









TOTAL E&P PNG LIMITED

# PAPUA LNG

## Upstream Environmental Impact Statement

### Volume 2: Environmental and Social Baseline

Part 18
Upstream Land and Natural Resources Baseline Report

TOTAL
TOTAL E&P PNG LIMITED









BOOYONG
FOREST SCIENCE

# Papua LNG Project

## Total E&P PNG Limited

## Upstream Land and Natural Resources Use Baseline Report

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# EXECUTIVE SUMMARY

Total E&P PNG Limited (TEP PNG) is proposing to develop the Papua LNG Project (the Project) to commercialize the natural gas resource present in the Elk-Antelope gas field in Gulf Province, Papua New Guinea (PNG). As part of the Project environmental, social and health impact assessment (ESHIA), a land and natural resource use study has been commissioned to provide a baseline characterization of the land tenure and land and natural resource use across the Project Area of Influence (PAOI). This involved identifying, describing and where possible, mapping land and natural resources that have importance for social values in the PAOI, that require consideration in the development of the Project. Information contained in this report will contribute to the assessment of provisioning ecosystem services.

## REGULATORY FRAMEWORK AND STANDARDS

The Project is regulated under two primary PNG laws; the *Environment Act 2000* and *Oil and Gas Act 1998*. In addition, there are three acts relevant to land tenure, land rights and disputes:

- *Land Act 1996* – establishes customary land and provides the mechanisms for acquiring granting leases of customary land.
- *Land Dispute Settlement Act 1975* – sets out three stages for the attempted settlement of disputes over customary land.
- *Lands Group Incorporation Act 1974* – an Act identifying the process for identifying and officially recognizing, through registration, the owners of customary land.

TOTAL SA (TOTAL), the parent company of TEP PNG, has a Social Baseline Study general specification (GS_EP_SDV_101) that sets out the parameters to be studied with regards to land and natural resources.

This report has been prepared in accordance with the social baseline standards and requirements of the International Finance Corporation (IFC) and International Petroleum Industry Environment and Conservation Agency (IPIECA), both of which are referenced in TOTAL's Social Baseline Study general specification.

## PROJECT AREA OF INFLUENCE

The Project Area of Influence (PAOI) is the area that is likely to be affected by the Project, its activities and its facilities that are directly owned, operated or managed by the upstream Project (including by Project contractors).

The PAOI includes 39 villages and one government station with a combined population in mid-2016 of approximately 12,750. It covers approximately 269,393 ha of the Purari catchment, which encompasses a wide variety of land resources (vegetation types) as well as freshwater and marine ecosystems. It includes extensive areas of hill forest, alluvial forest, freshwater swamp forest and globally important mangroves, tidal flats and estuaries, freshwater swamps and lakes, hundreds of river kilometers. Forests (78%) are the dominant land cover resource in the PAOI followed by wild stands of sago (9%) and mangroves (7%). The remainder comprises grassland and herb land, and areas dominated by land use (villages, subsistence agriculture, abandoned coconut plantations and planted sago) and ocean.

## METHODS

The study was designed to characterize patterns of natural resource use of importance to villages across the landscape of the PAOI. This included identifying important land, marine and freshwater resources, and determining why and how these resources are used across the landscape, and how patterns of resource use vary amongst the villages within the PAOI. The primary means of assessment were as follows:

- Bibliographic review involving a desktop review of existing literature.
- Assessment of spatial datasets, focusing on vegetation and identifying major land use units where practicable.
- Community level data collection involving focus group discussions (FGDs) and key informant interviews (KIIs), as part of the social baseline studies (SBS).
- Household level data collection involving the detailed surveying of individual households from a selection of communities across the PAOI (also as part of the SBS).
- Ecosystem services (flora and fauna) community level data collection and field assessment of flora resources using a rapid rural appraisal approach (RRA).
- Incorporation of data from other Project-related studies where applicable, e.g. vegetation mapping spatial data.
- Informal discussion with landowners during SBS and other Project-related surveys.

## RESULTS

### Land Tenure

All the land in the PAOI is customary owned, with the exception of Wabo Station and Muro Mission, which have been alienated. Land ownership is vested in clans, which identify themselves and their land through oral histories, including genealogies, stories, beliefs, customs and practices. The importance of being recognized as the landowner has become more important in parts of Papua New Guinea, including the PAOI, as land ownership has become linked to economic opportunities from logging and other extractive industries.

Clan boundaries are distinguished by natural geographic features, such as large trees or a group of trees, streams, hills and lakes. Clan boundaries are not necessarily permanent: they may change over time as people relocate in response to changes in population and/or the level of resources available.

Clan land generally includes (i) common areas of land in which all clan members can fish, hunt and collect other resources, and (ii) specific land areas allocated to families where people will live and make gardens. The areas allocated to families are most often the more fertile areas of land where gardens can be grown, and are generally in close proximity to villages.

Land in the PAOI is mostly held on a patrilineal basis, passing from father to the first-born son, however, it is not the ownership of the land that is inherited (as this remains with the clan), but the right to use the land.

Clan members need to hunt or fish or extract other resources from their clan land on a periodic basis to (i) help maintain the recognition that it is their land and (ii) ensure others do not encroach on their land. Similarly, within the clan, families need to use the land allocated to them to ensure their ongoing right to the land (for example, making food gardens or planting sago).

### *Special Agriculture and Business Leases*

The Purari Development Association, a landowner umbrella group, was granted a Special Agriculture and Business Lease (SABL) for an area of 656,034 ha in 2010 (Numapo, 2013). This area stretches from the Papuan coast to the Provincial border between Gulf and Simbu and Eastern Highlands, and includes PRL-15. Irregularities in the allocation of SABLs across Papua New Guinea led to an SABL Commission of Inquiry (COI) from 2011 to 2013. The COI found widespread abuse, fraud and other problems, and recommended that SABLs issued under irregular circumstances be rectified or nullified (Numapo, 2013). However, at the time of writing, there has been no response by government.

### *Forestry Leases*

The PAOI is affected by two logging operations:

- Vailala Block 3, comprising 196,200 ha southeast of the Purari River.
- Baimuru Block 3, comprising 320,960 ha northwest of the Purari River (including PRL-15).

Various benefits are to be paid to the landowners based predominantly on the value of logs extracted. The majority of villages included in the SBS contain Incorporated Land Groups (ILGs), which are the vehicle for receiving logging royalties.

There is a long history of complaints involving the logging industry. There are various disputes between landowners (or alleged landowners) of Vailala Block 3, and between landowners and Frontier Holdings Limited, which is a subsidiary of the large Malaysian logging company Rimbunan Hijau and the operator of Vailala Block 3 (Provincial Forestry Officer, pers. com., 17 August 2016).

