



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

AND ACTION PLAN







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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



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



What is the main reason you were away?

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 Yearlywage 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	-	-	-	-

Daviqele	-	+	-	+
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 notake 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 Yale. Responses in the remaining districts vary from 2.46 to 4.24. Similarly, in response to the statement "There is conflict with yale high statement "There is conflict with yale are 5.75 and 2.26, respectively on the 0-10 scale, indicating moderate agreement in Sanima and general disagreement in Yale. 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	Lomanikoro	Nakaunakoro	Nakoronawa	Nakaugasele	Kavala	Lawaki	Solotavui
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	Lomanikoro	Nakaunakoro	Nakoronawa	Nakaugasele	Kavala	Lawaki	Solotavui
					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	Lomanikoro	Nakaunakoro	Nakoronawa	Nakaugasele	Kavala	Lawaki	Solotavui
		Vetiver grass to stop		\sim 2011 and probably a	now but more	and may affect	
		erosion (planting		little less erosion);	sea crabs as they	coral; also	
		~2011 and probably		affects all gardens; less	like the mud	sediment	
		a little less erosion) ;		fish now but more sea		coming from	
		affects all gardens;		crabs as they like the		the road	
		less fish now but		mud		(noticed a big	
		more sea crabs as				difference since	
		they like the mud				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 &	Reef: piggery near the	Reef: piggery near		River water: use for			River water: use for
waste treatment	sea damages the coral	the sea damages the		drinking and cleaner			drinking and cleaner than
		coral		than the spring water			the spring water they
				they used to use			used to use
Biological control	White flies: affects	White flies: affects	White flies: affects	White flies: affects	White flies:	Dalo beetle:	White flies: affects
	yagona and cassava	yagona and cassava	yagona and	yagona and cassava	affects yagona	only the lower	yagona and cassava
	Fruit flies: affects all	Fruit flies: affects all	cassava	Fruit flies: affects all	and cassava	areas affected	Fruit flies: affects all fruit
	fruit	fruit	Fruit flies: affects	fruit	Fruit flies: affects	by Dalo beetle	Rats: no mongoose
	Rats: no mongoose	Rats: no mongoose	all fruit	Rats: no mongoose	all fruit	(only village	Wild pigs: get into
	Wild pigs: get into	Wild pigs: get into	Rats: no mongoose	Wild pigs: get into	Rats: no	with the dalo	gardens
	gardens	gardens	Wild pigs: get into	gardens	mongoose	beetle)	Weeds: lots of them but
	Weeds: lots of them	Weeds: lots of them	gardens	Weeds: lots of them but	Wild pigs: get	White flies:	not really a problem
	but not really a	but not really a	Weeds: lots of	not really a problem	into gardens	affects yagona	Snakes: lots of them but
	problem	problem	them but not really	Snakes: lots of them but	Weeds: lots of	and cassava	they are considered good
	Snakes: lots of them	Snakes: lots of them	a problem	they are considered	them but not	Fruit flies:	
	but they are	but they are	Snakes: lots of	good	really a problem	affects all fruit	
	considered good	considered good	them but they are		Snakes: lots of	Rats: no	

Ecosystem Services	Lomanikoro	Nakaunakoro	Nakoronawa	Nakaugasele	Kavala	Lawaki	Solotavui
Ecosystem Services	Lomanikoro	Nakaunakoro	Nakoronawa considered good	Nakaugasele	<i>Kavala</i> them but they are considered good	Lawaki mongoose Wild pigs: get into gardens Weeds: lots of them but not really a problem Snakes: lots of them but they are considered	Solotavui
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	good 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) 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	Lomanikoro	Nakaunakoro	Nakoronawa	Nakaugasele	Kavala	Lawaki	Solotavui
				storm surges have	h	killing the	
				eroded them away; big		mangroves; lots	
				tsunami washed a lot of		of fish	
				the mangroves away		spawning in	l l
						mangroves	
						Forest: not	;
						much change	2
						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	Sanima District					
Services	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara
Crops	Navuatu Irrigation: none 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 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)	Drue 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 Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees Chemicals: stopped using chemicals in last 2 years (but some still use them); some	Naikorokoro Irrigation: none Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees	Naivakarauniniu Irrigation: none Coconut: produce virgin coconut oil (processing done in the village; some for sale to tourists/hotel); forefathers planted the trees	<u>Mataso</u> Irrigation: none	Namara Irrigation: none
Livestock		edge (~5 steps from the river) Cattle: ~ 30 cattle in an area they have fenced off	Cattle: used to have 100+ but they kept trampling on their gardens so they are gatting rid of them			
Medicines etc	Lots of medicines: mostly collected near villages and gardens Mangrove breathing tubes: used for coughs & fever in children	Lots of medicines: mostly collected near villages and gardens Mangrove breathing tubes: used for coughs & fever in children	Lots of medicines: mostly collected near villages and gardens Mangrove breathing tubes: used for coughs & fever in children	Lots of medicines: mostly collected near villages and gardens Mangrove breathing tubes: used for coughs & fever in children	Lots of medicines: mostly collected near villages and gardens Mangrove breathing	Lots of medicines: mostly collected near villages and gardens Mangrove breathing tubes: used for coughs & fever in children





