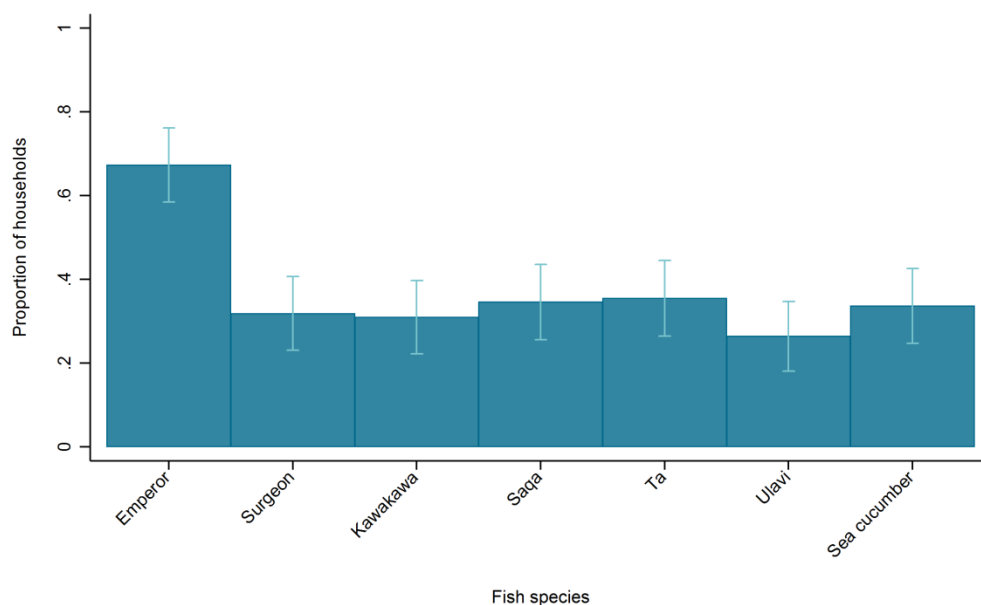


Figure 18 Proportion of households catching various fish species among households fishing for commercial purposes

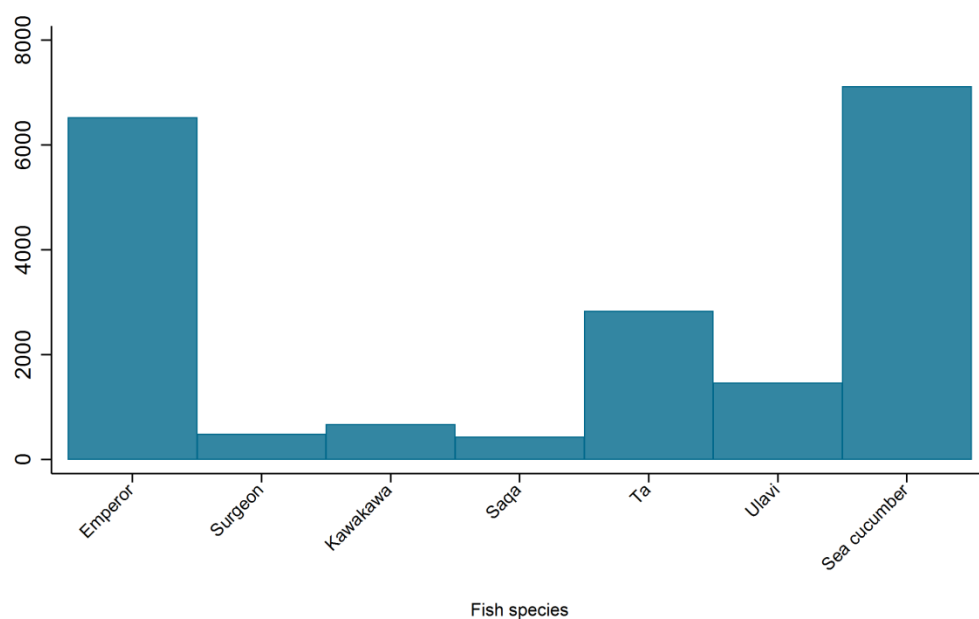


Figure 19 Quantities of specific fish species sold in the previous 12 months by Kadavuans

With the exception of sea cucumbers, few households surveyed sell fish to wholesalers or in Viti Levu: most sell within the village or elsewhere in Kadavu province (Figure 20). However, more than 20% of the households that fish for commercial purposes in *Naceva* and *Yale* sell seafood to a wholesaler, as do 20% who sell fish in Viti Levu. Typically, the price per string of fish is independent of species, with most species selling for somewhere between \$10 and \$20 per string.

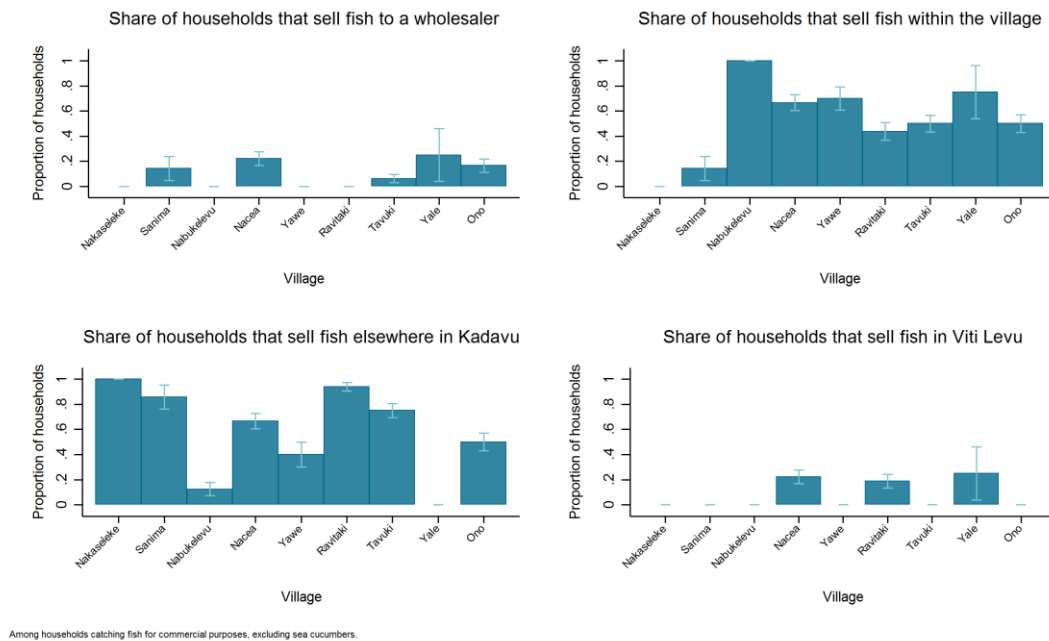


Figure 20 Proportions of households selling fish in various markets by district, excluding sea cucumber

The proportions of households that sell sea cucumbers in various markets differ dramatically from what is observed for *yaqona* and other fish. Specifically, most individuals sell to a sea cucumber processor and exporter who recently set up operations near *Vunisea*. Thus, sales elsewhere in Kadavu occupy the lion's share of market activity around sea cucumbers everywhere apart from Yale, where a wholesaler is involved. The price of sea cucumbers can differ greatly depending on species; for example, greenfish sea cucumber sells for \$1.20 each while *sucuwalu* sells for \$100 each.

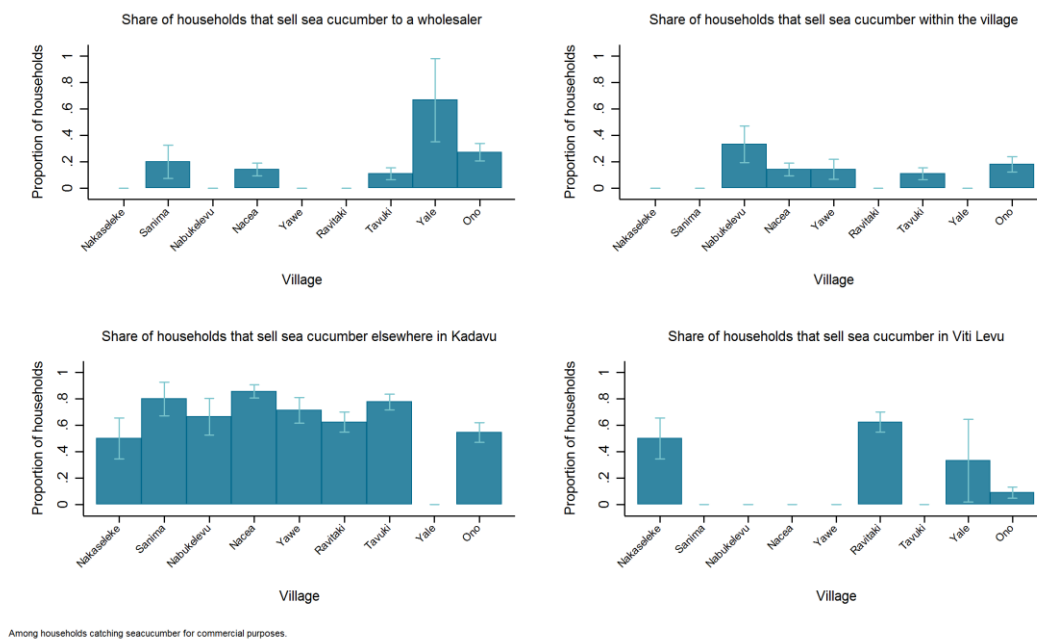


Figure 21 Proportions of households selling sea cucumber in various markets by district

In the 34 villages surveyed, the 27 *turaga ni koro* indicate that fishing contributes significantly to village wealth, a figure that exceeds that for wage work but is less than that for agriculture. Of these 27 villages, the mean stated contribution is 23%, far lower than that of agriculture.

Indeed, Figure 22 confirms that most villages create wealth through cropping rather than fishing: a greater proportion of households grow crops for commercial purposes than catching/and or gleaning fish for commercial purposes in 29 of the 34 sampled villages. In only three villages is commercial fishing more prominent than commercial cropping: Buliya, Dravuni, and Narikoso. Buliya is entirely unique in this respect, with the sample including no households that grow crops for commercial purposes; instead, most households either catch fish for commercial purposes or work for wages.

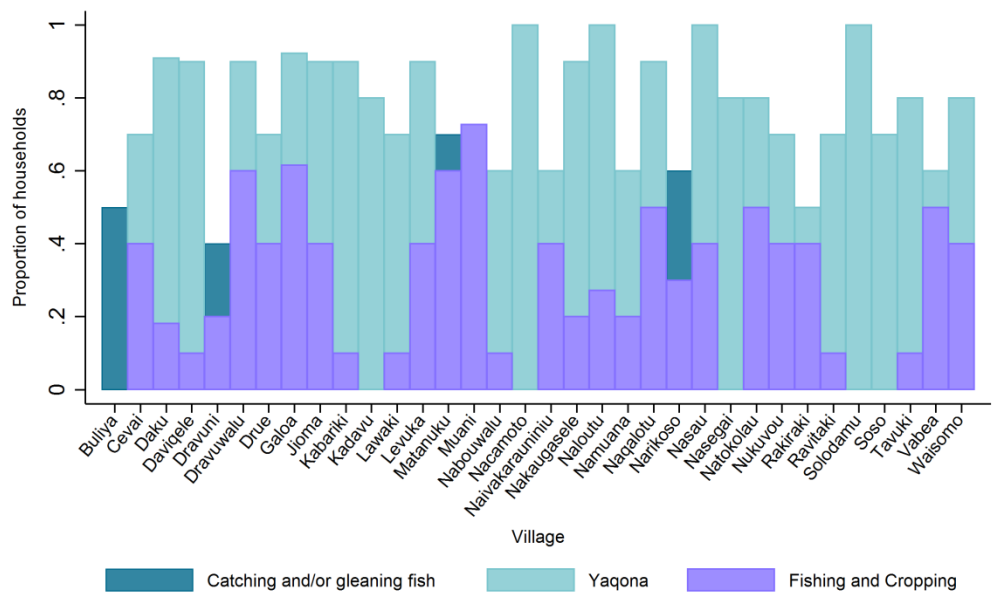


Figure 22 Proportion of households catching and/or gleaning fish, growing yaqona, or both for commercial purposes by village

Figure 23 shows the dietary diversity of respondents. Nearly 80% eat cassava on a typical day in July. The next two most widely eaten starches are wheat and rice, at 52% and 47%, respectively. Only 27% report eating taro on a typical day. Kumara, breadfruit, maize, potato, and other root vegetables are less commonly consumed.

Food consumption

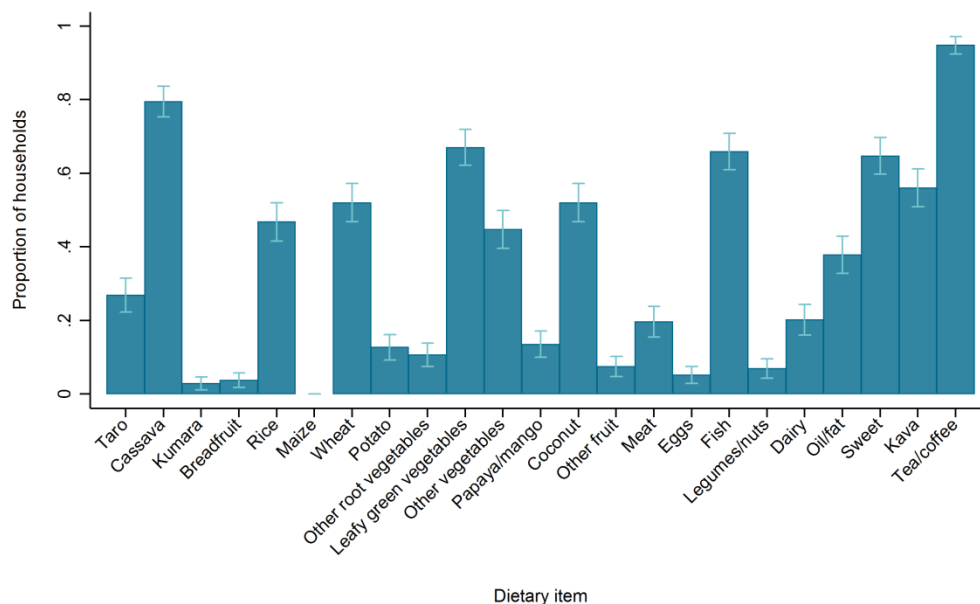


Figure 23 Share of households in Kadavu province consuming dietary item

Approximately 80% eat at least one type of vegetable on a typical day, with more households eating leafy green vegetables than other types: Two-thirds of households eat leafy green vegetables on a typical day and 45% eat other vegetables on a typical day. In contrast, only 57% of households eat at least one type of fruit on a typical day. The vast majority of households that do eat fruit in July report consuming coconut.