### *Mining and Petroleum Exploration Licenses*

The PAOI overlaps with three petroleum prospecting licenses and eight mining exploration licenses.

### *Land Registration*

A common approach for commercializing land (without alienation) is to lease the land. The customary landowners are officially recognized through a process of forming an Incorporated Land Group (ILG). Problems with ILGs resulted in amendments to the *Land Groups Incorporation Act 1974* and the *Land Registration Act 1981* in March 2012. The amendments included tighter regulation on all ILGs and requires compliance by March 2017. It is unknown whether the ILGs in the PAOI, in their current form, will meet the requirements of the amended Land Groups Incorporation Act.

### *Land Related Disputes and Land Dispute Settlement*

Papua New Guinea has a formal process for attempting to resolve land disputes this being the Land Disputes Settlement Act, starting with mediation, then Local Land Courts, and finally, District Provincial Land Courts. In special cases, particularly relating to large-scale extractive industries, the National Government may instruct a dispute to be settled by other means, such as a hearing of the Land Titles Commission.

Within the PAOI, village leaders indicated that land disputes had occurred in 27 villages (79% of villages surveyed) within the past decade. A total of 57% of villages had land disputes between two parties from within the village, and these were generally minor disputes over gardening land or sago, and easily resolved. Sixty percent of villages indicated that land disputes had also occurred with clans from other villages. These disputes often focused on land boundaries and generally involved some kind of benefits, or potential future benefits, such as logging royalties, land rental for a communication tower, land rental for an airstrip, or potential benefits from sand mining.

Clans may not agree on land boundaries and may discuss such over periods extending several years. However, when land is recognized as having a potential monetary value, either from the extraction of logs, gas or other minerals, clans generally will vigorously defend their land boundaries.

Disputes from within villages are addressed by village leaders, which may include the councilor, traditional leaders, church leaders and members of the village court. For disputes involving parties from different villages, the councilors of the disputing villages will generally coordinate a meeting and attempt to resolve the dispute through mediation. A land mediator may or may not be involved. With the exception of the Pawaia villages, where there is generally an absence of village court magistrates and land mediators, the village court system appears to be relatively active in the PAOI. However, if land disputes cannot be resolved then the parties may take their dispute to the land courts.

Disputes involving an external entity such as a logging company are more likely to be handled in the courts. The major difference between this approach and the local process is that, unlike the local process, mediation is not a desired outcome (there is only a winner and a loser), and the parties have legal representation.

## Agriculture

### *Swidden Agriculture*

Agriculture is dominated by a type of subsistence agriculture known as swidden agriculture where staple food crops are grown in temporary 'gardens' which are made by clearing and burning tall woody regrowth, typically over 15 years old. Gardens are also made in undisturbed forest, across coastal shoreline sand dunes and occasionally (among villages without easy access to forest lands) on elevated land within mangroves dominated by nipa palms. Small areas of food crops are also established adjacent to houses and in back yards provided flooding is infrequent. A wide variety of crops are grown, but cooking bananas, taro, sweet potato, cassava, Chinese taro, sugar cane, aibika, sweet corn, watermelon, cucumber and pineapples

are widely planted. Inland, sweet potato is more likely to be planted as a staple in addition to cassava, but in coastal areas there appears to be less planting of sweet potato but more planting of cassava and yam.

Land for subsistence agriculture is located in different areas for each village. Land is not located in a regular modern agricultural layout but appears sporadic reflecting suitable soil, individual clan boundaries and fallow periods. Food crops are typically grown:

1. In recently cleared forest or regrowth, particularly where alluvial soils are present.
2. In logging gaps in alluvial forest, along river banks in small forest clearings.
3. Across the beach ridge and plain landforms in the Orokolo Bay hinterland.
4. In shoreline sand dunes and in small nipa palm clearings on raised mounds.

Extensive disturbance for food gardens and sago production only occurs in the Orokolo Bay hinterland where widespread clearing of forest across the beach ridge and plains landform has occurred.

***Sago**:* The planting and harvesting of sago palms is the most important food production activity across the PAOI. Sago is the main staple food for all the villages, and is also one of the most important famine foods, being resilient to floods and drought. Sago is harvested from planted and wild sago stands although harvesting from planted stands is more common. Planted sago is grown along river banks, drainage lines and almost any small, poorly drained depression in the landscape that is accessible to nearby villages. The most extensive areas of planted sago occur across the swales of the beach plains to the north of the coastal Orokolo villages.

Yields of between 100 and 150 kg per sago palm are likely which is usually sufficient for a family for a month. Sago palm by-products are widely used across almost all villages for roofing and building.

***Other Food**:* In addition to sago and food gardens, coconuts are planted throughout the PAOI and are an important staple food particularly when other foods are in short supply. Coconuts are more abundant in coastal villages and the inland Orokolo villages of Ere and Kilavi, partly reflecting historical planting for copra production. Fruit and nut crops are also commonly grown throughout the PAOI and typically include citrus trees, laulau, pawpaw and Okari nut trees.

### *Livestock Use and Production*

The two types of domestic livestock widely encountered in the PAOI are pigs and chickens; the husbandry practices follow traditional methods, with no significant opportunity for intensification or stock improvement.

The highest rates of pig ownership and the largest herds were reported in the Kaimare, Koriki and Maipua villages located on the coast and in the Mangroves ecological zone. In these villages pig ownership is not ubiquitous but occurs by more than 60% of households (as high as 70% in Koriki villages), with average herd sizes usually between 5 and 6 (but as high as 9) in the Maipua village of Apiope. Occasionally, herds of 15–25 were recorded but these represent a degree of specialization that is unusual in the PAOI.

The lowest rates of pig ownership, rarely above 10% of households, were recorded among the Iare villages living along the Purari River above the marine tidal influence in the Delta Swamps and Plains ecological zone. Immigrant families living in the Pawaia area around Subu, Wabo and Ura villages have introduced some new husbandry practices based on methods used in the highlands.

In the PAOI the lowest rates of chicken husbandry were recorded in the Pawaia villages from the Middle Purari Hills ecological zone (42%) and Koriki villages from the Mangroves zone (48%), and the highest rates in the Kaimare villages (83%) and the Ahia village of Evara (86%). It is interesting to note that the Pawaia villages located in the Delta Swamp and Plains zone, were amongst the higher practicers of chicken husbandry (80%), compared with the low rates undertaken by their Middle Purari Hills relatives, mentioned above. Koriki villages had the biggest and smallest average flock sizes with 9.1 amongst villages in the Delta Swamp and Plains zone and 22.8 amongst villages in the Mangrove zone. Average flock size across the PAOI was 14 birds.