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

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

Ecosystem	Sanima Distr	ict												
Services	Navuatu			Drue				Naikor	okoro		Naivaka	rauniniu	Mataso	Namara
	understory	(if garden	clean	understory	(if	garden	clean	many	they v	will kill	eats dal	lo (taro) and	l crops	the stem and if too
	then no rats)	J		then no rat	s)			the plai	nt		most ot	her crops	White flie	es: many they will kil
	Wild pigs:	all throug	h the	Wild pigs:	all	through	the	Rats:	will e	eat the	White	flies: or	n on yaqoi	na the plant
	forest			forest				cassava	a in g	gardens	yagona	(breeds or	n (breeds d	on Rats: will eat the
								were	lots	s of	the ster	n and if to	the stem ar	nd cassava in gardens
								unders	tory	(if	many t	hey will kil	l if too mai	ny were lots o
								garden	clean	then no	the plan	it	they will k	ill understory (i
								rats)			Rats: v	vill eat th	e the plant	garden clean ther
								Wild	pigs	all	cassava	in garden	s Rats: will e	at no rats)
								throug	h the f	orest	were	lots o	f the cassava	in Wild pigs: al
											underst	ory (i	f gardens we	re through the forest
											garden o	clean then n	olots	of
											rats)		understory	(if
											Crown	of Thorns	garden clea	an
											Papager	10 Resor	t then no rats)
											used to	pick them up	Wild pigs: a	all
											and bu	ry them bu	t through the	ne
											they do	n't know; se	eforest	
											them a	ill the tim	2	
											and hav	ve been her	9	
											for a	long time	;	
											alan t	realise the	/	
											were a p	problem.	1	
											through	pigs: a	1	
Disease regulation	Somo dong	in forror (i		Sama dan		Forman (1)	maller	Somo	dongu	o forror	Como d	l the lorest	n Como dona	10 Como donguo forro
Disease regulation	from pooplo	who come	to the	from noon	gue i	ever (u	sually	Some (usually	uengu v from	e level	Some u	from noonly	fovor (usual	ly (usually from
	island and sr	who come	to the	island and	e wii	d it)	.0 the	who c	y II OII.	to the	who co	ame to the	from neon	le neonle who come
	isianu anu sp	neau ng		typhoid a f	ew v	ears ago	from	island a	and sn	read it)	island a	nd spread it	who come	to to the island and
				animal was	te in f	the water	rway	isiana c	inu sp	reau iej	isiana a	nu spredu nj	the island ar	id spread it)
						the water	way						spread it)	iu spiedu iej
Pollination	Fruit drop:	noted th:	at the	Fruit dror	: no	ted that	t the	Fruit	drop:	noted	Fruit o	drop: note	l Fruit dro	p: Fruit drop: noted
	small fruit	are fallir	ng off	small frui	t ar	e falling	g off	that th	ie sma	all fruit	that the	e small frui	t noted that t	he that the small fruit
	(mango, o	range, pa	wpaw,	(mango,	orang	ge, pav	vpaw,	are	falling	g off	are	falling of	f small fruit a	reare falling of
	banana); sta	arted to see	e it in	banana); s	tarted	d to see	it in	(mango),	orange,	(mango	, orange	, falling o	off (mango, orange
	the last 2-	3 yrs; the	ey are	the last 2	2-3 v	vrs; they	/ are	pawpav	w, b	anana);	pawpaw	v, banana)	; (mango,	pawpaw, banana)
	turning bl	ack and	then	turning l	olack	and	then	started	to se	ee it in	started	to see it in	orange,	started to see it in
	starting to fa	ll off		starting to	fall of	f		the last	t 2-3 y	rs; they	the last	2-3 yrs; the	pawpaw,	the last 2-3 yrs