No fewer than 80% of households surveyed eat a protein-rich food (meat, fish, dairy, eggs, or legumes/nuts) on a typical day. Among these, fish is most commonly eaten, with two-thirds of all households eating fish on a typical day. The next most commonly consumed protein-rich foods are meat and dairy.

Nearly all households report consuming tea or coffee in a typical day while over half report consuming kava on a typical day. Two-thirds also report consuming sweets on a typical day.

Fish stocks and trends

In the community survey, villages' *turaga ni koro* were queried on species of fish that were seen prior to implementation of the LMMA, species of fish that were seen in the last 12 months, and the change in abundance of these species, recorded as either "increasing", "decreasing", or "similar".

Figure 24 shows the proportion of fish species stated to have increased or stayed similar in abundance since establishment of the LMMA by village. Eight villages claimed that all species seen before establishment of the LMMA have increased in abundance while only two villages, Dravuni and Vabea, stated that no species have increased in abundance. Figure 24 implies that no village reported that all species seen before establishment of the LMMA have decreased in abundance. Drue had the lowest proportion of species stated to be at either higher or similar levels of abundance, around 16%. Of the 30 villages in Figure 24, 22 stated that over 65% of all fish species seen before implementation of the LMMA have increased in abundance. Thus, for a majority of villages, most fish species have experienced a general increase in abundance

since establishment of the villages' respective LMMA. Note that none of the fish species listed were reportedly seen in Dravuwalu, Nabouwalu, Nacamoto, or Waisomo; hence they have been excluded from Figure 24.

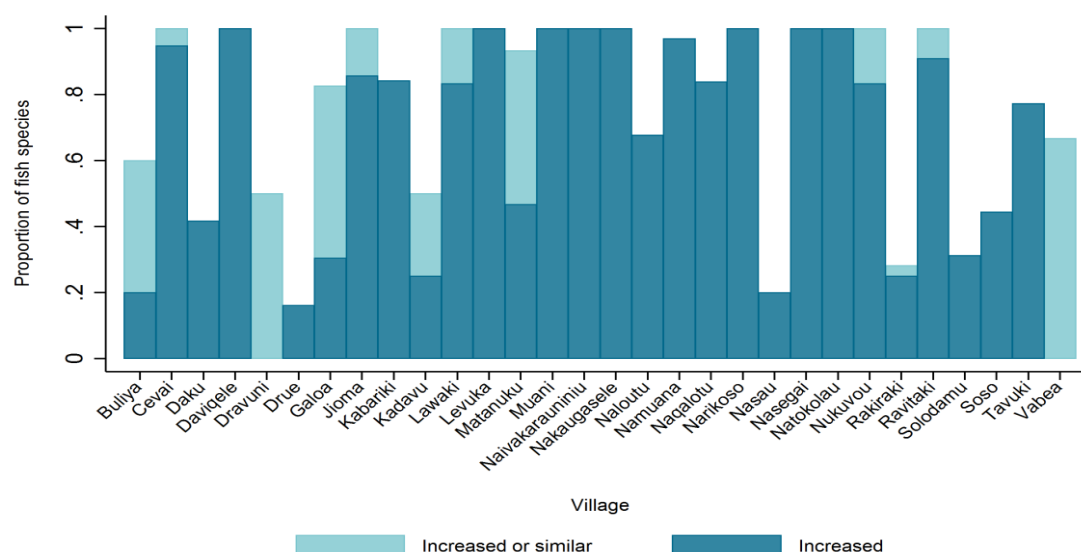


Figure 24 Proportion of fish species stated to have increased in quantity since establishment of the LMMA over fish by village.

Most villages report that emperors, *kawakawa*, *saqa*, *ta*, and *ulavi* have all either increased in stock or remained at similar levels. Responses for surgeon fish are mixed: species such as *ika loa* are reportedly increasing in most villages while others such as *balagi* are decreasing in most villages. Stated changes in sea cucumber stocks are dependent on species: most villages reported increases in greenfish sea cucumber, *loli*, and *vula*, whereas *sucuwalu*, *sucudrau*, and curry fish are reported as having increased by approximately half of the villages and having decreased by the other villages.

In addition to reported provided by *turanga ni koro*, historical and contemporary transect data can be used to identify trends over time. Transect data were obtained by swimming 50 metres and recording both the species and number of sea life seen at a width of 10 metres. This process was repeated five times over the same area and an average calculated. In 2016, transect dives were conducted in all surveyed villages save Galoa, Naloutu, Natokolau, Naqalotu, Dravuwalu, Soso, Vabea, and Nabouwalu.

Similar transect data were collected by IAS from 2005 to 2008 for a handful of villages. The transect data collected over the 2005-2008 period is less consistently reported than the transect data collected in 2016, so the reliability of any trends identified through comparison of these two datasets is perhaps less certain. However, a major benefit of the transect data collected in 2016 is its availability as baseline data for future work.

Table 1 Indication of fish abundance in 2005-2008 based on transect survey in 2016

Village	Surgeon fish	Emperor fish	Parrotfish	Grouper
Buliya	-	-	-	-
Cevai	-	-	-	-

Davigele	-	+	-	+
Jioma	-	-	+	-
Kabariki	+	+	+	-
Matanuku	-	+	+	+
Muani	-	-	-	-
Nacamoto	-	/	-	+
Naivakarauniniu	-	-	-	-
Nakaugasele	+	-	-	-
Namuana	-	+	+	-
Nasau	-	+	+	+
Nasegai	-	+	.	-
Nukuvou	-	-	-	-
Rakiraki	+	/	+	-
Ravitaki	-	-	-	-
Solodamu	+	+	+	+
Tavuki	-	-	-	+
Naloutu	-	-	-	-

A forward slash indicates no difference and a dot represents missing data.

Table 3 indicates trends in the abundance of four fish species in 2016 vis-à-vis 2005-2008. Of the 19 villages included in Table 3, seven have lower stocks for all species listed, while only one village, Solodamu, has higher stocks for all fish species listed. Emperor fish are at similar or higher levels in the most villages, with 9 of the 19 villages having either a similar or greater number of emperor fish recorded in 2016 than in the 2005 to 2008 period. Conversely, surgeon fish are decreasing across most villages, with 15 of the 19 villages having recorded decreases between 2005-2008 and 2016.

Some clear discrepancies exist between Figure 24 and Table 1 Cevai, Muani, Naivakarauniniu, Nukuvou, and Ravitaki each reported that all species of fish seen before the establishment of the LMMA had increased in abundance while the transect data shows that surgeon fish, emperor fish, parrotfish, and grouper have decreased in abundance for these villages. Similarly, Nasau and Solodamu reported that a relatively low proportion of fish seen before establishment of the LMMA have increased in abundance while the transect data shows that these villages had increases in emperor fish, parrotfish, and grouper, with Solodamu having an additional increase in surgeon fish.

6. Conditions of LMMAs

The current total area protected under no-take zones was 29.4 km². This included 12% of key shallow reefs habitats across the study site had already been protected. Significant sites such as spawning aggregation sites, cultural sites and turtle nesting sites protected 0.5 km². These marine management designs scenarios were used by the chiefs who are qoliqoli owners and decision makers and other representatives within each district to re-design the community-based network of no-take protected areas for Kadavu.

Results demonstrated an overall increase in protection after the systematic designed process. The number of no-take zones had increased from 60 to 77 and the total area protected had

also increased from 29.4 km² to 50.1 km² as a result of the re-designed study. There was also an increase in representation and replication for all the key habitats across the network with sparse seagrass being the only target achieving the 30% provincial targets. The overall representation rose from 12% to 19%, an increase of 7% across the modified network of no-take zones. In addition, the area of significant sites protected also increased from 0.5 km² to 1 km². For instance, there was a 39% increase in SPAGS, 37% increase in turtle nesting sites and 14% increase in cultural areas protected across the modified network after the study.

Findings show that the minimum area needed to hit the targets was 60 km². This would produce a network that gained 36 km², 18% more compacted but with a sum of costs of over 50% than the pre-existing network design.

Findings are crucial as Fiji strives to achieve bold conservation targets to effectively manage 30% of nearshore waters in a network of marine protected areas. The outcome will be invaluable for developing marine protected area network design approaches that combine traditional knowledge with ecosystem-based management tools in a manner appropriate to a Melanesian context.

Perceptions of locally managed marine protected areas

Figure 25 shows the average levels of agreement to six qualitative statements about the village, reported at the district level. There is a high degree of consensus regarding the first four statements, "The level of environmental knowledge among people in this community is high", "People in this community value nature for non-material reasons", "The environmental attitude of people in this community is positive", and "Community members have the right to access marine resources". In contrast, there is large variation between districts in response to the statement "There is conflict within the community for marine resources". The average responses in *Sanima* and *Yawe* are 5.75 and 2.26, respectively, on the 0-10 scale, indicating moderate agreement in *Sanima* and general disagreement in *Yawe*. Responses in the remaining districts vary from 2.46 to 4.24. Similarly, in response to the statement "There is conflict with outsiders for marine resources" *Sanima* has the highest average level of agreement at 8.1 and *Yawe* the lowest at 4.77. Responses in the remaining districts range varying from 5.6 to 7.3.

These results suggest that there is higher conflict for marine resources in *Sanima* than in *Yawe*. Interestingly, both *Sanima* and *Yawe* have similar proportions of households who fish for commercial purposes, 40% and 42% respectively (Figure 24). However, only 65% of the households surveyed in *Sanima* grow *yaqona* for commercial purposes while 90% of the households surveyed in *Yawe* do so. With less diversified income sources in *Sanima*, competition for marine resources may indeed be more acute.

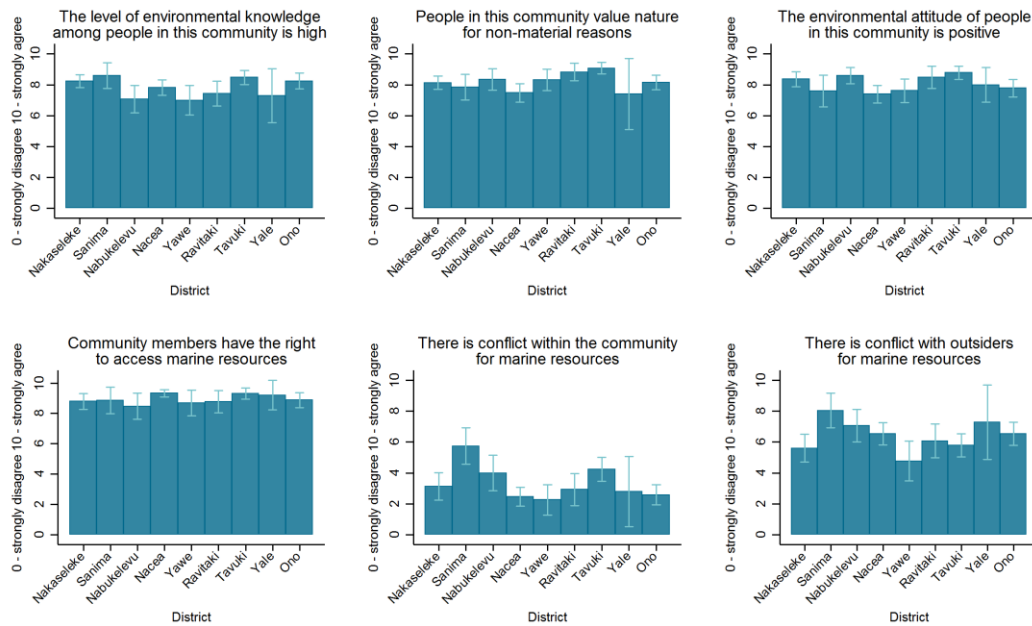


Figure 25 Average responses of districts to six resilience questions

Respondents were also asked to report their views on locally managed marine areas (LMMAs). Figure 26 shows the average responses to nine different statements about LMMAs, reported at the district level. The figure demonstrates a high degree of consensus across the statements, although three demonstrate greater variation. For the statement "Community members comply with LMMA rules", *Tavuki* showed the lowest level of agreement while *Nakasaleka* showed the most.

For the statement "Those who enforce LMMA rules are credible", respondents in *Sanima* are neutral, on average, while those in *Nakasaleka* strongly agree, on average.

For the statement "Penalties for breaking LMMA rules are high", two districts, respondents in *Sanima* and *Yale* are generally neutral. In comparison, respondents in *Nabukelevu*, *Yawe*, *Ravitaki*, and *Tavuki* generally disagree with this statement, on average. Interestingly, the two districts that agree with this statement the most, *Sanima* and *Yale*, have relatively high proportions of households fishing for commercial purposes.

Nevertheless, of the 34 villages surveyed, 22 indicated that poaching is a challenge facing the village and of these 22 villages, 19 believe it is getting worse. This poaching may be discouraging villagers from engaging in more fishing even though fish stocks are increasing on average. This may be an indication of where current rules surrounding LMMAs need strengthening.