### *Community-based Commercial Activities*

Community based commercial activities are common throughout the PAOI but are mainly associated with the selling and exchange of betel nut, sago, fish, mud crabs and a range of common garden vegetables, coconuts and pigs and chickens. There is also some minor trade in crocodile skins and meat, Pandanus mats, and kwila logs for house posts. Typically exchange takes place between villages with different resources, e.g., fish caught by coastal villages will be exchanged for garden food grown by inland villages.

Domestic pigs are a valuable commodity throughout the PAOI but their principal use appears to be for customary payments such as bride price and compensation, and for presentation during ceremonies; in most villages, they are rarely consumed outside of these contexts. However, domestic pigs are occasionally sold either as live animals or as butchered meat, with immigrant families and staff of logging camps and barges as major clients. Domestic pigs are also used in non-cash 'commercial' exchanges for other valuable commodities, such as canoes.

As well as for meat and egg consumption, chickens also represent an important commercial commodity with some sales made to staff at logging camps and barges. Chickens appear to have come into use (alongside pigs) as items of customary payment. A small number of households across the PAOI appear to be producing chickens on a large scale, albeit with no obvious changes in husbandry practices.

## Fishing and Aquaculture

### *Subsistence and Artisanal Practices*

Most members in the household in all villages carry out fishing across the PAOI. It provides a variable but usually significant proportion of the animal food intake, and represents an important opportunity for community based commercial earnings for some villages. Apart from along the coast of Orokolo Bay, where much of the activity is focused on the ocean, fishing activities primarily take place in the tributaries of the Purari River and the network of interconnected channels that make up its deltaic extension. Since access to these habitats from villages often involves travel of

several hours, fishing often takes place in combination with other activities, including sago production and/or hunting. Travel to these locations is usually by paddle canoe. Fishing grounds are mostly under customary ownership, although sections of the main channels of the Purari and the coastal marine resources are said to be available to anyone within local villages.

Information collected from the social baseline surveys and ecosystem services interviews, shows strong contrasts in the composition of captures in each of the major environmental zones, with sharks, sawfish and rays, barramundi, threadfin salmon and mullet common in catches in the marine and river mouth habitats; a changeover to dominance of black bass, emperors and many species of catfish in the estuarine and lower freshwater zones; and a major loss of diversity but the addition of eels in the freshwater headwater streams. Prawns are common throughout the system but there is a change from freshwater prawns to saltwater prawns in the estuarine and marine habitats. In many of the PAOI villages, people consume prawns more often than they do fish or sharks.

Many people in the PAOI believe that boat and barge activity on the rivers has led to a reduction in fish stocks over the past decade or so, while a subset of people also suspect other factors such as chemical pollution related to industrial activities. Many residents of the freshwater sections of the river point to a near complete decline of several species in these habitats, including barramundi and black bass. Over the same period people have observed the spread of introduced fish species through the catchment, some of which are now regularly eaten.

### *Community-based Commercial Activities*

Residents of all villages engage in some commercial activity, usually involving opportunistic sales or exchanges with other members of their own or nearby villages. Markets also provide venues for sales of fish and prawns but some of the best prospects for sale involve travel to localities outside of the immediate area, including markets at Baimuru and further west in the Kikori catchment. Local opportunities include the supply of the logging camps located near Evara and Poroi 2, to the barges that enter and exit via the Purari channels, to Kapuna Health Centre and to Herd Base. Fish is smoked before being transported to the more remote markets. Sale of shark fins to Chinese buyers in Kerema and Port Moresby appears to be the only current export of fish products; this opportunity exists for only a few villages among the coastal Orokolo communities.

Despite the lack of any true commercial fisheries ventures, sale of fish and other seafood products is considered a significant source of income in many of the villages. Significant annual revenue from fish were recorded in all but a few villages, with 53% of all households claiming earnings ranging from PGK 360 (US$115) to PGK 21,600 (US$6,912). The overall average for all vendors was PGK 1,722 (US$551), with 9 of the 27 villages recording average amounts above the PAOI average. The highest average revenue was recorded among coastal Iare and Kaimare villages, at the Ahia village of Evara (close to the logging camp), and at Wabo; and the lowest average revenue was recorded among the inland Orokolo villages and among the coastal Iare and Koriki.

### *Government Programs*

Currently there are no government fisheries programs active in the PAOI. This contrasts with the situation in the region during the mid- to late-1970s, when local and national government programs actively supported commercial fisheries ventures in Gulf Province, including trials on the use of village freezers, mobile freezer barges and industrial smoke house facilities to help overcome key problems with regularity of supply and transport.

A commercial prawn fishing operation has been active in the waters off Orokolo Bay and the mouths of the Purari delta since the early 1970s. By-catch of fish and sharks is occasionally purchased by residents of Orokolo villages (and possibly other villagers) who take outriggers to the fishing vessels and obtain fish either by purchase or exchange for other local products.

## Hunting and Collecting

Members of all communities within the PAOI use a wide variety of naturally occurring plants and animals on a day-to-day basis as part of their subsistence livelihoods, and also in support of a range of commercial activities. The majority is obtained from the various forest resources including mangroves, and a smaller number are obtained from the rivers, estuary and beaches.

### *Subsistence and Artisanal Practices*

The land and aquatic/marine ecosystems of the PAOI are essential for a variety of provisioning services. These are essential ecosystem services that fall into the categories:

- Construction materials (plants used in building construction and fencing).
- Non-cultivated plant foods.
- Canoe, paddles and rafts.
- Domestic (brooms, floor mats, containers, washing tools, plant extracts used as shampoo etc.).
- Firewood and torches/matches.
- Medicinal plants.
- Cultural plants and animals (used in celebrations, plants used in sorcery, plant dyes, plants used to make bilums and mats and traditional fiber etc.)
- High value non-timber forest products (NTFPs) (e.g., Eaglewood)
- Famine resources.
- Animal foods obtained by hunting and collecting.

The dominant plant resource uses across the PAOI were for house construction, followed by domestic, food and medicinal purposes. Across the 'useful plant' categories (trees, ferns herbs, etc.), trees were the most useful plants with 552 recorded uses, followed by palms, which had 157 uses. Other useful plants had a relatively small number of recorded uses in comparison.

The pattern of resource use by life form did not differ substantially amongst the villages based on the plant use percentage for each village; however, coastal villages use mangrove resources, which are not available for the Pawaia and some of the riverway villages.