Services Navuatu Drue Naikorokoro Naivakarauniniu Mataso Nam	nara
Sandalwood: birds are starting Sandalwood: birds are starting are turning black are turning black banana); they	are turning
to take the seeds and is to take the seeds and is and then starting to and then starting to started to see black	k and then
spreading the sandalwood spreading the sandalwood fall off fall off it in the last start	ting to fall off
Sandalwood: birds Sandalwood: birds 2-3 yrs; they Sand	dalwood: birds
are starting to take are starting to take are turning are s	starting to take
the seeds and is the seeds and is black and the	seeds and is
spreading the spreading the then starting sprea	ading the
sandalwood sandalwood to fall off sand	lalwood
Sandalwood:	
birds are	
starting to	
take the seeds	
and is	
spreading the	
sandalwood	
Natural hazards king tides: not an issue king tides: not an issue king tides: not an king tides: not an Drought Drou	ught:
Droughts: last drought in 2013 Droughts: last drought in 2013 issue issue	
that affected all; lasted about 8 that affected all; lasted about 8 Droughts: last Droughts: last	
months and the gardens died, months and the gardens died, drought in 2013 that drought in 2013 that	
small native trees and yagona small native trees and yagona affected all; lasted affected all; lasted	
died and old branches on the died and old branches on the about 8 months and about 8 months and	
yagona died; previous drought yagona died; previous drought the gardens died, the gardens died,	
was 1992 was 1992 small native trees small native trees	
and yagona died and and yagona died and	
old branches on the old branches on the	
yagona died; yagona died;	
previous drought previous drought	
Was 1992 Was 1992	at. gotting
mabilal condition Reef: see more sediment on Reef: see more sediment on Porest: getting Mangroves: see Porest: Porest	est: getting
colour and clipporty and clipporty want to lots of small troog the mangrouse area land green lots	of small troop
Sea grass: more prevalent create an MPA to stop potato coming up: no Sea grass: more lots of small comi	ing up no
now not affected by sodiment load fishing in July Aug Sent as planting of native prevalent new, not trees coming plant	ting up, no
wayes can take the seagrasses this is when the cod come to trees: more hirds affected by by unit in a potrees	s more hirds
Forest: getting bigger and snawn (proposed MPA is now because of less sediment: waves can planting of now	because of
green: lots of small trees about 40x40 m) fire and maybe more take the seagraces in the seagrace in the seagraces in the seagrace in the seagrace in the seagraces in the seagraces in the seagraces in the seagraces in the seagrace in the seagraces in the seagrace in the seagra	fire and maybe
coming up: no planting of Sea grass: more prevalent trees in the forest Forest. getting more hirds more	e trees in the
native trees: more birds now now: not affected by sediment: bigger and green now because forest	st