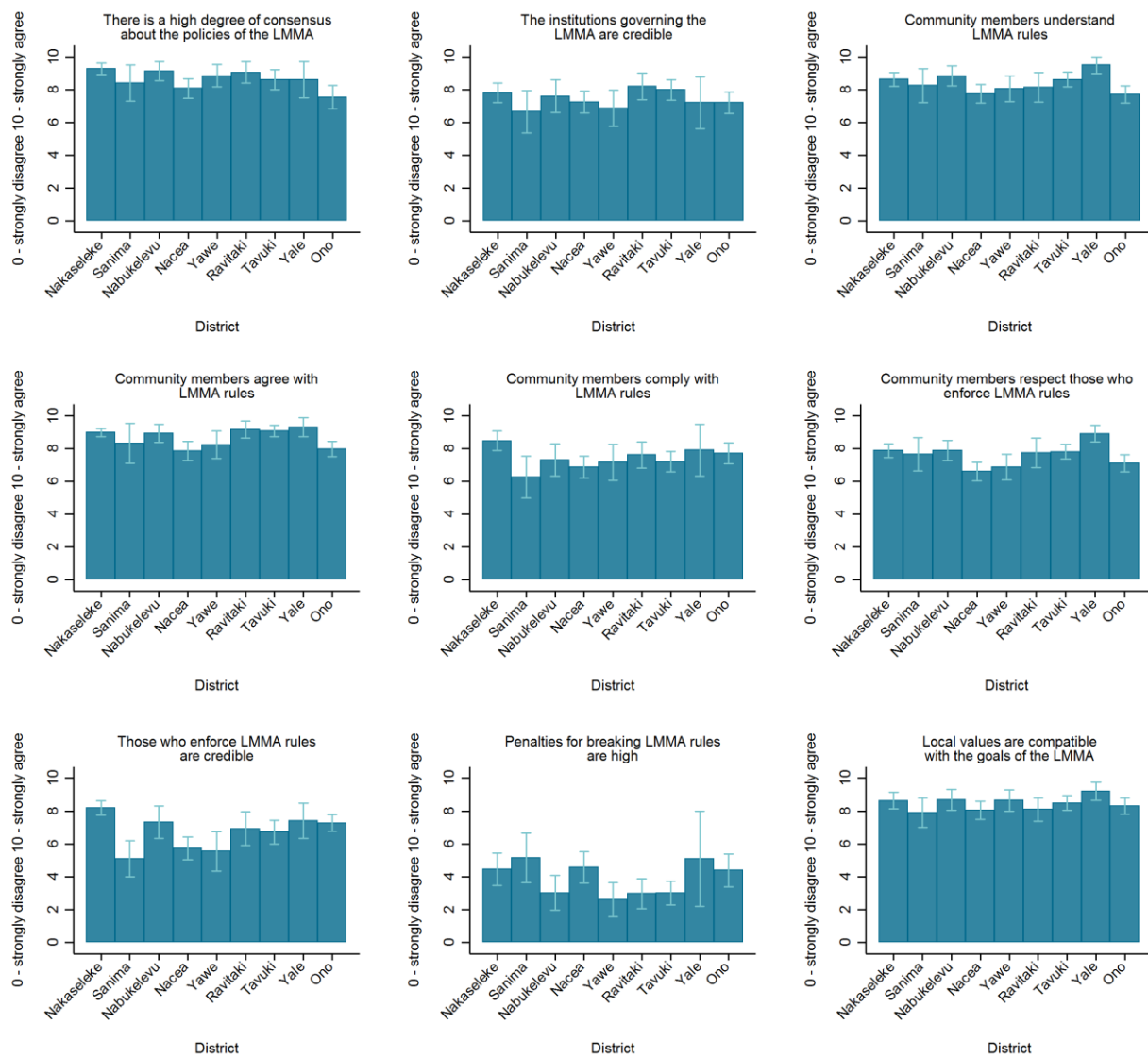


Figure 26. Average responses of districts to nine LMMA questions (note that Waisomo was not included as it no longer has a LMMA)

This information infers that efforts to improve the credibility of the institutions and officials governing the LMMA will aid in making the LMMA system more effective. Sanima is a key district to engage with to improve credibility as individuals from Sanima indicate they experience higher levels of conflict both within the community and with outsiders as well as believing that LMMAs are less credible.

7. Ecosystem Services Assessment Findings

The following matrix are the detailed findings from the community participatory ecosystem services assessment that was held for eight districts in Kadavu. Portions of the matrix that is empty indicated that community had no significant issues about it.

The Annex has all the maps of key ecosystem services and issues affecting the various districts.

Nakasaleka District

COMMENTS

- During the rainy season they don't use river water as they have tanks (not sure if refers to all villages).
- The villagers are growing less food and more food in shops. Sell kava(*Yaqona*), cassava and fish.

Ecosystem Services	<i>Lomanikoro</i>	<i>Nakaunakoro</i>	<i>Nakoronawa</i>	<i>Nakaugasele</i>	<i>Kavala</i>	<i>Lawaki</i>	<i>Solotavui</i>
Crops	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)	Chemical use: all farms use chemicals (weedkiller and a little bit of fertiliser); weed killer on dalo throughout the year Root crops: size are getting smaller (think this is from chemicals that are killing soil biota)
Livestock	Piggery: near the sea (unsure of # pigs)	Piggery: 20+ pigs		Piggery: ~ 6 pigs Cattle: ~20+; some horses (for carrying crops to village)	Piggery: 10+ pigs	Piggery: ~ 5 pigs	Piggery: 20+ pigs
Medicines etc	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)	Natural medicines: for running stomach, colds, toothache (comes from tree and vines depending on ailment)
Wildfoods		Honey		Honey			
Air quality	No issue	No issue	No issue	Smoke: when burn cassava farm (don't burn for other crops)	Piggery odour: depending on the wind Smoke: from lit	Mud smells: happens sometimes; more mud is	No issue

Ecosystem Services	<i>Lomanikoro</i>	<i>Nakaunakoro</i>	<i>Nakoronawa</i>	<i>Nakaugasele</i>	<i>Kavala</i>	<i>Lawaki</i>	<i>Solotavui</i>
					fires in dry season	coming from the upland; it is the combined mud and leaves that makes it smell	
Climate regulation	Sea level rise: no Coral bleaching: no	Sea level rise: no Coral bleaching: no	Sea level rise: no Coral bleaching: no	Sea level rise: no Coral bleaching: no	Sea level rise: yes Coral bleaching: all dead; coral could have been affected by more sediment from upland farms	Sea level rise: no Coral bleaching: no	Sea level rise: no Coral bleaching: no
Water regulation	Water availability: okay Flooding: floods in winter; floods almost every year; affects mostly houses; mangroves help with flooding	Water availability: okay Flooding: floods in winter; floods almost every year; affects mostly houses; mangroves help with flooding; lose coconut trees during floods	Water availability: okay Flooding: floods in winter; floods almost every year; affects mostly houses; mangroves help with flooding	Water availability: insufficient water; spring dried up; more gardens near spring (don't use it for irrigation though); use river water now Flooding: floods in winter; floods almost every year; affects mostly houses; mangroves help with flooding	Water availability: spring runs dry in the dry season (runs during the rainy season); have built a dam near the spring Flooding: floods in winter; floods almost every year; affects mostly houses; mangroves help with flooding	Water availability: okay Flooding: floods in winter; floods almost every year; affects mostly houses; mangroves help with flooding	Water availability: insufficient water; spring dried up; more gardens near spring (don't use it for irrigation though); use river water now Flooding: no issue
Erosion control	Sediment: more sediment coming from farms Inland erosion: has landslides and stream bank erosion; mostly during rainy season; water not clear and may affect coral	Sediment: more sediment coming from farms Inland erosion: has landslides and stream bank erosion; mostly during rainy season; water not clear and may affect coral; planted some	Sediment: more sediment coming from farms Inland erosion: has landslides and stream bank erosion; mostly during rainy season; water not clear and may affect coral	Sediment: more sediment coming from farms Inland erosion: has landslides and stream bank erosion; mostly during rainy season; water not clear and may affect coral; planted some Vetiver grass to stop erosion (planting	Sediment: more sediment coming from farms; planted Vetiver grass to stop erosion (planting ~2011 and probably a little less erosion); affects all gardens; less fish	Sediment: more sediment coming from farms Inland erosion: has landslides and stream bank erosion; mostly during rainy season; water not clear	Sediment: more sediment coming from farms

Ecosystem Services	<i>Lomanikoro</i>	<i>Nakaunakoro</i>	<i>Nakoronawa</i>	<i>Nakaugasele</i>	<i>Kavala</i>	<i>Lawaki</i>	<i>Solotavui</i>
		Vetiver grass to stop erosion (planting ~2011 and probably a little less erosion) ; affects all gardens; less fish now but more sea crabs as they like the mud		~2011 and probably a little less erosion); affects all gardens; less fish now but more sea crabs as they like the mud	now but more sea crabs as they like the mud	and may affect coral; also sediment coming from the road (noticed a big difference since the road has been built) ; planted Vetiver grass to stop erosion (planting ~2011 and probably a little less erosion); affects all gardens; less fish now but more sea crabs as they like the mud	
Water purification & waste treatment	Reef: piggery near the sea damages the coral	Reef: piggery near the sea damages the coral		River water: use for drinking and cleaner than the spring water they used to use			River water: use for drinking and cleaner than the spring water they used to use
Biological control	White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered good	White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered good	White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are	White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered good	White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered good	Dalo beetle: only the lower areas affected by Dalo beetle (only village with the dalo beetle) White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no	White flies: affects yagona and cassava Fruit flies: affects all fruit Rats: no mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered good

Ecosystem Services	<i>Lomanikoro</i>	<i>Nakaunakoro</i>	<i>Nakoronawa</i>	<i>Nakaugasele</i>	<i>Kavala</i>	<i>Lawaki</i>	<i>Solotavui</i>
			considered good		them but they are considered good	mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered good	
Disease regulation	Disease: occasionally dengue fever but not often; no real problems	Disease: occasionally dengue fever but not often; no real problems	Disease: occasionally dengue fever but not often; no real problems	Disease: occasionally dengue fever but not often; no real problems	Disease: occasionally dengue fever but not often; no real problems	Disease: occasionally dengue fever but not often; no real problems	Disease: occasionally dengue fever but not often; no real problems
Pollination	No issue	No issue Honey: have	No issue	No issue	No issue	No issue	No issue
Natural hazards	Storm surges: no Coastal erosion: no Drought: no	Storm surges: yes Coastal erosion: yes (losing coconuts) Drought: no	Storm surges: no Coastal erosion: no Drought: no	Storm surges: yes; used to have mangroves (with less protection they are moving to village to higher ground) Coastal erosion: no Drought: no	Storm surges: no Coastal erosion: no Drought: no	Storm surges: no Coastal erosion: no Drought: no	Storm surges: yes Coastal erosion: no Drought: no
Habitat condition	Seagrasses: not in good condition; think it is because of chemicals and erosion Forest: not much change over time; used for pig hunting; a few special birds Mangroves: none	Seagrasses: not in good condition; think it is because of chemicals and erosion Forest: not much change over time; used for pig hunting; a few special birds Mangroves: none	Seagrasses: not in good condition; think it is because of chemicals and erosion Forest: not much change over time; used for pig hunting; a few special birds Mangroves: none	Seagrasses: not in good condition; think it is because of chemicals and erosion; one of worst affected area (3 badly affected areas) Forest: not much change over time; used for pig hunting; a few special birds Mangroves: used to have mangroves but	Forest: not much change over time; used for pig hunting; a few special birds Mangroves: none	Seagrasses: not in good condition; think it is because of chemicals and erosion; one of worst affected area (3 badly affected areas) Forest: not much change over time; used for pig hunting; a few special birds Mangroves: ocean sand seems to be	Seagrasses: not in good condition; think it is because of chemicals and erosion; one of worst affected area (3 badly affected areas) Forest: not much change over time; used for pig hunting; a few special birds Mangroves: lots of fish spawning in mangroves

Ecosystem Services	<i>Lomanikoro</i>	<i>Nakaunakoro</i>	<i>Nakoronawa</i>	<i>Nakaugasele</i>	<i>Kavala</i>	<i>Lawaki</i>	<i>Solotavui</i>
				storm surges have eroded them away; big tsunami washed a lot of the mangroves away		killing the mangroves; lots of fish spawning in mangroves Forest: not much change over time; used for pig hunting; a few special birds	

Sanima District

(representatives present from *Navuatu*, *Drue*, *Naivakarauniniu* and *Naikorokoro*)

COMMENTS

- Crops: every 2-3 years they move to a new place for a garden as the soil loses fertility
- Yaqona: harvest yagona every 4-5 years but they plant a new area every year (to increase production area), can be grown in the same place for about ~15 yrs (they tend to keep it in the same place until the yagona starts to get smaller)
- Seagrasses: turtle and fish eat the sea grass
- Evidence of coral bleaching in *Navuatu* village

Ecosystem Services	Sanima District					
	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
Crops	<p>Irrigation: none</p> <p>Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees; new plantings of coconut trees as head toward Vunisea</p> <p>Chemicals: stopped using chemicals in last 2 years (but some still use them); some gardens are right to the river edge (~5 steps from the river)</p>	<p>Irrigation: none now; used to have some irrigation when there was a commercial veg grower (grew cabbage, cucumber, lettuce, tomato, cauliflower); grower died and no-one took it up and the irrigation equipment was taken and used in the village</p> <p>Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees</p> <p>Chemicals: stopped using chemicals in last 2 years (but some still use them); some gardens are right to the river edge (~5 steps from the river)</p>	<p>Irrigation: none</p> <p>Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees</p>	<p>Irrigation: none</p> <p>Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees</p>	<p>Irrigation: none</p>	<p>Irrigation: none</p>
Livestock		<p>Cattle: ~ 30 cattle in an area they have fenced off</p>	<p>Cattle: used to have 100+ but they kept trampling on their gardens so they are getting rid of them</p>			
Medicines etc	<p>Lots of medicines: mostly collected near villages and gardens</p> <p>Mangrove breathing tubes: used for coughs & fever in children</p>	<p>Lots of medicines: mostly collected near villages and gardens</p> <p>Mangrove breathing tubes: used for coughs & fever in children</p>	<p>Lots of medicines: mostly collected near villages and gardens</p> <p>Mangrove breathing tubes: used for coughs & fever in children</p>	<p>Lots of medicines: mostly collected near villages and gardens</p> <p>Mangrove breathing tubes: used for coughs & fever in children</p>	<p>Lots of medicines: mostly collected near villages and gardens</p> <p>Mangrove breathing tubes: used for coughs & fever in children</p>	<p>Lots of medicines: mostly collected near villages and gardens</p> <p>Mangrove breathing tubes: used for coughs & fever in children</p>