Village respondents emphasized that all forest resources were of high value, and rarely was a resource considered more important than another. This reflects the predominantly subsistence livelihoods of most villages and the high value of forest-based resources for their livelihoods.

Men were typically responsible for collecting/harvesting the heavier resources and for the production of canoes and the building of houses and fences. Women were mostly responsible for processing sago and collecting firewood, which are regular and ongoing tasks.

The PAOI villages enjoy a diversity of protein sources (red meat, fish, crustaceans, shellfish, invertebrates), with varied nutritional values. Although the contribution of each group varies between villages in accordance with their variable environmental settings, all groups enjoy access to varied animal foods. Among the most important animal resources obtained from hill and alluvial forests are wild pigs, cassowaries, wallabies, bush fowl and their eggs, and cave-roosting bats, but a host of smaller vertebrates and a range of invertebrates including sago grubs are regularly consumed. Availability of these resources varies seasonally and across the PAOI, as determined by forest type, disturbance history (especially forestry and gardening activity), and local population density. Larger game items such as wild pigs and cassowaries are highly prized and are actively pursued. However, most procurement activity is highly opportunistic and the bulk of the 'hunting' returns consist of larger numbers of many different kinds of smaller food items. Animal foods obtained by hunting and collecting from the land are most important among the riverways and inland villages, and less so in the villages residing within the mangroves or along the coastal margin. In the latter areas, collecting of crabs, shellfish and mangrove worms provide a substantial proportion of the animal food intake. In many villages, there is a perception that 'high value' land resources such as cassowaries and wild pigs are locally depleted due to disturbance (usually attributed to logging) and over-hunting.

Men, women and children all contribute to the harvesting and production of animal foods but there are systematic contrasts in the pattern of food gathering activity between villages living in different parts of the PAOI. In villages situated within estuarine and marine areas, animal food resources are typically associated with particular habitats and the gathering activities are mostly localized and relatively intensive. Under these circumstances, much of the gathering is done by women (who can often work unaccompanied or in all-female groups) or more equally by the sexes. In villages situated within the freshwater part of the PAOI, animal food resources are mostly dispersed across broadly-distributed habitats. Hunting and collecting activities typically involve extensive travel within a territory. Under these circumstances, much of the hunting and collecting activity is done by men or by family groups, and rarely by unaccompanied women, either due to concerns about personal security or because women have other responsibilities (e.g. young children) that limit their mobility.

Residents of most villages engage in some opportunistic sale of hunted and collected animal food with other members of their own or nearby villages. Markets also provide venues for sales of bushmeat (especially wild pig and cassowary), crabs and shellfish. Local opportunities include the supply of the logging camps located near Evara and Poroi 2, to the barges that enter and exit via the Purari channels and to Kapuna Health Centre. Other opportunities for sales are outside of the immediate area, including markets at Baimuru and further west in the Kikori catchment. Bushmeat is usually smoked before transport to the more remote markets, while crabs and shellfish can be transported live. Access to diversity of animal foods also depends on systems of exchange between villages, with animal foods variably exchanged for other animal foods and for sago and garden produce. Although the volume of exchanged animal foods was not quantified during the SBS, it is likely to greatly exceed the cash economy of surplus animal foods.

Although many households earn some revenue from occasional sales of hunted or collected animal foods, only a small number earn significant annual revenue. Among the 354 households surveyed, only six reported annual earnings from sale of bushmeat, with the highest being PGK 1,820 (US$582.40) and an average of PGK 863 (US$276.16). More people reported earnings from crabs but 25 vendors made a combined total of PGK 10,991 (US$3,517.12) or an average of PGK 439.64 (US$140.68). One enterprising resident of Paevera village reported revenue of PGK 3,120 (US$998.40) from sales of sago cooked with sago grubs. None of these figures point to any significant widespread commercial gain from sale of bushmeat or other hunted or collected land animal resources. This is likely because most residents have access to adequate resources of their own, with most opportunistic sales made to staff of logging camps, barge crews, Kapuna Health Centre and various regional markets. Local opportunities for selling hunted or collected animal foods are clearly limited and costs involved in travel to regional markets probably deter the majority of potential vendors.

### *Commercial Uses*

Large-scale forestry is the main commercial use in the PAOI. There are two logging concessions, known as Forest Management Areas (FMAs) that overlap the PAOI; Vailala Block 3 and Baimuru Block 3 of which only Vailala Block 3 is active. Much of the concession has been logged with current harvesting occurring in hill forest approximately 15 km to the southwest of Herd Base. Logs are transported to Evara Logging Camp just south of Evara for shipment by logging barge. Approximately one to two logging barges depart Evara Logging Camp each month.

Despite national efforts to encourage crocodile farming, the present trade in crocodile skins from the Purari area is based almost exclusively on hunted crocodiles. Sales are made either directly to businesses in Port Moresby or through intermediaries. Prices depend on the size and quality of the skins but an average sized skin in good condition might be expected to sell for PGK 500 to PGK 600 (US$160 to US$192); animals that have been shot are often damaged and receive lower prices.

Only 9 out of 354 surveyed households reported significant annual sales from crocodile skins. Four of these, with sales of PGK 300 to PGK 800 (US$96 to US$256). The highest revenue was PGK 16,000 (US$5,120). The total revenue from crocodile

skins amounts to annual sales of around 60 skins. Many more crocodiles are killed and consumed, many after snaring in fishing nets, but without sale of the skins.

## Natural Resource Use Constraints

## Environmental Conditions

The PAOI is subject to natural disasters caused by extreme climatic events, particularly flooding and drought associated with El Niño climatic perturbation events. In 2014 high rainfall resulted in severe flooding along the Purari River which was most severe upstream, particularly in the Pawaia villages where strong river flows and high water swept away houses, destroyed riverside food gardens and uprooted planted sago palms.

The PAOI was impacted by severe drought associated with the 1997 El Niño climatic perturbation. Across the PAOI extremely low river flows occurred and there was insufficient water to process sago in some locations, and drinking water was in short supply in some villages, particularly in the Baimuru LLG area. Approximately 2.3% of the population of Gulf Province was severely affected (Allen and Bourke, 1997).

The major impact of these events is:

1. The loss of access to food resources from flooding.
2. The physical loss of food from intense flooding.
3. The loss of the ability to grow food because of prolonged inundation or drought.
4. The loss of the ability to process sago from low water levels due to drought.

*Trade winds and travel:* The south coast of Papua New Guinea including Orokolo Bay is subject to seasonally rough seas associated with the trade winds which impact much of the south coast of Papua New Guinea restricting travel by small boat along the coast particularly from June to September.