Ecosystem	Sanima District									
Services	Navuatu	Drue	Naikorokoro	Naivakarauniniu	Mataso	Namara				
	because of less fire and maybe	waves can take the seagrasses		lots of small trees	of less fire					
	more trees in the forest	Forest: getting bigger and		coming up; no	and maybe					
		green; lots of small trees		planting of native	more trees in					
		coming up; no planting of		trees; more birds	the forest					
		native trees; more birds now		now because of less						
		because of less fire and maybe		fire and maybe more						
		more trees in the forest		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	Nabukelevu Distri	ct								
Services	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	Dagai
Crops	Weedkiller: some	Virgin coconut oil:	Virgin coconut oi	l: Virgin	Virgin	Virgin	Virgin	Soil fertility:	Soil fertility:	Soil fertility:
	use of it in the	used in the village;	used in th	e coconut oi	coconut oil:	coconut oil:	coconut oil:	this has	this has	this has
	village gardens	now more trees	village; now mor	e usea in th	e usea in the	used in the	used in the	improved over	improved	improved
	Soli fertility: this	but the older ones	trees but th	e village; nov	village; now	village; now	village; now	time; nave been	over time;	over time;
	nas improved	nave less coconuts	older ones hav	e more tree	smore trees	more trees	more trees	planting more	nave been	nave been
	over time; have		less coconuts	but the olde	but the older	but the	but the	legumes;	planting more	planting more
	been planting			ones hav	e ones have	older ones	older ones	participant	legumes;	legumes;
	more legumes;			less coconuts	less	have less	have less	perception	participant	participant
	participant				coconuts	coconuts	coconuts	climate change	perception	perception
	perception							may be making	climate	climate
	climate change							soil more	change may	change may
	may be making							fertile.	be making	be making
	soil more fertile.							Virgin coconut	soil more	soil more
	Virgin coconut							oil: used in the	fertile.	fertile.
	oil: used in the							village; now	Virgin	Virgin
	village; now more							more trees but	coconut oil:	coconut oil:
	trees but the							the older ones	used in the	used in the
	older ones have							have less	village; now	village; now
	less coconuts							coconuts	more trees	more trees
									but the older	but the older
									ones have less	ones have less
		D: 0 :							coconuts	coconuts
LIVESTOCK		Pigs: 3 pigs								
Medicines etc					c		D 1 1			
Wildfoods	Pigs: lots of wild	Pigs: lots of wild	Pigs: lots of wil	d Pigs: lots c	t		Balaboo			
	pigs; go hunting	pigs; go hunting	pigs; go huntin	g wild pigs; g)		fish: only	*		
	every 2-4 weeks	every 2-4 weeks	every 2-4 weeks	hunting ever	7		found			
	Balaboo fish: only	Balaboo fish: only		2-4 weeks			between Oct	· · · · · · · · · · · · · · · · · · ·		
	found between	found between Oct					and Nov; is			
	Oct and Nov; is a	and Nov; is a sea					a sea worm			
	sea worm that	worm that can be					that can be			
	can be caught 8	caught 8 days after					caught 8			
	days after the full	the full moon					days after			
	moon						the full			
A	N	NT -	N	+			moon	NT .	N	N
Air quality	No issues; no	No issues; no	No issues; n	0	No issues; no	No issues;	No issues;	No issues; no	No issues; no	No issues; no

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

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

Ecosystem	Nabukelevu Distrie	ct								
Services	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	Dagai
	soil loss with the	about 5 years ago	(did not see much		loss with the	loss with	loss with	they are cutting	ago (might be	0
	burning)	(did not see much	soil loss with the		burning)	the	the burning)	the trees from	due to climate	
		soil loss with the	burning)		Coastal	burning); Pt	Coastal	their gardens	change); they	
		burning)	0,		erosion: all	G there was	erosion: all	0	are getting	
		0,5			along the	a lot of	along the		erosion	
					coast around	sediment	coast		where they	
					Daigele;	that came	around		are cutting	
					damages the	down from	Daigele;		the trees from	
					coconut	this point in	damages the		their gardens	
					trees	the 1940s	coconut		U	
						Coastal	trees			
						erosion: all				
						along the				
						coast				
						around				
						Daiqele;				
						damages the				
						coconut				
						trees				
Water	Water quality:	Water quality: the	Water quality: the							
purification &	considered to	water is dirty	water is dirty							
waste	have the dirtiest	when it floods	when it floods							
treatment	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									
	tarming areas;									