Ecosystem Services	Sanima District					
	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
					tubes: used for coughs & fever in children	
Timber	Pine, Vesi, Dakua, Maghony, Kauvula, Buabua (hardwood), Kaudamu trees used for timber	Pine, Vesi, Dakua, Maghony, Kauvula, Buabua (hardwood), Kaudamu trees used for timber	Pine, Vesi, Dakua, Maghony, Kauvula, Buabua (hardwood), Kaudamu trees used for timber	Pine, Vesi, Dakua, Maghony, Kauvula, Buabua (hardwood), Kaudamu trees used for timber	Pine, Vesi, Dakua, Maghony, Kauvula, Buabua (hardwood), Kaudamu trees used for timber	Pine, Vesi, Dakua, Maghony, Kauvula, Buabua (hardwood), Kaudamu trees used for timber
Wildfoods						
Air quality	No issues Fires: some fires but not often they get away; only occur in dry season and there is a ban on using fire during the dry season	No issues Fires: some fires but not often they get away; only occur in dry season and there is a ban on using fire during the dry season	No issues Fires: some fires but not often they get away; only occur in dry season and there is a ban on using fire during the dry season	No issues Fires: some fires but not often they get away; only occur in dry season and there is a ban on using fire during the dry season	No issues	No issues
Climate regulation	Winter and summer is colder but not affecting anything Coral bleaching: last bleaching event was ~3 yrs ago, it was a bad one but the coral is starting to recover; last bad bleach was 30-40 yrs ago when the fish died as well	Winter and summer is colder but not affecting anything	Winter and summer is colder but not affecting anything	Winter and summer is colder but not affecting anything	Winter and summer is colder but not affecting anything	Winter and summer is colder but not affecting anything
Water regulation	Water availability: less water in the dry season but still have a slow flow of water; don't turn the tap off; spring doesn't feed all the village (they need to find another water source, was okay when only 5 houses when village formed but now	Water availability: less water in the dry season but still have a slow flow of water; don't turn the tap off Flooding: last flood was 1990-1991	Water availability: has lots of springs around it	Water availability: less water in the dry season but still have a slow flow of water; don't turn the tap off; cement tank was built in 1967 when 5 taps but now		

Ecosystem Services	Sanima District					
	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
	~25 houses); also use stream water (stream flows through the village) but is quite dry during the dry season; river near the Matana Resort has dried up Flooding: last flood was 1990-1991			reservoir is not big enough as >20 taps; used to get water from the river that has dried up Floods: floods with heavy rain because have cement footpaths and water can't get away; have heavy rain about every 2 years; houses get affected but gardens are far away and not affected		
Erosion control	Coastal erosion: lots of coastal erosion	Coastal erosion: lots of coastal erosion	Coastal erosion: lots of coastal erosion	Coastal erosion: lots of coastal erosion	Rock cliffs so no erosion	Rock cliffs so no erosion
Water purification & waste treatment	Spring: spring water is clean and use this until 8am in the morning; after that use the river (for washing etc) River: use this water after 8am; some gardens close to the river	Spring: spring water is clean and use this until 8am in the morning; after that use the river (for washing etc) River: use this water after 8am; some gardens close to the river		Water source: ~ 3 months have to clean out the mile-a-minute vine from their water source (cement tank), also some soft soil in there as well Sickness: get runny tummy during the rainy season		
Biological control	Minor birds: arrived about 10 yrs ago on ships Green caterpillar: eats dalo (taro) and most other crops White flies: on yagona (breeds on the stem and if too many they will kill the plant) Rats: will eat the cassava in gardens were lots of	Minor birds: arrived about 10 yrs ago on ships Green caterpillar: eats dalo (taro) and most other crops White flies: on yagona (breeds on the stem and if too many they will kill the plant) Rats: will eat the cassava in gardens were lots of	Minor birds: arrived about 10 yrs ago on ships Green caterpillar: eats dalo (taro) and most other crops White flies: on yagona (breeds on the stem and if too	Mile-a-minute: causes issue in the water tank; also a medicine (put on cuts) Minor birds: arrived about 10 yrs ago on ships Green caterpillar:	Minor birds: arrived about 10 yrs ago on ships Green caterpillar: eats dalo (taro) and most other	Minor birds: arrived about 10 yrs ago on ships Green caterpillar: eats dalo (taro) and most other yagona (breeds on

Ecosystem Services	Sanima District					
	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
	understory (if garden clean then no rats) Wild pigs: all through the forest	understory (if garden clean then no rats) Wild pigs: all through the forest	many they will kill the plant Rats: will eat the cassava in gardens were lots of understory (if garden clean then no rats) Wild pigs: all through the forest	eats dalo (taro) and most other crops White flies: on yagona (breeds on the stem and if too many they will kill the plant) Rats: will eat the cassava in gardens were lots of understory (if garden clean then no rats) Crown of Thorns: Papageno Resort used to pick them up and bury them but they don't know; see them all the time and have been here for a long time; didn't realise they were a problem. Wild pigs: all through the forest	crops White flies: on yagona (breeds on the stem and if too many they will kill the plant) Rats: will eat the cassava in gardens were lots of understory (if garden clean then no rats) Wild pigs: all through the forest	the stem and if too many they will kill the plant Rats: will eat the cassava in gardens were lots of understory (if garden clean then no rats) Wild pigs: all through the forest
Disease regulation	Some dengue fever (usually from people who come to the island and spread it)	Some dengue fever (usually from people who come to the island and spread it) typhoid a few years ago from animal waste in the waterway	Some dengue fever (usually from people who come to the island and spread it)	Some dengue fever (usually from people who come to the island and spread it)	Some dengue fever (usually from people who come to the island and spread it)	Some dengue fever (usually from people who come to the island and spread it)
Pollination	Fruit drop: noted that the small fruit are falling off (mango, orange, pawpaw, banana); started to see it in the last 2-3 yrs; they are turning black and then starting to fall off	Fruit drop: noted that the small fruit are falling off (mango, orange, pawpaw, banana); started to see it in the last 2-3 yrs; they are turning black and then starting to fall off	Fruit drop: noted that the small fruit are falling off (mango, orange, pawpaw, banana); started to see it in the last 2-3 yrs; they	Fruit drop: noted that the small fruit are falling off (mango, orange, pawpaw, banana); started to see it in the last 2-3 yrs; they	Fruit drop: noted that the small fruit are falling off (mango, orange, pawpaw, banana); started to see it in the last 2-3 yrs; they	Fruit drop: noted that the small fruit are falling off (mango, orange, pawpaw, banana); started to see it in the last 2-3 yrs; they

Ecosystem Services	Sanima District					
	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
	Sandalwood: birds are starting to take the seeds and is spreading the sandalwood	Sandalwood: birds are starting to take the seeds and is spreading the sandalwood	are turning black and then starting to fall off Sandalwood: birds are starting to take the seeds and is spreading the sandalwood	are turning black and then starting to fall off Sandalwood: birds are starting to take the seeds and is spreading the sandalwood	banana); started to see it in the last 2-3 yrs; they are turning black and then starting to fall off Sandalwood: birds are starting to take the seeds and is spreading the sandalwood	they are turning black and then starting to fall off Sandalwood: birds are starting to take the seeds and is spreading the sandalwood
Natural hazards	king tides: not an issue Droughts: last drought in 2013 that affected all; lasted about 8 months and the gardens died, small native trees and yagona died and old branches on the yagona died; previous drought was 1992	king tides: not an issue Droughts: last drought in 2013 that affected all; lasted about 8 months and the gardens died, small native trees and yagona died and old branches on the yagona died; previous drought was 1992	king tides: not an issue Droughts: last drought in 2013 that affected all; lasted about 8 months and the gardens died, small native trees and yagona died and old branches on the yagona died; previous drought was 1992	king tides: not an issue Droughts: last drought in 2013 that affected all; lasted about 8 months and the gardens died, small native trees and yagona died and old branches on the yagona died; previous drought was 1992	Drought	Drought:
Habitat condition	Reef: see more sediment on the reef; rocks are different in colour and slippery Sea grass: more prevalent now; not affected by sediment; waves can take the seagrasses Forest: getting bigger and green; lots of small trees coming up; no planting of native trees; more birds now	Reef: see more sediment on the reef; rocks are different in colour and slippery; want to create an MPA to stop potato cod fishing in July, Aug, Sept as this is when the cod come to spawn (proposed MPA is about 40x40 m) Sea grass: more prevalent now; not affected by sediment;	Forest: getting bigger and green; lots of small trees coming up; no planting of native trees; more birds now because of less fire and maybe more trees in the forest	Mangroves: see more sediment in the mangroves area Sea grass: more prevalent now; not affected by sediment; waves can take the seagrasses Forest: getting bigger and green; now because	Forest: getting bigger and green; lots of small trees coming up; no planting of native trees; less fire and maybe more trees in the forest	Forest: getting bigger and green; lots of small trees coming up; no planting of native trees; more birds now because of forest

Ecosystem Services	<i>Sanima</i> District					
	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
	because of less fire and maybe more trees in the forest	waves can take the seagrasses Forest: getting bigger and green; lots of small trees coming up; no planting of native trees; more birds now because of less fire and maybe more trees in the forest		lots of small trees coming up; no planting of native trees; more birds now because of less fire and maybe more trees in the forest	of less fire and maybe more trees in the forest	

Nabukelevu District

(representatives present from Tabuya, Muainuku, Levuka, Nasau, Daviqele, Nabukelevu, and Kabariki)

COMMENTS

- Mt Washington was a tabu site before Birdlife came to establish a protected area
- Participants have not noted any pest or weed problems on Mt Washington
- Changes participants have noted are rise in sea level and more stronger currents (~3/month when in very few in the past)
- All villages used to use duva (derris root) for fishing (it is a stunning poison) but this stopped on advice from fisheries (this was about the same time the MMA were put in place)
- After the road was built there is more erosion and more flooding (also brings paraquat
- Observation: people are getting smaller. People eat less vegetables/fruit now than in the past and eat more chicken and pork.
- Not many people are fishing now as there are not many fish
- More people are buying food rather than growing food. Selling yaqona to buy the food.
- Hot springs marked on the map
- Coral bleachingCoral bleaching: bleaching occurred during the 2014/15 drought; first time the younger participants (~25-35yrs) remembered
- Balolo fish...note not sure of village boundaries for some areas where Balolo is found
'Balolo fish: only found between Oct and Nov; is a sea worm that can be caught 8 days after the full moon
- Giant clam: found in this area and the communities are trying to reseed the them

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	Dagai
Crops	Weedkiller: some use of it in the village gardens Soil fertility: this has improved over time; have been planting more legumes; participant perception climate change may be making soil more fertile. Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Soil fertility: this has improved over time; have been planting more legumes; participant perception climate change may be making soil more fertile. Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Soil fertility: this has improved over time; have been planting more legumes; participant perception climate change may be making soil more fertile. Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts	Soil fertility: this has improved over time; have been planting more legumes; participant perception climate change may be making soil more fertile. Virgin coconut oil: used in the village; now more trees but the older ones have less coconuts
Livestock		Pigs: 3 pigs								
Medicines etc										
Wildfoods	Pigs: lots of wild pigs; go hunting every 2-4 weeks Balaboo fish: only found between Oct and Nov; is a sea worm that can be caught 8 days after the full moon	Pigs: lots of wild pigs; go hunting every 2-4 weeks Balaboo fish: only found between Oct and Nov; is a sea worm that can be caught 8 days after the full moon	Pigs: lots of wild pigs; go hunting every 2-4 weeks	Pigs: lots of wild pigs; go hunting every 2-4 weeks			Balaboo fish: only found between Oct and Nov; is a sea worm that can be caught 8 days after the full moon			
Air quality	No issues; no	No issues; no	No issues; no		No issues; no	No issues; no	No issues; no	No issues; no	No issues; no	No issues; no

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Davigele	Qaliira	Lomati	Taulaulia	Dagai
	changes noticed	changes noticed	changes noticed		changes noticed	no changes noticed	no changes noticed	changes noticed	changes noticed	changes noticed
Climate regulation	Sea level: noticed this now seeing the top of the reef about twice/month (used to be about once/month); now also more coral on the beach Currents: noticed now there are a lot of strong currents ~ 3 times/month; very few strong currents in the past	Sea level: noticed this now seeing the top of the reef about twice/month (used to be about once/month); now also more coral on the beach	Sea level: noticed this now seeing the top of the reef about twice/month (used to be about once/month); now also more coral on the beach		Sea level: noticed this now seeing the top of the reef about twice/month (used to be about once/month); now also more coral on the beach Coral bleaching: occurred ~ 20 years ago, coral is starting to recover but is still a lot worse than 40 years ago.	Sea level: noticed this now seeing the top of the reef about twice/month (used to be about once/month); now also more coral on the beach	Sea level: noticed this now seeing the top of the reef about twice/month (used to be about once/month); now also more coral on the beach Tsunami: a Tsunami damaged the old villages so the village moved to the top of the hill			
Water regulation	Water availability: have water at water source A during the rainy season but during the dry season; this water source started to dry up in 2014 (lots of pine in the area which is ~40 yrs old)		Flooding: May 2016 flood; only caused a little bit of damage; floods happened at low tide; affected houses and gardens		Water source: Base of Mt Washington (shared between Nasau, Davigele, Qaliira, Nabukelevu) - provides enough water all	Water source: Base of Mt Washington (shared between Nasau, Davigele, Qaliira, Nabukelevu) - provides enough water all	Water source: Base of Mt Washington (shared between Nasau, Davigele, Qaliira, Nabukelevu) - provides enough water all			