## Flora and Fauna

*Weeds:* Land based activities are impacted by a range of common weeds, however only three weeds are particularly problematic. These are the 'mile-a-minute' vine, which can smother banana plants, water hyacinth which can clog slow flowing waterways and kangkong which, according to local inhabitants has inhibited access to the PRL-15 oxbow wetlands. Terrestrial biodiversity and cultural heritage values and sensitivities of the area are described in the Upstream Terrestrial Biodiversity Baseline Report (Woxvold et al, 2017; Part 6 of ESBS Dossier) and the Upstream Cultural Heritage and Archaeology Baseline Report (Skelly, 2017; Part 17 of ESBS Dossier).

## Animal Pests

*Introduced fish species:* At the time of the Purari River (Wabo) Hydropower Scheme studies in the late 1970s there were no records of introduced fish in the Purari system below Hathor Gorge. However, over the last 40 years several introduced fish species have progressively invaded the Purari River and its tributaries. Tilapia arrived in the PAOI in the mid-1990s and others including one or more species of mahseer (locally known as 'besta' or 'mackerel'), carp and 'trout' (probably Snow Trout) only

in the last few years. The large flood event in 2014 was mentioned by several villages as heralding the arrival of many new kinds of fish.

*Fish diseases:* A widespread epizootic disease event occurred in southern New Guinea late 1975 to mid-1976, with reports of mass fish mortality from an ulcer disease from Merauke in the Indonesian Province of Papua to Port Moresby. All species of bony fish were affected and the rate of infection was locally high, with peak incidences of 50% early in the outbreak in the Purari and Kikori rivers. Outbreaks are believed to be triggered by heavy inflow of freshwater into estuarine systems, with the drop in salinity causing a lowering of resistance to a persistent environmental bacterium.

*Rodents:* Several species of rodents are long-established in near-coastal parts of the PAOI but these are currently expanding their distributions into villages and disturbed habitats in the hinterland. These species cause damage to garden and tree crops, and to household possessions, predate on eggs and chicks, and can spread diseases to pigs as well as to people. Their impacts are poorly documented in Papua New Guinea but can be assumed to follow patterns that are well-known from other parts of the world.

## Cultural Uses

Only nine cultural sites were described by respondents in the context of land and natural resource use questioning, as part of the community interviews, which probably reflects a small proportion of the total number of sites across the PAOI. It is not known if harvesting natural resources is permitted at these sites, apart from the PRL-15 oxbow wetlands where harvesting is allowed.

It is likely that accessing natural resources from those sites is part of maintaining the cultural heritage value of those areas (i.e., the natural resources assemblages derive their character from cultural activities and as such the value of such sites would be diminished if resources were not accessed).

Many plant and animal products are used for a range of decorative and utilitarian purposes. Many of the latter are traditional usages that are maintained today (e.g. use of shark and ray skin as sandpaper and of rat teeth as engraving tools), either because the modern alternative is not locally available or is seen as an unnecessary expense. Use of wildlife products for the production of musical instruments and as decorative items represents a resurgence of traditional practices that were suspended (and the heritage material culture mostly destroyed) during the late 1940s to late 1969s under the influence of the Tom Kabu Movement.

## Commercial

Forestry is the only large-scale commercial operation in the PAOI. Once the logging concessions have completed harvesting and the Forest Management Agreement has expired logging is not permitted until a new Forest Management Agreement is negotiated. However, this is also dependent on adequate forest regeneration and growth since logging will not be viable until sufficient timber volumes are present to support another logging operation. The Vailala Block 3 and Baimuru Block 3 FMAs expire in 2045.

## Access and Market Restriction

The PAOI has little transport infrastructure and many villages are remote with travel via the Purari River and ocean the only means of accessing markets, medical/education facilities and other regions. Travel within the PAOI and to regional centers is dominated by river and ocean travel, particularly using dugout canoes or motorized dinghies. Many villages are isolated with no walking tracks connecting other villages apart from the coastal and inland Orokolo villages. No government owned or public roads exist in the PAOI. There are however logging roads, which fall into disrepair and are unusable once logging has ceased and a Project road that runs north-south through PRL-15.

In additional to seasonal restrictions for ocean travel due to rough weather, riverway travel can be restricted by tidal movements in the lower Purari with canoe travel limited to travelling upstream with the incoming tide and downstream with the outgoing tide for longer trips. Moreover, when in flood floating debris prevents safe travel on the Purari River.

## Food Storage and Gender Issues

There is very little capacity in the villages to store animal foods for any length of time. Very few people own refrigerators or freezers (2% across the PAOI) and smoking of fish, pig and other meats is done over a fire which results in a level of preservation that allows for only short-term storage in such tropical conditions. Because of these constraints, most animal foods are consumed very soon after they are obtained. Shellfish and crabs can be kept alive for several days and thus are better suited than other animal foods for transport. The inability to effectively store food limits the capacity of household members to schedule food production or gathering activities around other potential opportunities such as paid labor.

While men, women and children all contribute to the harvesting and production of animal foods, there are imbalances in the gender roles and contributions. In particular, men play an essential security role in exploitation of any resources that are localized at distance from a village (e.g. fishing camps, sago plantations) and thus require extended travel or overnight stays. Similarly, activities such as pig or cassowary hunting that require extensive individual or small group movement within a broad territory are usually done by men, and only rarely by unaccompanied women, either due to concerns about personal security or because women have other responsibilities (e.g. young children) that limit their mobility.

# 1 INTRODUCTION

## 1.1 PROJECT OVERVIEW

Joint venture partners, Total E&P PNG Limited (TEP PNG) (40.13%), ExxonMobil (XOM) (37.03%) and Oil Search Limited (Oil Search) (22.84%), are planning the development of the Elk-Antelope gas fields located in Gulf Province, Papua New Guinea. The gas fields are located within Petroleum Retention License 15 (PRL-15). The Project will include infrastructure development inside PRL-15, and the construction of gas and condensate pipelines (export pipeline) to an LNG Plant site at Caution Bay, 20 km northwest of Port Moresby.

The Elk-Antelope gas field is a significant gas discovery in Papua New Guinea consisting of a gas reservoir with several trillion cubic feet of gas reserves located approximately 120 km inland from the township of Kerema, and 340 km northwest of Port Moresby.

The Project will comprise upstream production well development and associated infrastructure at the gas field within PRL-15, construction of an upstream central processing facility (CPF) and delivery of gas and condensate via onshore and offshore export pipelines to a LNG Plant site at Caution Bay, Central Province, 20 km northwest of Port Moresby. The design life for the Project will be 25 years.