Ecosystem	Nabukelevu Distri	ct								
Services	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	Dagai
Biological control	some farm houses near the river and they use the water above the water source for cleaning and washing. 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 yaqona Caterpillars: on the dalo White flies: on cassava, fruit (mango, citrus); think the Drala bought the white fly (Drala 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 Drala bought the white fly (Drala 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 Drala bought the white fly (Drala was planted to enrich the soil) Black spot: found on many of the fruits	Caterpillars: on the dalo White flies: on cassava, fruit (mango, citrus); think the Drala bought the white fly (Drala was planted to enrich the soil) Black spot: found on many of the fruits	Fruit bats: all fruits; more fruit bats than 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 yagona	White fly: cassava and yagona	White fly: cassava and yagona	White fly: cassava and yagona
Disease regulation	No issues noted	No issues noted	No issues noted	No issues						
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	Nabukelevu Distri	ct								
Services	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	Dagai
	citrus, pawpaw,	citrus, pawpaw,	citrus, pawpaw,							
	banana, wild	banana, wild apple	banana, wild							
	apple (Kavika));	(Kavika)); started	apple (Kavika));							
	started to notice	to notice the fruit	started to notice							
	the fruit drop in	drop in last 20	the fruit drop in							
	last 20 years;	years; most years	last 20 years;							
	most years they	they lose about	most years they							
	lose about 80% of	80% of the fruit	lose about 80% of							
	the fruit but in	but in last 2 years	the fruit but in							
	last 2 years they	they think it is	last 2 years they							
	think it is closer	closer to 90%;	think it is closer							
	to 90%; when	when Drala was	to 90%; when							
	Drala was planted	planted gasau	Drala was planted							
	gasau grass (not	grass (not from	gasau grass (not							
	from Kadavu) can	Kadavu) can and if	from Kadavu) can							
	and if the fruit is	the fruit is not big	and if the fruit is							
	not big before the	before the grass	not big before the							
	grass flowers the	flowers the fruit	grass flowers the							
	fruit will fall off	will fall off (this is	fruit will fall off							
	(this is the story	the story from the	(this is the story							
	from the	participants).	from the							
	participants).		participants).							
Natural hazards	High tides: affects	Storm surges:	Storm surges:		Droughts:	Droughts:	Droughts:	Droughts: have	Droughts:	Droughts:
	village often (see	these storm surges	these storm		have a	have a	have a	a drought	have a	have a
	water regulation)	take a lot of sand;	surges take a lot		drought	drought	drought	problem;	drought	drought
	Storm surges:	sea bed is quite	of sand; sea bed is		problem;	problem;	problem;	sometimes lose	problem;	problem;
	these storm	shallow and there	quite shallow and		sometimes	sometimes	sometimes	50-60% of	sometimes	sometimes
	surges take a lot	are more	there are more		lose 50-60%	lose 50-60%	lose 50-60%	crops; the	lose 50-60%	lose 50-60%
	of sand; sea bed is	seagrasses	seagrasses		of crops; the	of crops; the	of crops; the	mountain	of crops; the	of crops; the
	quite shallow and				mountain	mountain	mountain	affects the	mountain	mountain
	there are more				affects the	affects the	affects the	rainfall; have a	affects the	affects the
	seagrasses				rainfall; have	rainfall;	rainfall;	lighter soil that	rainfall; have	rainfall; have
					a lighter soil	nave a	nave a	is more	a lighter soil	a lighter soll
					that is more	lighter soil	lighter soil	affected by	that is more	that is more
					arrected by	that is more	that is more	arought	anected by	arrected by
					urougni	drought	drought		urougni	urougni
Habitat	Dools (Vatural:	Mangnauag, navar	Mangnarage about		Soo grogoog					
Habitat	ROCK (Vatuvali	mangroves: never	mangroves: about		sea grasses	sea grasses:	sea grasses:			