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Davigele	Qaliira	Lomati	Taulaulia	Dagai
	Flooding: occurred in 2012, 2013 and May 2016 (this flood was 2 weeks before the big swell on May 23 rd (see news article) that caused all the damage); affected houses and gardens				year round Flooding: during heavy rains when water runs off the mountain; stream entrances at the sea get blocked by the sand and causes the water coming down the streams to back up.	year round Flooding: during heavy rains when water runs off the mountain; stream entrances at the sea get blocked by the sand and causes the water coming down the streams to back up.	year round; they started to use this water source in the 1990s as they didn't have enough water from their water source Flooding: during heavy rains when water runs off the mountain; stream entrances at the sea get blocked by the sand and causes the water coming down the streams to back up.			
Erosion control	Coastal erosion: a lot in the last year Inland erosion: a big landslip caused by a lot of rain; farmers told to stop burning about 5 years ago (did not see much)	Coastal erosion: erosion present; coconut trees still standing but only hanging by the roots Inland erosion: farmers told to stop burning about 5 years ago	Coastal erosion: each year lose about 60 cm of coast but last year they lost ~2m Inland erosion: farmers told to stop burning about 5 years ago		Inland erosion: farmers told to stop burning about 5 years ago (did not see much soil)	Inland erosion: farmers told to stop burning about 5 years ago (did not see much soil)	Inland erosion: farmers told to stop burning about 5 years ago (did not see much soil)	Inland erosion: see more erosion than 10-20yrs ago (might be due to climate change); they are getting erosion where	Riverbank erosion: erosion is occurring at pt H Inland erosion: see more erosion than 10-20yrs	

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	Dagai
	soil loss with the burning)	about 5 years ago (did not see much soil loss with the burning)	(did not see much soil loss with the burning)		loss with the burning) Coastal erosion: all along the coast around Daiqele; damages the coconut trees	loss with the burning); Pt G there was a lot of sediment that came down from this point in the 1940s Coastal erosion: all along the coast around Daiqele; damages the coconut trees	loss with the burning) Coastal erosion: all along the coast around Daiqele; damages the coconut trees	they are cutting the trees from their gardens	ago (might be due to climate change); they are getting erosion where they are cutting the trees from their gardens	
Water purification & waste treatment	Water quality: considered to have the dirtiest water in Kadavu; use water source A for drinking but there is not much water at this source; village is looking for a new water source; they do use some water tanks; water source B has lots of sediment; some use of weedkiller in the village farming areas;	Water quality: the water is dirty when it floods	Water quality: the water is dirty when it floods							

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Taulaulia	Dagai
	some farm houses near the river and they use the water above the water source for cleaning and washing.									
Biological control	Red snails: came from another village in the gravel used to make the road in 2014; not sure if it causes any problems as yet Red ant: killing the <i>yaqona</i> Caterpillars: on the <i>dalo</i> White flies: on cassava, fruit (mango, citrus); think the <i>Drala</i> bought the white fly (<i>Drala</i> was planted to enrich the soil) Black spot: found on many of the fruits	Caterpillars: on the <i>dalo</i> White flies: on cassava, fruit (mango, citrus); think the <i>Drala</i> bought the white fly (<i>Drala</i> was planted to enrich the soil) Black spot: found on many of the fruits	Caterpillars: on the <i>dalo</i> White flies: on cassava, fruit (mango, citrus); think the <i>Drala</i> bought the white fly (<i>Drala</i> was planted to enrich the soil) Black spot: found on many of the fruits	Caterpillars: on the <i>dalo</i> White flies: on cassava, fruit (mango, citrus); think the <i>Drala</i> bought the white fly (<i>Drala</i> was planted to enrich the soil) Black spot: found on many of the fruits	Fruit bats: all fruits; more fruit than bats before White fly: cassava and <i>yaqona</i>	White fly: cassava and <i>yaqona</i> Minor birds: arrived 2-3 years ago; they nest in houses but don't seem to be affecting the houses yet. Fruit bats: all fruits	White fly: cassava and <i>yaqona</i>	White fly: cassava and <i>yaqona</i>	White fly: cassava and <i>yaqona</i>	White fly: cassava and <i>yaqona</i>
Disease regulation	No issues noted	No issues noted	No issues noted	No issues noted						
Pollination	Fruit drop: quite a lot of fruit are dropping their fruit when they are small (Mango,	Fruit drop: quite a lot of fruit are dropping their fruit when they are small (Mango,	Fruit drop: quite a lot of fruit are dropping their fruit when they are small (Mango,							

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Davigele	Qaliira	Lomati	Taulaulia	Dagai
	citrus, pawpaw, banana, wild apple (Kavika)); started to notice the fruit drop in last 20 years; most years they lose about 80% of the fruit but in last 2 years they think it is closer to 90%; when Drala was planted gasau grass (not from Kadavu) can and if the fruit is not big before the grass flowers the fruit will fall off (this is the story from the participants).	citrus, pawpaw, banana, wild apple (Kavika)); started to notice the fruit drop in last 20 years; most years they lose about 80% of the fruit but in last 2 years they think it is closer to 90%; when Drala was planted gasau grass (not from Kadavu) can and if the fruit is not big before the grass flowers the fruit will fall off (this is the story from the participants).	citrus, pawpaw, banana, wild apple (Kavika)); started to notice the fruit drop in last 20 years; most years they lose about 80% of the fruit but in last 2 years they think it is closer to 90%; when Drala was planted gasau grass (not from Kadavu) can and if the fruit is not big before the grass flowers the fruit will fall off (this is the story from the participants).							
Natural hazards	High tides: affects village often (see water regulation) Storm surges: these storm surges take a lot of sand; sea bed is quite shallow and there are more seagrasses	Storm surges: these storm surges take a lot of sand; sea bed is quite shallow and there are more seagrasses	Storm surges: these storm surges take a lot of sand; sea bed is quite shallow and there are more seagrasses		Droughts: have a drought problem; sometimes lose 50-60% of crops; the mountain affects the rainfall; have a lighter soil that is more affected by drought	Droughts: have a drought problem; sometimes lose 50-60% of crops; the mountain affects the rainfall; have a lighter soil that is more affected by drought	Droughts: have a drought problem; sometimes lose 50-60% of crops; the mountain affects the rainfall; have a lighter soil that is more affected by drought	Droughts: have a drought problem; sometimes lose 50-60% of crops; the mountain affects the rainfall; have a lighter soil that is more affected by drought	Droughts: have a drought problem; sometimes lose 50-60% of crops; the mountain affects the rainfall; have a lighter soil that is more affected by drought	Droughts: have a drought problem; sometimes lose 50-60% of crops; the mountain affects the rainfall; have a lighter soil that is more affected by drought
Habitat	Rock (Vatuvali)	Mangroves: never	Mangroves: about		Sea grasses	Sea grasses:	Sea grasses:			

Ecosystem Services	Nabukelevu District									
condition	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Davigele	Qaliira	Lomati	Talaulia	Dagai
	Point???: special rock where if you stand on it the sea will be rough Another rock that if you pour water on it will rain Reef: harder to catch the fish; reef is more damaged; this reef damage is due to climate change and overfishing (use fishing nets so catch lots of fish, no SCUBA but do fish at night), poaching though; coral not in such good condition as the sea cucumbers are not cleaning the reef (being harvested for sale in China), also harvested for sale coming down the rivers (more rain and nothing to slow down runoff) which could be damaging the reef.	any mangroves there; but mangroves between Muainuku and Levuka Reef: harder to catch the fish; reef is more damaged; this reef damage is due to climate change and overfishing (use fishing nets so catch lots of fish, no SCUBA but do fish at night), poaching though; coral not in such good condition as the sea cucumbers are not cleaning the reef (being harvested for sale in China), also harvested for sale coming down the rivers (more rain and nothing to slow down runoff) which could be damaging the reef.	10 yrs ago started to see more mangroves; there could be less erosion with mangroves and more fish Reef: harder to catch the fish; reef is more damaged; this reef damage is due to climate change and overfishing (use fishing nets so catch lots of fish, no SCUBA but do fish at night), poaching though; coral not in such good condition as the sea cucumbers are not cleaning the reef (being harvested for sale in China), also harvested for sale coming down the rivers (more rain and nothing to slow down runoff) which could be damaging the reef. Coral bleaching:		(at pt C and other side of peninsula from Nasau): before the road there was lots of sea grasses and mussels but now there is nothing; the area got really muddy and killed everything; water is starting to get cleaner though; where still some seagrasses there are less seagrasses and now much smaller (used to be ~2 ft but now ~1ft); a new seagrass also arrived about 2013 (after the road was built) Forest: unchanged condition; more birds; less burning now (before they would burn if needed to plant crops) Reef: less coral; less big fish; lots of small fish in the new seagrass (new sea grass is ~ 1 ½ ft tall) ; coral not in such good condition as the sea	less seagrasses and now much smaller (used to be ~2 ft but now ~1ft); a new seagrass also arrived about 2013 (after the road was built) Forest: unchanged condition; more birds; less burning now (before they would burn if needed to plant crops) Reef: less coral; less big fish; lots of small fish in the new seagrass (new sea grass is ~ 1 ½ ft tall) ; coral not in such good condition as the sea	less seagrasses and now much smaller (used to be ~2 ft but now ~1ft); a new seagrass also arrived about 2013 (after the road was built) Forest: unchanged condition; more birds; less burning now (before they would burn if needed to plant crops) Reef: less coral; less big fish; lots of small fish in the new seagrass (new sea grass is ~ 1 ½ ft tall) ; coral not in such good condition as the sea			

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Davigele	Qaliira	Lomati	Taulaulia	Dagai
			bleaching occurred during the 2014/15 drought; first time the younger participants (~25-35yrs) remembered		built) Forest: unchanged condition; more birds; less burning now (before they would burn if needed to plant crops) Reef: less coral; less big fish; lots of small fish in the new seagrass (new sea grass is ~ 1 ½ ft tall); coral not in such good condition as the sea cucumbers are not cleaning the reef (being harvested for sale in China), also more freshwater coming down the rivers (more rain and nothing to slow down runoff) which could be damaging the reef. Coral bleaching: bleaching occurred during the 2014/15 drought; first time the younger participants (~25-35yrs) remembered	cucumbers are not cleaning the reef (being harvested for sale in China), also more freshwater coming down the rivers (more rain and nothing to slow down runoff) which could be damaging the reef.	cucumbers are not cleaning the reef (being harvested for sale in China), also more freshwater coming down the rivers (more rain and nothing to slow down runoff) which could be damaging the reef.			

Ecosystem Services	Nabukelevu District									
	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Davigele	Qaliira	Lomati	Taulaulia	Dagai
					slow down runoff) which could be damaging the reef.					
Cultural importance							Giant clam: found in this area and trying to reseed the clam			

Naceva District

(representatives present from *Kadavu*, *Nacomoto*, *Soso*; chief from *Nacomoto* and *Soso* present)

COMMENTS

- *Kadavu*: moved the village to get closer to the coast and a water supply.
- *Kadavu* (special place): ancestors bought a salt stone when they came to the area many 100s of years ago
- *Soso*: no MPA now; stopped about 2009
- *Jioma*: MMA is to protect the crabs
- *Nacomoto*: village was moved from the top of the hill to the coast; easier transport and downstream of water supply; 2 villages moved to the same site
- *Nacomoto* (special place): there is a tree and if a branch gets broken there is a tidal wave. So if you want some visitors to leave you go and break a branch.
- Seems like there is more inland erosion in the last couple of years
- Not a lot of *Drala* has been planted in the district
- *Muanisolo* has a dam for the water source.

Ecosystem Services	<i>Naceva District</i>								
	<i>Kadavu</i>	<i>Nacomoto</i>	<i>Jioma</i>	<i>Niudua</i>	<i>Vukavu</i>	<i>Soso</i>	<i>Dravuvalu</i>	<i>Vunisei</i>	<i>Daku</i>
Crops									
Livestock		Pigs: 20 pigs located right on the mangrove passage; less fish where the pigs are	Pigs: ~ 50 pigs; located on the mangrove passage		Pigs: ~15-25 pigs	Pigs: 25 pigs; located on mangrove passage; have notice more fish in the area	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens
Medicines etc									
Wildfoods	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens			
Air quality	No issues	No issues	No issues	No issues	No issues	No issues	No issues	No issues	No issues
Climate regulation	Rainfall: annual rainfall has increased; now a band of continuous rain between Kadavu and Soso (marked on map and misses Nacomoto) Coral bleaching:					Coral bleaching: there was a bleach ~10 yrs ago and coral hasn't come back			

Ecosystem Services	<i>Naceva District</i>								
	<i>Kadavu</i>	<i>Nacomoto</i>	<i>Jioma</i>	<i>Niudua</i>	<i>Vukavu</i>	<i>Soso</i>	<i>Dravuwalu</i>	<i>Vunisei</i>	<i>Daku</i>
	there was a bleach ~10 yrs ago and coral hasn't come back								
Water regulation	Water source: waterfall for the village; there is a separate water fall for the school Water availability: no issues Flooding: when heavy rain; water is very dirty; small was damaged; flood about every 2 yrs and last flood was 2015	Water availability: no issues Flooding: when heavy rain; water comes down and breaks the seawall when there is inland flooding; last big flood was ~ 5 years ago with the previous flood being a year before that	Water availability: no issues Flooding: last flood was 3 yrs ago	Water availability: no issues		Water availability: no issues	Water source: a dam Water availability: no issues	Water source: a dam that supports both the school and the village Water availability: no issues	Water source: a dam Water availability: no issues
Erosion control	Inland erosion: there is some erosion behind the village where there are no trees	Coastal: some erosion; now less mangroves as used for firewood and removed to clear entrance to the village Inland: cut down trees near the stream for cattle farming ~35 yrs ago; there are no cattle anymore but					Riverbank: has some erosion; ~ 20yrs ago a lot of land was cleared; seems like more floods than before Coastal: some erosion where the stream meets the ocean		Coastal: coconut trees falling into the ocean; started happening about 15 yrs ago

Ecosystem Services	<i>Naceva District</i>								
	<i>Kadavu</i>	<i>Nacomoto</i>	<i>Jioma</i>	<i>Niudua</i>	<i>Vukavu</i>	<i>Soso</i>	<i>Dravuwalu</i>	<i>Vunisei</i>	<i>Daku</i>
		the trees have not regrown; every time it rains the land slips away.							
Water purification & waste treatment	Water quality: no issues	Water quality: no issues for drinking water Coastal water quality: pigs are located on the mangrove passage and there are less fish there	Water quality: no issues	Water quality: no issues		Water quality: no issues	Water quality: no issues	Water quality: no issues	Water quality: no issues
Biological control	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens Crown of Thorns: lots of them but not sure of the amount of damage they are causing Para grass: don't have any	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens Crown of Thorns: lots of them but not sure of the amount of damage they are causing Minor birds: came in 2005; they peck at everything and pull seeds out Para Grass: came ~40 yrs ago; have to poison it	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens Para Grass: came ~40 yrs ago; have to poison it	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens Para Grass: came ~40 yrs ago; have to poison it	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens Para Grass: came ~40 yrs ago; have to poison it	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens Para Grass: came ~40 yrs ago; have to poison it	White flies: on <i>yagona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	White flies: on <i>yaqona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens	White flies: on <i>yagona</i> Slugs/snails: not a big problem Wild pigs: lots of them everywhere; hunt them about once/month when the pigs start to damage the gardens