The Project area comprises the physical footprint of the various Project components and associated infrastructure as detailed below.

- Production, processing and related facilities (within PRL-15):
    - Wellpads and the associated gathering system (including flowlines and trunkline).
    - CPF.
    - Logistics base and river offloading facilities, accommodation camps, airstrip, roads and bridges.
    - Quarries and communications infrastructure.
    - Initial section of the onshore export pipeline.
- Onshore pipeline (outside PRL-15):
    - Remainder of the onshore export pipeline to landfall on the Gulf coast including valve stations.
    - Temporary laydown areas and camps.
    - Quarries and communications infrastructure.
- Transport (river) corridors:
    - River transport routes — the Purari, Urika-Ivo and Wame-Varoi rivers.
- Offshore pipeline:
    - Offshore section of the export pipeline to a LNG Plant site, Caution Bay.

## 1.2 STUDY OBJECTIVES

The key objective of the land and natural resource use study is to provide a baseline characterization of the land, natural resource use and land tenure across the PAOI. This involved identifying, describing and where possible, mapping land and natural resources that have importance for social values in the PAOI, that require consideration in the development of the Project.

This includes the characterization of the following:

- Natural resources and their distribution.
- Provisioning ecosystem services including subsistence agriculture, fishing and hunting.
- Commercial uses.
- Natural resource use constraints.
- Natural resource values.

The Land and Natural Resource Use Baseline Report aims to meet the requirements of national legislation and international guidelines, including the relevant aspects of the International Finance Corporation's (IFC) Performance Standard 1 – Assessment and Management of Environmental and Social Risks and Impacts (including aspects related to stakeholder engagement) and TEP PNG Sustainable Development Specifications (GS EP SDV 101 Social Baseline Study). Information contained in this report will also contribute to the assessment of provisioning ecosystem services.

# 2 REGULATORY FRAMEWORK AND STANDARDS

## 2.1 PAPUA NEW GUINEA

The most relevant Papua New Guinea laws and guidelines to the land and natural resource use study are the:

- *Environment Act 2000* – outlines the environmental and social impact assessment process and rights of customary landowners.
- *Oil and Gas Act 1998* – outlines the obligations to pay compensation to customary landowners who are impacted.
- *Land Act 1996* – establishes customary land and provides the mechanisms for acquiring granting leases of customary land.
- *Land Dispute Settlement Act 1975* – sets out three stages for the attempted settlement of disputes over customary land.
- *Lands Group Incorporation Act 1974* – an Act identifying the process for identifying and officially recognizing, through registration, the owners of customary land.
- Conservation and Environmental Protection Authority (CEPA, formerly Department of Environment and Conservation (DEC)) guideline GL-Env02/2004: Guideline for Conduct of Environmental Impact Assessment & Preparation of Environmental Impact Statement (DEC, 2004) – assists developers meeting their legal obligations of the Environment Act.
- CEPA (formerly DEC): Social Impact Assessment Guideline, 2001 (Draft) – outlines the key issues in which social impact assessment should focus.

## 2.2 INTERNATIONAL STANDARDS AND GUIDELINES

### 2.2.1 International Finance Corporation (IFC)

The International Finance Corporation (IFC) Performance standards set out the environmental, health, safety and community requirements for project financed by IFC (IFC, 2012). The most relevant performance standards to the land and natural resources study are:

- IFC Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts. This performance standard requires companies seeking investment to identify the environmental and social impacts, risks and opportunities of its project, effectively engage with communities on matters that directly affect them and manage its environmental and social performance throughout the life of the Project.
- IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement. This performance standard applies to the physical and/or economic displacement of people as a result of project-related land acquisition or restrictions on land use.
- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. This performance standard requires companies seeking investment to manage natural resources in a way or at a rate that enables people and communities to provide for their present social, economic and cultural wellbeing while also sustaining the potential of those resources to meet the reasonable foreseeable needs of

future generations and safeguarding the life-supporting capacity of air, water and soil ecosystems. It defines ecosystem services as 'the benefits that people, including businesses, obtain from ecosystems'.

- IFC Performance Standard 7: Indigenous Peoples. This performance standard recognizes the often-strong connection between Indigenous people and their lands and resources and requires companies seeking investment to specifically recognize and engage with Indigenous people.

### 2.2.2 IPIECA

IPIECA is the good practice association to the oil and gas industry. It has produced a range of good practice guidelines describing good practice social baseline preparation (IPIECA, 2002; IPIECA, 2004). IPIECA highlights the need, particularly when a project may affect Indigenous Peoples, to gain a full and detailed understanding of:

- Land tenure and land access (including the legal context, traditional and cultural land governance, and the importance of land as it relates to cash incomes and livelihoods).
- Cultural heritage and traditional knowledge.
- Natural resource use (IPIECA, 2012).

### 2.2.3 TOTAL company standards and commitments

TOTAL's General Specification 101 (GS EP SDV 101) defines the Company's requirement for establishing a social baseline study (SBS) and sets out the parameters to be studied with regards to land and natural resources as:

- Identification and quantification of actual land use/land cover units including: farmland, grazing land, forest/shrub lands, residential land, institutional land, social infrastructure (schools, markets, hospitals etc.), any other formal or informal use (e.g. squatting or hawking) of land, and other features e.g. water bodies, roads, foot tracks, etc.
- Land tenure systems (customary, lease, freehold ownership and rights etc.).
- Land tenure distribution patterns.
- Agricultural and seasonal calendars (e.g. different crop seasons, agricultural production calendar, preparation, seeding, harvest, threshing, etc.).
- Occupancy rights: granted, deemed, customary, informal etc.
- Land claims whether official or unofficial, religious, Indigenous, de facto (e.g. occupancy or squatting), or other.
- Women's land rights; and any other land rights or claims by any other vulnerable groups.
- Previous or current land or land related disputes and speculation.
- Land prices, valuation systems, and processes.
- Land registers.
- Natural resource use and consumption.

- Natural resource challenges and pressures.
- Land set aside or utilized (whether recognized or not) for nomadic peoples or other formal/informal migrant groups.
- Notable natural calamities e.g. droughts, floods etc.

TOTAL's Charter of Principles and Guidelines Regarding Indigenous and Tribal Peoples reflects the principles of the International Labor Organization's Indigenous and Tribal Peoples Convention (C169). The Charter states that TOTAL affiliates will:

- Dialogue with communities in order to understand their goals, needs, values and constraints.
- Communicate plans to indigenous groups through presentations and local meetings.
- Inform indigenous groups about the development of the project.
- Work with all stakeholders to ensure the overall impact of the project is considered positive.