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

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

Ecosystem	Nabukelevu District												
Services	Tabuya	Muainuku	Levuka	Kabariki	Nasau	Daviqele	Qaliira	Lomati	Talaulia	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	Naceva District										
	Kadavu	Nacomoto	Jioma	Niudua	Vukavu	Soso	Dravuwalu	Vunisei	Daku		
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	Naceva Distric	t							
-	Kadavu	Nacomoto	Jioma	Niudua	Vukavu	Soso	Dravuwalu	Vunisei	Daku
	there was a	t							
	bleach ~10								
	yrs ago and								
	coral hasn't	-							
	come back								
Water regulation	Water source:	Water availability:	Water	Water		Water	Water source: a	Water source: a	Water source: a
-	waterfall for	no issues	availability: no	availability: no		availability: no	dam	dam that	dam
	the village;	Flooding: when	issues	issues		issues	Water	supports both	Water availability:
	there is a	heavy rain; water	Flooding: last				availability: no	the school and	no issues
	separate	comes down and	flood was 3 yrs				issues	the village	
	water fall for	breaks the seawall	ago					Water	
	the school	when there is	0					availability: no	
	Water	inland flooding;						issues	
	availability:	last big flood was							
	no issues	\sim 5 years ago with							
	Flooding:	the previous flood							
	when heavy	being a year before							
	rain; water is	that							
	verv dirty;								
	small was								
	damaged;								
	flood about								
	everv 2 vrs								
	and last flood								
	was 2015								
Erosion control	Inland	Coastal: some					Riverbank: has		Coastal: coconut
	erosion: there	erosion; now less					some erosion;		trees falling into
	is some	mangroves as used					~ 20yrs ago a		the ocean; started
	erosion	for firewood and					lot of land was		happening about
	behind the	removed to clear					cleared; seems		15 yrs ago
	village where	entrance to the					like more		
	there are no	village					floods than		
	trees	Inland: cut down					before		
		trees near the					Coastal: some		
		stream for cattle					erosion where		
		farming ~35 yrs					the stream		
		ago; there are no					meets the		
		cattle anymore but					ocean		

Ecosystem Services	Naceva Distric	t							
	Kadavu	Nacomoto	Jioma	Niudua	Vukavu	Soso	Dravuwalu	Vunisei	Daku
		the trees have not							
		regrown; every							
		time it rains the							
		land slips away.							
Water purification &	Water	Water quality: no	Water quality: no	Water quality:		Water quality: no	Water quality:	Water quality: no	Water quality: no
waste treatment	quality: no	issues for drinking	issues	no issues		issues	no issues	issues	issues
	issues	water							
		Coastal water							
		quality: pigs are							
		located on the							
		mangrove passage							
		and there are less							
		fish there							
Biological control	White flies:	White flies: on	White flies: on	White flies: on	White flies: on	White flies: on	White flies: on	White flies: on	White flies: on
	on yaqona	yaqona	yaqona	yaqona	yaqona	yaqona	yagona	yaqona	yagona
	Slugs/snails:	Slugs/snails: not a	Slugs/snails: not	Slugs/snails:	Slugs/snails: not a	Slugs/snails: not	Slugs/snails:	Slugs/snails: not	Slugs/snails: not a
	not a big	big problem	a big problem	not a big	big problem	a big problem	not a big	a big problem	big problem
	problem	Wild pigs: lots of	Wild pigs: lots of	problem	Wild pigs: lots of	Wild pigs: lots of	problem	Wild pigs: lots of	Wild pigs: lots of
	Wild pigs: lots	them everywhere;	them	Wild pigs: lots	them everywhere;	them	Wild pigs: lots	them	them everywhere;
	of them	hunt them about	everywhere;	of them	hunt them about	everywhere;	of them	everywhere;	hunt them about
	everywhere;	once/month when	hunt them about	everywhere;	once/month when	hunt them about	everywhere;	hunt them about	once/month when
	hunt them	the pigs start to	once/month	hunt them	the pigs start to	once/month	hunt them	once/month	the pigs start to
	about	damage the	when the pigs	about	damage the	when the pigs	about	when the pigs	damage the
	once/month	gardens	start to damage	once/month	gardens	start to damage	once/month	start to damage	gardens
	when the pigs	Crown of Inorns:	the gardens	when the pigs	Para Grass: came	the gardens	when the pigs	the gardens	
	start to	lots of them but	Para Grass: came	start to damage	~40 yrs ago; nave	Para Grass: came	start to damage		
	damage uie	amount of damage	~ 40 yrs ago;	Dara Crace	to poison it	~ 40 yrs ago;	the gardens		
	galuells	thow are causing	have to poison it	rala Glass:		have to poison it			
	Thorney lote	Minor birds: camo		ago: have to					
	of them but	in 2005: they neck		noison it					
	not sure of	at everything and							
	the amount of	null seeds out							
	damage they	Para Grass came							
	are causing	~ 40 yrs ago have							
	Para grace	to noison it							
	don't have								
	anv								