Ecosystem Services	<i>Naceva District</i>								
	<i>Kadavu</i>	<i>Nacomoto</i>	<i>Jioma</i>	<i>Niudua</i>	<i>Vukavu</i>	<i>Soso</i>	<i>Dravuwalu</i>	<i>Vunisei</i>	<i>Daku</i>
Disease regulation	No issues	No issues	No issues	No issues	No issues	No issues		No issues	No issues
Pollination	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)		Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)	Bees: lots of bees around Fruit drop: coconut and mango only seem to fall off when still small; they think is due to weather; have noticed this since Cyclone Evan (Dec 2012)
Natural hazards		Drought: less rain behind Nacomoto (see map for location) ; affects the crops; used to know where there would be good rain but now not sure; change was ~20yrs ago						Storm surge: some effects but not sure where (Check map) Drought: less rain behind Vunisei (see map for location) ; affects the crops; used to know where there would be good rain but now not sure; change was ~20yrs ago	
Habitat condition	Mangroves: Matava resort cleared the mangroves from the resort area many years ago; less	Mangroves: now less mangroves as used for firewood and removed to clear entrance to the village; less mangroves now Reef: smaller fish	MMA: developed for crabs			Mangroves: seems like more mangroves			

Ecosystem Services	<i>Naceva District</i>								
	<i>Kadavu</i>	<i>Nacomoto</i>	<i>Jioma</i>	<i>Niudua</i>	<i>Vukavu</i>	<i>Soso</i>	<i>Dravuwalu</i>	<i>Vunisei</i>	<i>Daku</i>
	mangroves now Reef: still quite a lot of big fish; lots of poaching; hard to catch fish in the daytime but night is still okay (used to be easy to get fish during the day; within ½ hr used to get fish)	now; started to see the decrease in fish size about 10 years ago when they started to use a net instead of a line or spear							

Ecosystem Service	<i>Tavuki District</i>			
	Tavuki	<i>Solodamu</i>	Nanuku	<i>Baidamudamu</i>
Crops	<i>Yaqona</i> and <i>dalo</i> are the main crops planted in the village gardens			
Livestock		Pigs roaming around the village		
Medicines etc				
Wildfoods	Wild yams grown in forested areass		Wild yams grown in forested areas	
Air quality regulation	Forestry areas fresh air – cools the environment Southeast trade winds during cyclone season (in summer) is warm			
Climate regulation	Six months drought Water channels dries up normally happens during the cold/ dry season (May to October)	Six months drought	Six months drought	Six months drought
Water regulation	9pm every night There two sources of water	Low water flow village spring water has dried up	Water source (Mata ni wai) - village water is closed at	
Erosion control	Road construction – soil siltation on coastal areas Dried up coastal areas Fisheries population is low due to siltation and sedimentation	Road construction – soil siltation on coastal areas Dried up coastal areas Fisheries population is low due to siltation and sedimentation		
Water purification and waste treatment	Water is affected from deforestation – pine is affecting the water source			cattle dung in the waterway Natumua village – horse dung goes in the water way There are water treatment measures from the source. Water is normally boiled for drinking
Biological control	White fly is affecting the fruit	White fly is affecting the	White fly is affecting the	White fly is affecting the

Ecosystem Service	<i>Tavuki District</i>			
	<i>Tavuki</i>	<i>Solodamu</i>	<i>Nanuku</i>	<i>Baidamudamu</i>
	trees and other plants including vegetables such as bele (<i>Abelmoschus manihot</i>) Pigs – destroying agricultural crops Kaka (parrots) – eating banana and plantain Snails affecting vegetables Yellow insects eating leaves of vegetables as well as other plans	fruit trees and other plants including vegetables such as bele (<i>Abelmoschus manihot</i>) Pigs – destroying agricultural crops Kaka (parrots) – eating banana and plantain Snails affecting vegetables Yellow insects eating leaves of vegetables as well as other plans	fruit trees and other plants including vegetables such as bele (<i>Abelmoschus manihot</i>) Pigs – destroying agricultural crops Kaka (parrots) – eating banana and plantain Snails affecting vegetables Yellow insects eating leaves of vegetables as well as other plans	fruit trees and other plants including vegetables such as bele (<i>Abelmoschus manihot</i>) Pigs – destroying agricultural crops Kaka (parrots) – eating banana and plantain Snails affecting vegetables Yellow insects eating leaves of vegetables as well as other plans
Disease regulation	No dengue No Zika	No dengue No Zika	No dengue No Zika	No dengue No Zika
Pollination	Parrots (kaka)	Parrots (kaka)	Parrots (kaka)	Parrots (kaka)
Natural hazards	King tides more regular now compared to 10 years ago Agriculture land getting more swampy Sea wall not properly built In the last 5 years there have less incidence of tropical cyclone hitting Kadavu	Agriculture land getting more swampy due to inundation events from king tides	Agriculture land getting more swampy due to inundation events from king tides	Agriculture land getting more swampy due to inundation events from king tides
Habitat condition	Mangroves healthy Sand fish is back Fertile soil – places where they cannot plant kava – they can now Medicinal plants in the forest areas			

Terrestrial biodiversity

In Kadavu the only two forest systems that have been studied in detail regarding its biodiversity are located in the districts of *Nakasaleka* and *Nabukelevu*. A detail information of the terrestrial biodiversity is covered in Deliverable L2.3 “Establishment and maintenance of Protected Areas in Kadavu Province – diagnosis and action plan. In summary *Delaivuiivi* or Mt Washington in the district of *Nabukelevu* has a pristine montane forest with known endemics. Currently it is under threat from the extension of Kava cultivation into upper catchments. *Koronibanuve* in the highlands of *Matasawalevu* village in the district of *Nakasaleka* has the largest block of intact forest & watersheds on Kadavu with good populations of island endemics, important watersheds for reefs. This is where a new flowering plant belonging to the *Medinilla* plant group was discovered. The main threat in this location is indiscriminate burning of bushland and grassland. The plant’s common name has not been confirmed yet but the name ***Medinilla matasawalevu*** has been suggested to illustrate its locatio (Institute of Applied Sciences, 2012).

ENDEMIC BIRD SPECIES ON KADAVU

As stated in Deliverable L2.3 Kadavu Island has four endemic bird species of birds. These are

- Kadavu Shining (Musk) Parrot (*prosopeia splendens*);
- Kadavu Honeyeater (*xanthotis provocator*);
- Kadavu Fantail (*Rhipidura personata*); and
- Whistling Dove (*chrysoenas layardi*) (Masibalavu and Dutson, 2006).

Interestingly one of these birds specifically the Kadavu Shining (Musk) Parrot (*prosopeia splendens*) has been eating fruits such as pawpaws from most of the villager’s home gardens. In Tavuki villages the communities are finding these birds a nuisance. One of the reasons why these birds are venturing into village home gardens is because their habitats in the middle and upper catchments have been destroyed due to the extension of agricultural lands.

8. Status of ecosystem services: risks and opportunities

RISKS

Risks related to the economic & social livelihood

- Dependence on yaqona; few out-of-village opportunities and little income diversification
- Fisheries are available as an alternative source of income, but the status of fisheries is not very clear

Risks related to the biophysical environment

- Migration to the coast has facilitated transport, but has increased vulnerability to coastal disasters and impacts of climate change such as sea-level rise
- Erosion and subsequent environmental issues associated with developing a road network
- Indiscriminate burning a major threat to biodiversity.

KEY ISSUES AND OPPORTUNITIES

NAKASALEKA DISTRICT

- 1) Road construction (near Lawaki)
 - Caused a lot of problems in the forested area and coastal area
 - No EIA done for the road
- 2) Flooding
 - Nakaugasele: have put some rocks to stop the flooding
 - They would like buoys to mark the MMA so they can work out where they can stop people fishing
 - Kavala: have flooding and coastal inundation – would like something that addresses both (they haven't been affected this year but get affected in most years)
- 3) MMA
 - Nakaugasele: would like buoys to mark the MMA so they can work out where they can stop people fishing
- 4) Water
 - a. *Vacalea* and *Nukuvou* have problems with their current dam
- 5) Inundation/sea level rise
 - Need a retreat strategy for some villages
 - All villages affected now by high/king tides : every time there is a high/king tide there are 3 houses that get flooded in *Tiliva* and 5 houses in *Lawaki*
 - It is worse than in the past and there is much more inundation.
 - Kavala: have flooding and coastal inundation – would like something that addresses both (they haven't been affected this year but get affected in most years)
- 6) Mangroves

- No-one is planting mangroves to deal with coastal erosion
- 7) Coastal areas
- *Matasawalev* : coastal area is swampy because of erosion. They have built a boardwalk to get from the coast to the village
 - *Matasawalevu*: built a seawall but there are some gaps in the wall. This is causing more problems as water can't get out

TAVUKI, SANIMA, YAWE AND RAVITAKI DISTRICTS

- 1) MPA
- *Drue*: want to create a MPA to protect the cod who come to spawn in July, Aug, Sept; area is about 40x40m in size; would need a specific boat to police the MPA and they would go out at intervals all night to check that no one is fishing
 - *Ravitaki*: issues with policing of MPA and also the management of the areas as well
- 2) Water supply
- *Tavuki*: water supply was damaged last year by the cyclone; *Solodamu* uses bore holes and need support to buy pipes, etc.
 - *Ravitaki*: issues with the cleanliness and also a shortage in water; 7 out of 9 villages don't have good access to water (both water quality and water quantity); reservoir was built in the wrong place and needs to be moved to supply both the school and the village (water system issue); government is supposed to be helping (water is free for Fiji initiative) but not likely to be before 2018 and they need help before then (Fiji Water Authority is only looking after *Vunisea*); *Natumua* has water quality and access to water issues
 - *Yawe*: issues with water cleanliness and also the shortage of water
 - *Sanima*: water shortages and issues with the water sources/systems; animals roam around and cause damage; both *Navuatu* and *Drue* experiencing water shortages; *Drue* had typhoid a few years ago from animal waste in the waterway
- 3) Coastal erosion
- *Ravitaki*: have some coastal erosion
- 4) Pine
- *Yawe*: want to get the pine harvested and want a road and bridge built

NABUKELEVU DISTRICT

1. Market access
 - Plant a lot of root crops and catch fish
 - Distance from Vunisea is a problem and the road is very bad
 - Village/district problem
2. Flooding, due to king tides and storm surges
 - *Nasau* and *Daviqele*: regular floods
 - Tabuya: affected by king tides/surges and need help with an evacuation centre; have identified a place for the evacuation centre.
 - Muainuku: has frequent storm surges and is more of a regular occurrence rather than something that is not so common.
 - Levuka: has storm surges and coastal protection is an issue; thinking of a sea wall
3. Organic farming
 - Whole district is willing to go organic
 - Institutional structure is an issue: whole island wants to go organic so it is too slow for the district
 - KYMST is coming to the next provincial meeting on Aug 10th 2016 what can we share with them
 - Organic committee are visiting *Daviqele* on August 1st 2016 (they are going to be visiting different parts of the island at different times).
4. Shoreline erosion
 - Shoreline is getting smaller
 - Due to waves and surges
5. Transportation
 - *Daviqele*: not a good sea channel from village to the open ocean; have to wait until high tide to get boats out; this is a real issue for *Daviqele* as it is the chiefly village; if have a function then have to wait until high tide.
 - Proposed channel is in the middle of the MPA
 - What advice do we have on resolving the issue; can we propose an alternative area for the MPA
6. Water source
 - *Nasau*, *Daviqele*, *Qaliira*, *Nabukelevu-i-ra*: when it rains sediment causes the water supply to get dirty and also blocks the system and no one can get the water; there are no one can get water; someone needs to look and see what can be done with the system
7. Coral bleaching
 - Fisheries department has come to see the coral bleaching; said they will come to reseed the coral; will come now they have new funding for the year.
8. Drala
 - Was planted to help crops and soil health but now starting to cause a problem
9. Tilapia pond
 - Pond is losing water and suspect it is due to a wild tree '*Uto ni bulumakau*' (heart of cattle) (*Annona glabra*); has a root system like an African Tulip Tree and suckers from the root.

NACEVA DISTRICT

1. Storm surges/king tides/flooding:
 - Kadavu: would like a seawall to protect the village as coastal protection is not working (area marked on map); have cement foot paths so get both floods from the sea and the river
 - Nacomoto: they have inundation from the sea and the river; the storm surges are piling sand at the river mouth making it difficult for the river to flow into the sea and this causes water to back up; can't retreat as they are close to the water source (water source is close to the ocean) and can't find a new water source to move to.
 - Dravuvalu: similar issue to Kadavu and Nacomoto with flooding from the sea and the river
 - Daku: have some inundation from the sea but not the river
 - Vunisei: have some inundation from the sea but not the river
2. Ocean condition
 - a. Soso: FLMMA representative left the area in 1969 and when he came back he noticed there was no seashells anymore
3. Toilet waste:
 - a. Waste goes into a septic tank and then out to the sea
 - b. Can still swim in the sea though and people are not getting sick.