# 3 STUDY AREA

## 3.1 PROJECT AREA OF INFLUENCE

The PAOI is the area that is *likely to be affected* by the upstream Project, its activities and its facilities that are *directly owned, operated or managed by the upstream Project (including by Project contractors).* This definition includes *predictable direct, indirect and some cumulative impacts* arising from the upstream Project, including indirect impacts on biodiversity and ecosystem services upon which affected communities' livelihoods are dependent.

The upstream PAOI (thereafter referred to as PAOI) encompasses the areas associated with development of the upstream Project including:

1. Facilities, infrastructure and related activities within PRL-15 including well pads and gathering system, trunkline, central processing facility (CPF), logistics base, airstrip, accommodation camps, wharf and access roads.
2. Export Pipeline Corridor onshore and offshore between CPF and an LNG Plant site at Caution Bay.
3. Riverways along which Project vessels will travel to and from PRL-15.
4. Marine transport route between Caution Bay and the upstream riverways route to PRL-15.
5. Associated developments and activities such as quarries/borrow pits, logistical wharfs/terminals not operated by the Project.

The boundary for the upstream PAOI incorporates the communities and environment that are likely to be affected by the upstream Project and in doing so acknowledges the intricate link between the environment and the people who inhabit the area. Those people are dependent on the environment (land, air, water (fresh and marine) and natural resources) for their subsistence and as such any potential impact on the environment equates to potential impact on the livelihood and wellbeing of those people. The upstream PAOI is shown in Figure 3-1. Although not shown in Figure 3-1 (due to scale) the provincial capital of Kerema is also considered to be within the PAOI, as it is likely that goods and services and workers will be sourced from or transit through this provincial center.

The PAOI includes 39 villages and one government station with a combined population of 12,763 (Finlayson, 2017a).

## 3.2 STUDY AREA

The upstream study area for the social baseline study comprises local and regional study areas.

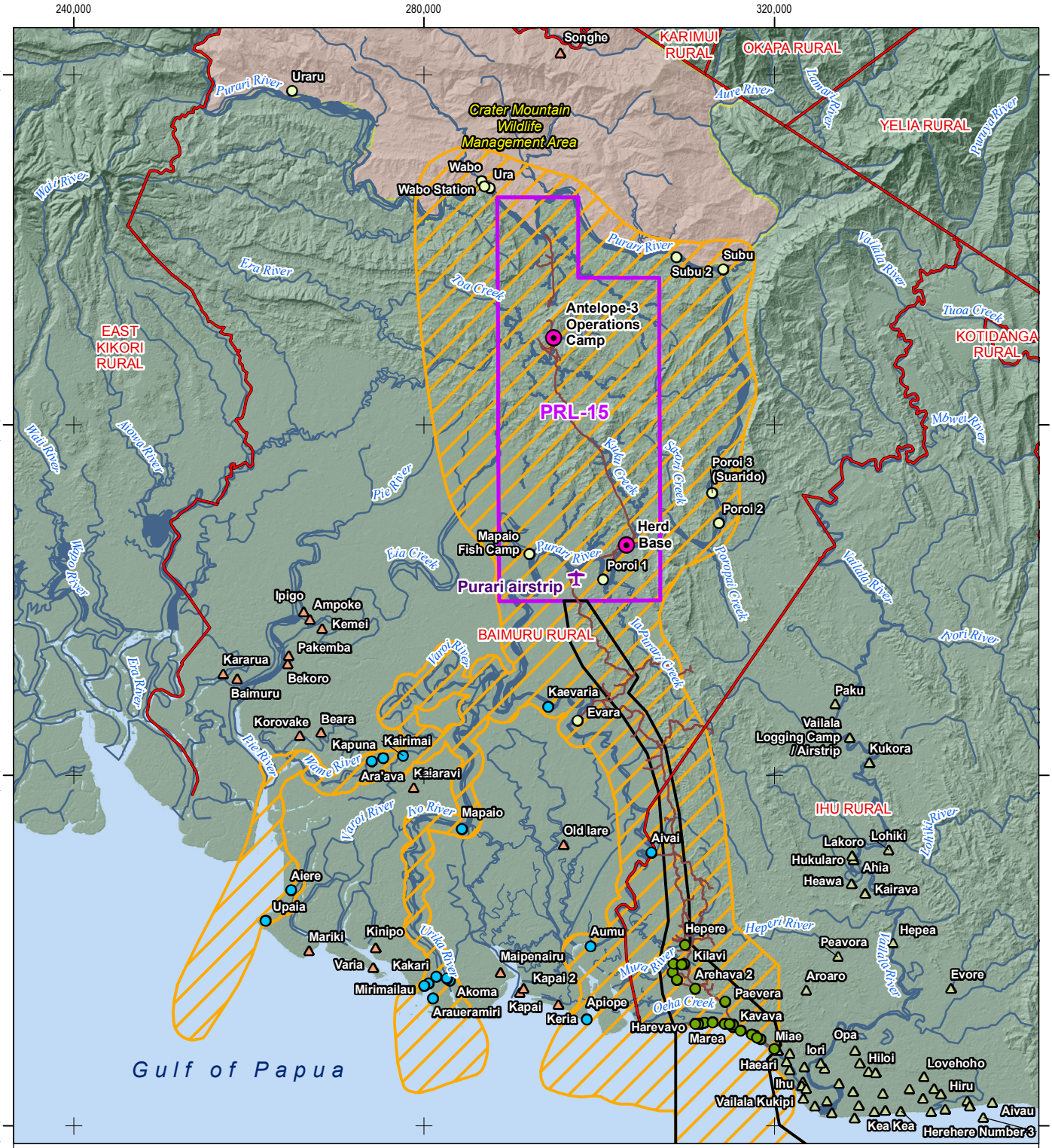
The local study area corresponds with the PAOI described above. It includes land and communities anticipated to be directly affected by Project infrastructure, facilities and associated activities within PRL-15, the onshore export pipeline and the Purari tributary riverways. Figure 3-2 identifies the PAOI, language groups

and ecological zones within this area, used in this study to assist with characterizing the land and natural resources of the PAOI.

The regional study area includes the relevant Provincial, District and Local Level Governments (LLGs). For the upstream study area, this includes:

- Gulf Province.
- Kikori District.
- Baimuru Rural and Ihu Rural LLGs.

Please note that baseline information on natural resources along the offshore export pipeline corridor is addressed in the Marine Fisheries and Resources Baseline Report (ERIAS Group, 2017; Part 13 of ESBS Dossier).