Ecosystem Services	Naceva Distric	t							
	Kadavu	Nacomoto	Jioma	Niudua	Vukavu	Soso	Dravuwalu	Vunisei	Daku
Disease regulation	No issues	No issues	No issues	No issues	No issues	No issues		No issues	No issues
Disease regulation Pollination	No issues 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	No issues 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)	No issues 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)	No issues 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	No issues 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)	No issues 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)		No issues 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)	No issues 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	2012)	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		2012)				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	Naceva District										
	Kadavu	Nacomoto	Jioma	Niudua	Vukavu	Soso	Dravuwalu	Vunisei	Daku		
	mangroves	now; started to see									
	now	the decrease in									
	Reef: still	fish size about 10									
	quite a lot of	years ago when									
	big fish; lots	they started to use									
	of poaching;	a net instead of a									
	hard to catch	line or spear									
	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)										

				1
Ecosystem Service	<i>Tavuki</i> District			
	Tavuki	Solodamu	Nanuku	Baidamudamu
Crops	Yaqona and dalo 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	Tavuki District			
	Tavuki	Solodamu	Nanuku	Baidamudamu
	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 dengue	No dengue	No dengue
	No Zika	No Zika	No Zika	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-off 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 policy 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 t 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 $10^{\rm th}\ 2016$ 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.
 - Dravuwalu: 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

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

Objective	On-ground	Partners to	Targeted	Expected Output	Expected	Cost	2017							
	activity	assist	communities		Outcome		May	June	July	Aug	Sep	Oct	Nov	Dec
	Developing and	KYMST and	Nine districts to	Districts reps who	community									
	implementing a	Landcare NZ	have a business	are involved in this	members are									
	business plan at		plan for their	training have a	able to see the									
	district level		surveillance	clear	means to									
	specifically to		boats operation	understanding on	sustainably									
	fundraise for			how to prepare a	manage their									
	the cost of			business plan for a	resources in an									
	LMMA no-take			community	economic and									
	zone regular			conservation	ecological way									
	boat			initiative such as										
	surveillance			the financial										
				aspects of the "no-										
	2 days training			take zone" and										
	on developing			LMMA										
	business plan on													
	natural													
	resources													
	enterprise					9,000								
	Clarify	FELA, Police	Nine districts	A brochure and	Kadavu									
	implication of			poster produced	resource									
	the surfing		KYMST	explain the	owners are able									
	decree in LMMA			implication of the	to incorporate									
	and how it		Kadavu	surfing degree on	with clear									
	overrides		Provincial	the customary	understanding									
	customary		Council	fishing ground and	such legislation									
	fishing rights		members	LMMA	in the village									
	and opens it up				resource									
	to poaching				management									
					meetings	2,000								
2.Awareness	2 day	KYMST	Nabouwalu	Villagers have clear	Villagers able to								1	
raising on	workshops in		Nasegai	understanding of	use water								1	
use of water,	the eight		Solodamu	Management	wisely (e.g. no								1	
livestock	villages		Namara	action plan for	running taps in	18,000						1	1	

Objective	On-ground	Partners to	Targeted	Expected Output	Expected	Cost	2017							
	activity	assist	communities		Outcome		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)			Daviqele Nukuvou Dravuwalu Daku	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</i> <i>asiatica</i> Collection of seedling, establishing nurseries and planting	KYMST	Nasegai Ravitaki Levuka Galoa Dravuni	¼ to ½ hectares of area planted	Coconuts are collected and sold by the communities	14,000								
4.Coastal	Replanting of	KYMST	Nasegai	Approximate ¼	Improvement of									
protection	mangroves		Ravitaki	hectare of the	the coastal									
	Establishing		Lawaki	coastal degraded	system									
	nursery and		Galoa	areas will be	resilience									
	planting on		Dravuni	replanted		8,000								

Objective	On-ground	Partners to	Targeted	Expected Output	Expected	Cost	.t 2017							
	activity	assist	communities		Outcome		May	June	July	Aug	Sep	Oct	Nov	Dec
	designated areas in the five villages		Richmond											
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	Namara Lawaki Solotavui Kabarirki	At most ¼ hectare of road side are replanted with use of gabion where possible	Stability of road structure	10,000								
Total	İ.		1			78,000								

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Annex Districts Maps on Ecosystem Services