OPTIONS TO CONSIDER:

1. Marine Protected Areas (LMMA) specifically "no-take" zones
 - a. Legal protection for the humphead wrasse (*Cheilinus undulates*), and how to fast track it.
 - b. Dedicated boat for policing of MPA
 - c. Clarify surfing decree about poaching
2. Erosion
 - a. Planting of coconuts to provide more income and also some coastal protection
 - b. Other coastal vegetation such as *Barringtonia asiatica*
3. Awareness raising
 - a. Use of water
 - b. Livestock control
 - c. Benefits of a health forest
 - d. Trees by water ways (benefits and also challenges with water use) – could be food trees – need to consider their water needs so don't compete with water supply
4. Coastal protection
 - a. Mangroves
 - b. Mapping to identify where to relocate houses (if relocation is necessary)
5. Erosion protection from road construction
 - a. Applications of appropriate ecosystem based management measures to complement engineering infrastructure erosion protection measures such as gabion and geo container) to reduce soil loss and damage caused by the road

Action Plan

Objective	On-ground activity	Partners to assist	Targeted communities	Expected Output	Expected Outcome	Cost	2017							
							May	June	July	Aug	Sep	Oct	Nov	Dec
1. Marine Protected Areas (LMMA) specifically “no-take” zones	<p>Consultation and working with communities at district level in establishing village by-laws that adhere to the protection of endangered species such as humphead wrasse</p> <p>9 X 2 days workshops for each village</p>	FELA & KYMST	<i>Nukuvou</i> <i>Nasegai</i> <i>Levuka</i> <i>Vabea</i> <i>Solodamu</i> <i>Vakarauniniu</i> <i>Drue</i> <i>Nalotu</i> <i>Nacomoto</i>	Participants who will attend the workshops and consultation have a clear understanding on the appropriate means of protecting endangered marine species	Participants mobilize other community members in their own village and districts to protect endangered marine species	14,000								

Objective	On-ground activity	Partners to assist	Targeted communities	Expected Output	Expected Outcome	Cost	2017							
							May	June	July	Aug	Sep	Oct	Nov	Dec
	Developing and implementing a business plan at district level specifically to fundraise for the cost of LMMA no-take zone regular boat surveillance 2 days training on developing business plan on natural resources enterprise	KYMST and Landcare NZ	Nine districts to have a business plan for their surveillance boats operation	Districts reps who are involved in this training have a clear understanding on how to prepare a business plan for a community conservation initiative such as the financial aspects of the “no-take zone” and LMMA	community members are able to see the means to sustainably manage their resources in an economic and ecological way	9,000								
	Clarify implication of the surfing decree in LMMA and how it overrides customary fishing rights and opens it up to poaching	FELA, Police	Nine districts KYMST Kadavu Provincial Council members	A brochure and poster produced explain the implication of the surfing degree on the customary fishing ground and LMMA	Kadavu resource owners are able to incorporate with clear understanding such legislation in the village resource management meetings	2,000								
2.Awareness raising on use of water, livestock	2 day workshops in the eight villages	KYMST	<i>Nabouwalu</i> <i>Nasegai</i> <i>Solodamu</i> <i>Namara</i>	Villagers have clear understanding of Management action plan for	Villagers able to use water wisely (e.g. no running taps in	18,000								

Objective	On-ground activity	Partners to assist	Targeted communities	Expected Output	Expected Outcome	Cost	2017							
							May	June	July	Aug	Sep	Oct	Nov	Dec
control benefits of a healthy forest trees by water ways (benefits and also challenges with water use)			<i>Daviqele Nukuvou Dravuwalu Daku</i>	addressing the objective issues A brochure and poster produced on water use, management of livestock, benefits of healthy forest system and related ecosystem services	villages) Livestock are properly fenced									
3.Erosion	Planting of coconuts to provide more income and also coastal protection Planting of coastal vegetation such as <i>Barringtonia asiatica</i> Collection of seedling, establishing nurseries and planting	KYMST	<i>Nasegai Ravitaki Levuka Galoa Dravuni</i>	¼ to ½ hectares of area planted	Coconuts are collected and sold by the communities	14,000								
4.Coastal protection	Replanting of mangroves Establishing nursery and planting on	KYMST	<i>Nasegai Ravitaki Lawaki Galoa Dravuni</i>	Approximate ¼ hectare of the coastal degraded areas will be replanted	Improvement of the coastal system resilience	8,000								

Objective	On-ground activity	Partners to assist	Targeted communities	Expected Output	Expected Outcome	Cost	2017							
							May	June	July	Aug	Sep	Oct	Nov	Dec
	designated areas in the five villages		<i>Richmond</i>											
5. identification of relocation sites	Guideline and mapping process to identify where to relocate houses (if relocation is necessary)			Map produced showing possible and potential relocation sites of each village	Villages have clear understanding where to relocate their houses and alternative garden and water source	3,000								
5.Erosion protection from road construction	Applications of appropriate ecosystem based management measures to complement engineering infrastructure erosion protection measures such as gabion and geo container) to reduce soil loss and damage caused by the road.	KYMST	<i>Namara Lawaki Solotavui Kabaririki</i>	At most ¼ hectare of road side are replanted with use of gabion where possible	Stability of road structure	10,000								
Total						78,000								

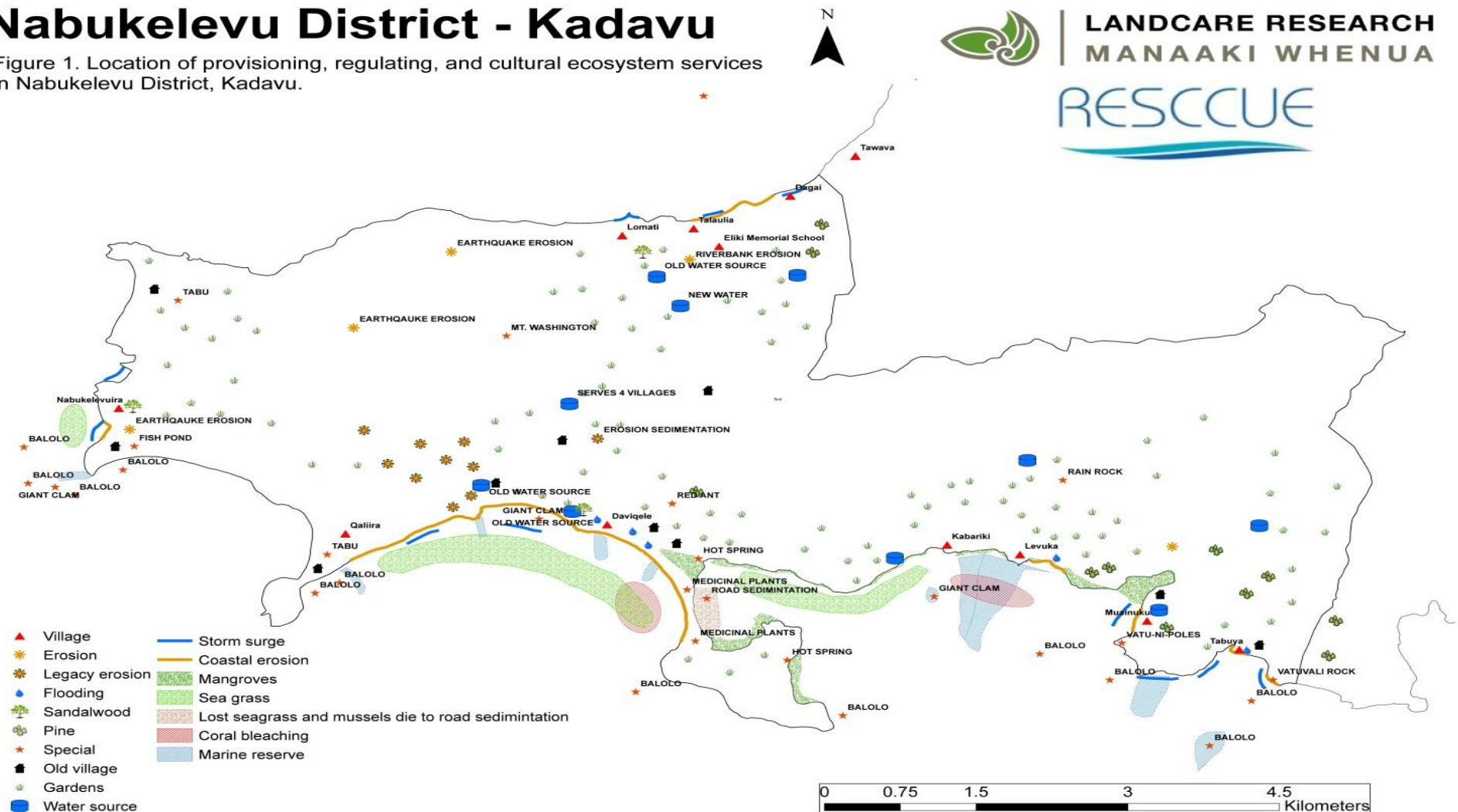
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Annex Districts Maps on Ecosystem Services

Nabukelevu District - Kadavu

Figure 1. Location of provisioning, regulating, and cultural ecosystem services in Nabukelevu District, Kadavu.



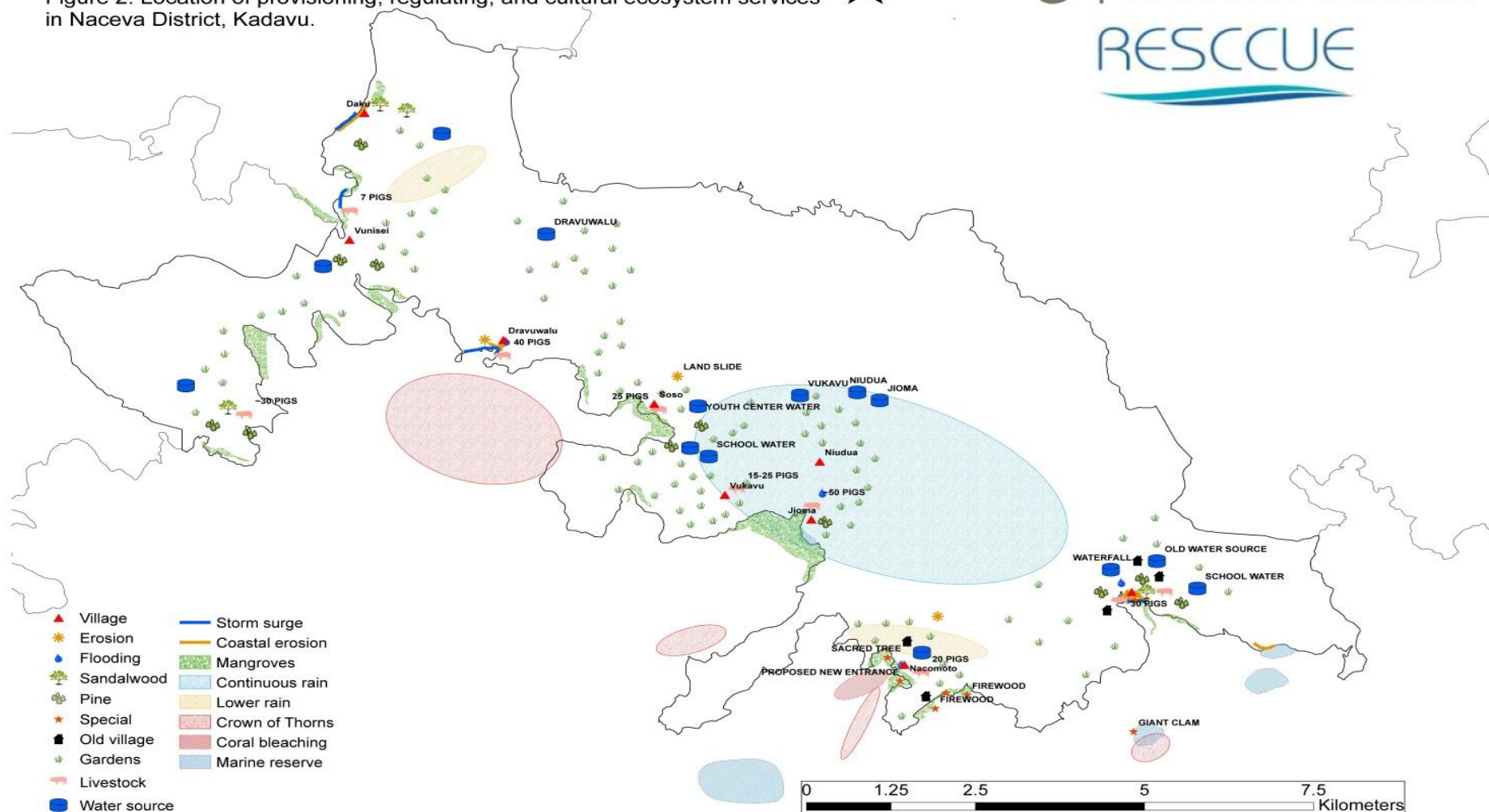
Naceva District - Kadavu

Figure 2. Location of provisioning, regulating, and cultural ecosystem services in Naceva District, Kadavu.



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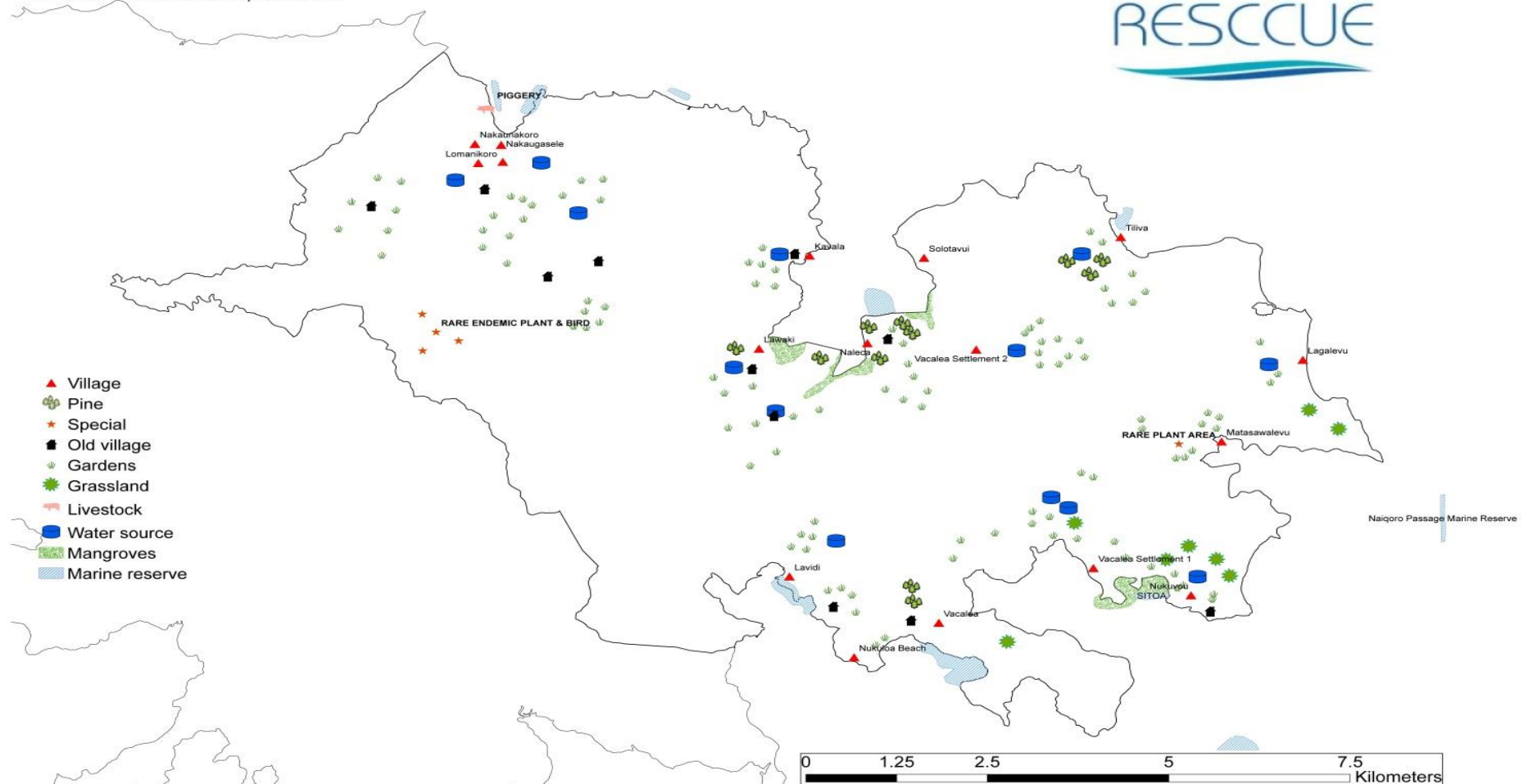
Nakasaleka District - Kadavu

Figure 3. Location of provisioning, regulating, and cultural ecosystem services in Nakasaleka District, Kadavu.



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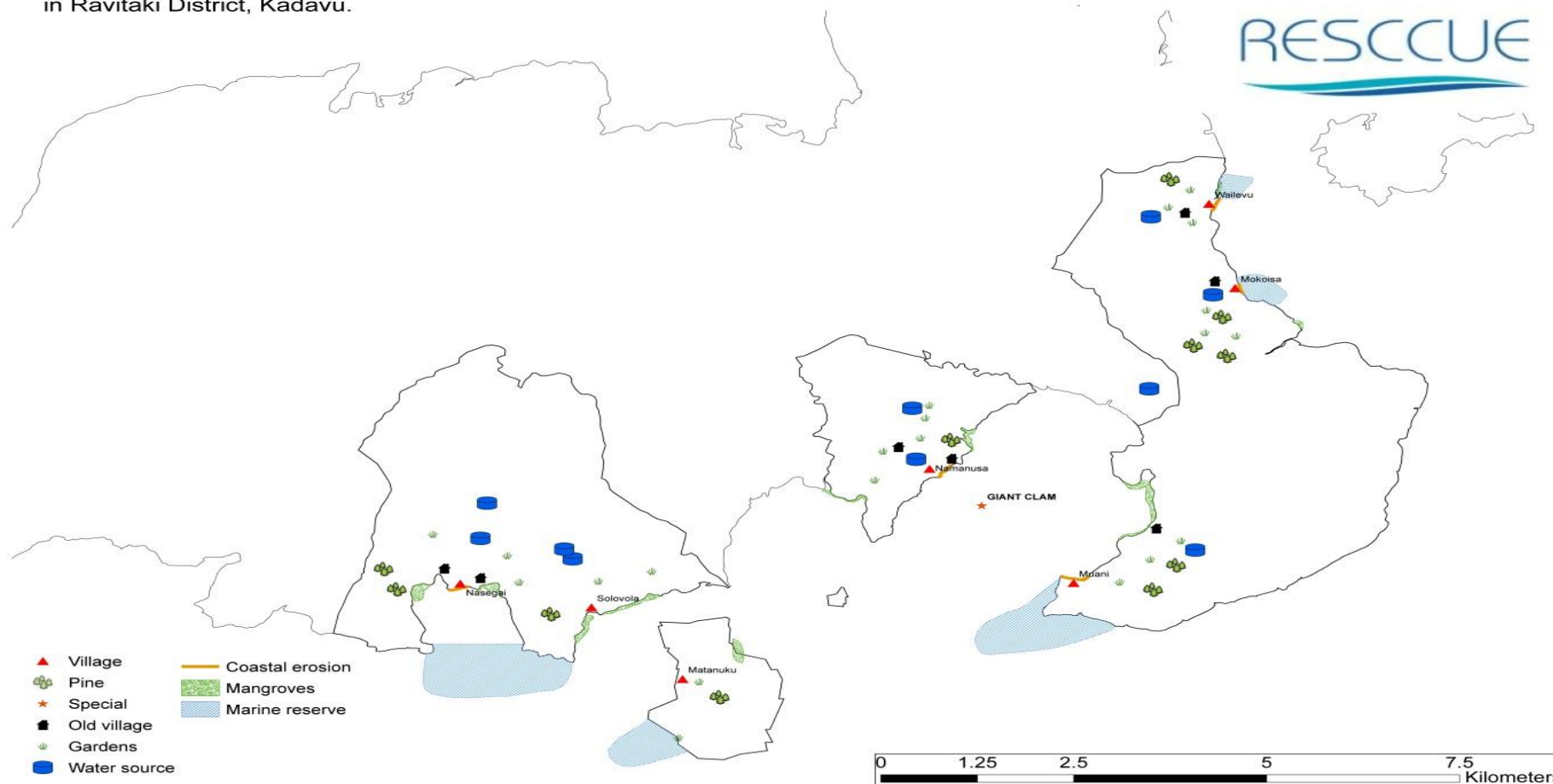
Ravitaki District - Kadavu

Figure 4. Location of provisioning, regulating, and cultural ecosystem services in Ravitaki District, Kadavu.



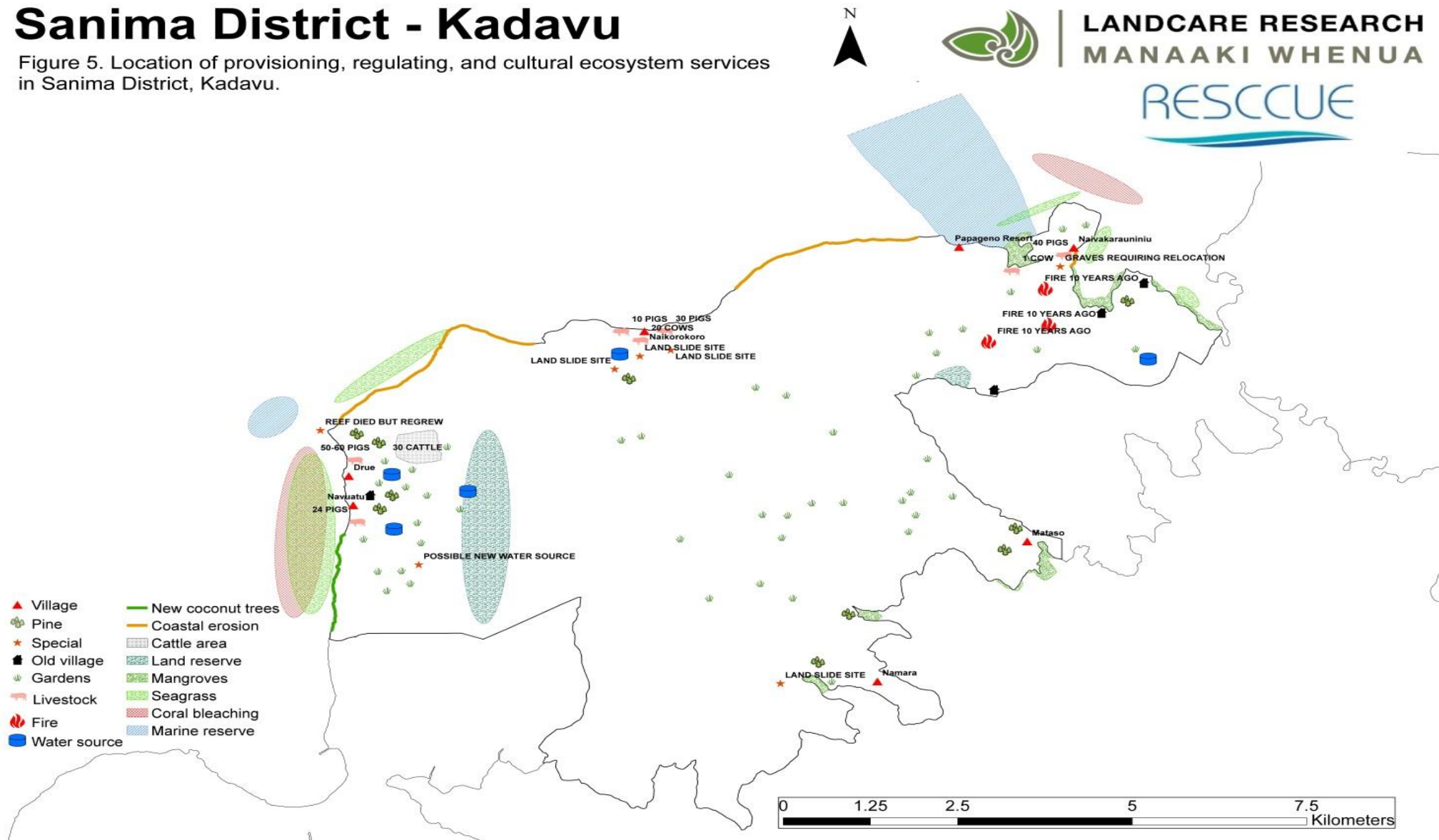
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Sanima District - Kadavu

Figure 5. Location of provisioning, regulating, and cultural ecosystem services in Sanima District, Kadavu.



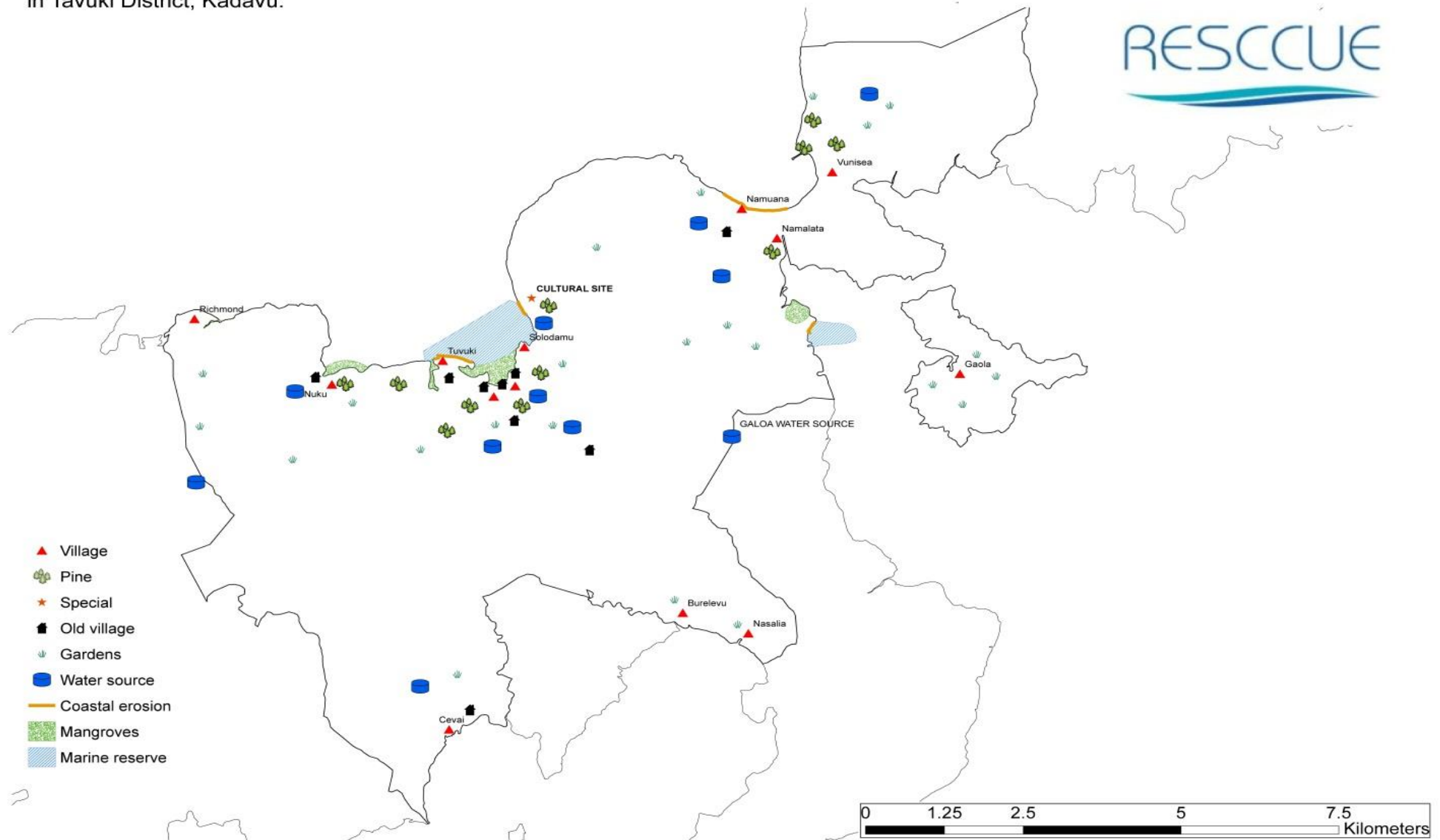
Tavuki District - Kadavu

Figure 6. Location of provisioning, regulating, and cultural ecosystem services in Tavuki District, Kadavu.



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Yawe District - Kadavu

Figure 7. Location of provisioning, regulating, and cultural ecosystem services in Yawe District, Kadavu.



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