**SCALE:** 1:650,000 @ A4

0 5,000 10,000 15,000 20,000 25,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Towns and Villages**

**Project Affected Communities**
- PRL-15
- Export pipeline corridor
- Riverways

**Host LLG Communities**
- Baimuru Rural
- Ihu Rural

- Local level government boundaries
- Tracks
- Waterways
- Waterbodies
- PRL-15
- Upstream project area of influence
- Crater Mountain Wildlife Management Area

- Export pipeline corridor

**Existing Facilities**
- Base camp
- Purari airstrip

*Note, not all Host LLG Communities have been verified in the field.*

N

# TITLE: Upstream Project Area of Influence - Upstream Study Area

## FIGURE: 3.1

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-80044 **REVISION:** C

**DATE:** 8/05/2017

**DATA SOURCES:**

Facilities, town and villages, rivers, airstrip, export pipeline corridor, PRL-15, hillshade supplied by ERIAS Group and TOTAL (2015-2016). LLG Boundaries from HDX and then spatially adjusted to align with background and coastal boundaries removed. Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). Crater Mountain Wildlife Management Area (IUCN and UNEP-WCMC (2016), The World Database on Protected Areas (WDPA), Cambridge, UK: UNEP-WCMC. Available at: www.protectedplanet.net).

**CLIENT:**

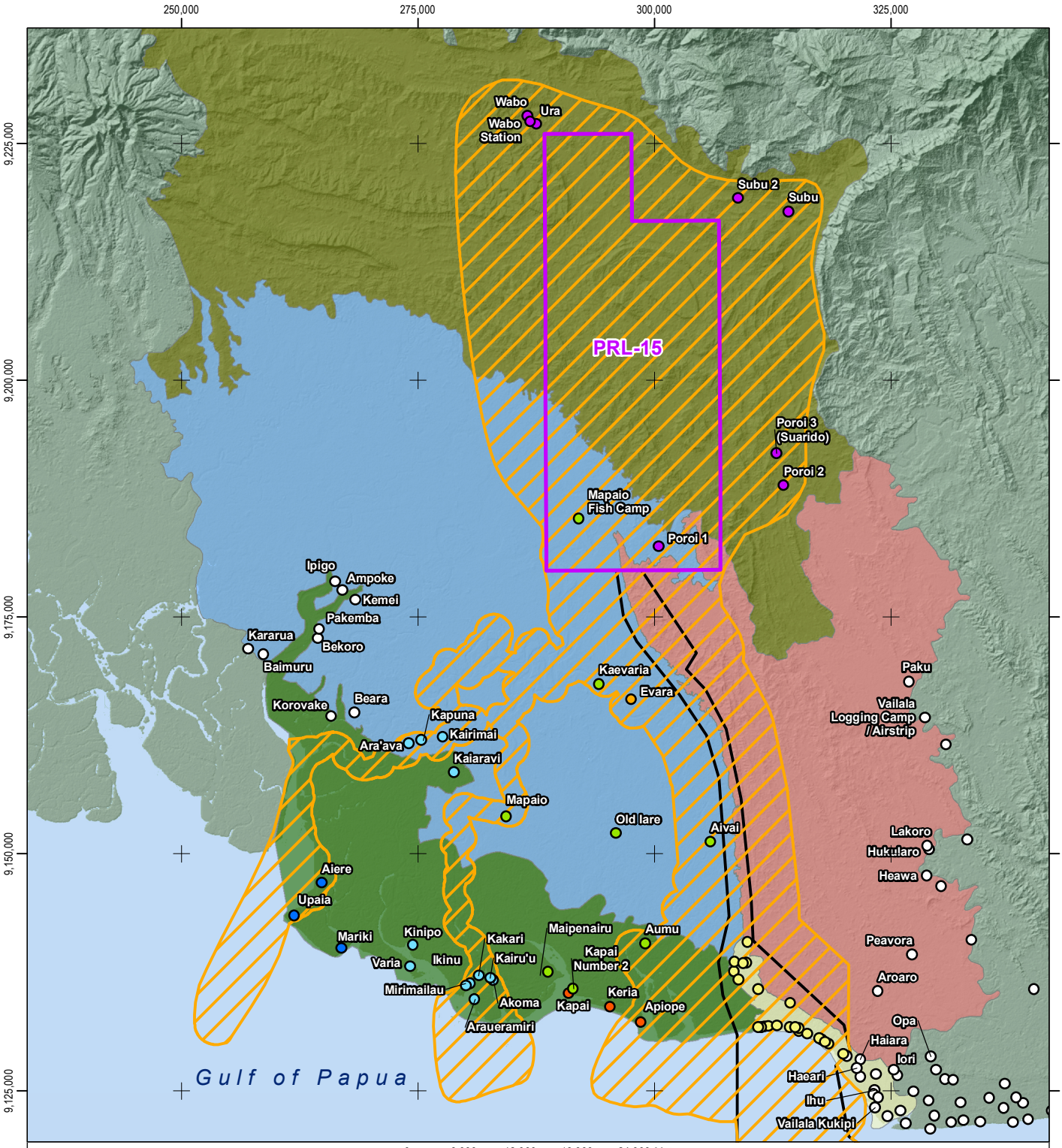
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T:\Projects\ER\002 Elk Antelope LNG Project EIS-ESHIA\Work Requests\R_097 - LNR Mapping\ER\002-R_097-80044-Figure 3.1-C.mxd




**SCALE:** 1:600,000 @ A4

0 6,000 12,000 18,000 24,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Language Group**
- A - Pawaian
- B - Kaimare
- C - Koriki
- D - Iare
- E - Orokolo
- F - Ahia
- G - Maipua
- Not verified

Upstream project area of influence

**Proposed Facilities**
- Pipeline export route corridor
- PRL-15 License

**Ecological Zones**
- Delta swamps and plains
- Mangroves
- Middle purari hills
- Southeast coast
- Southeast hills

N

*Note, not all communities have been verified in the field
**Note, language group does not represent land ownership

# TITLE: Upstream Language Groups and Ecological Zones

## FIGURE: 3.2

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79449 **REVISION:** C

**DATE:** 11/04/2017

**DATA SOURCES:**
Language Groups, villages, PRL-15, hillshade supplied by ERIAS and TOTAL (2015-2016). Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). Ecological Zones supplied by Iain Woxvold (2016).

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T:\Projects\ERI002 Elk Antelope LNG Project EIS-ESHIA\Work Requests\R_097 - LNR Mapping\ERI002-R_097-79449-Figure 3.2-C.mxd

# 4 EXISTING INFORMATION

## 4.1 PRIOR STUDIES WITHIN THE PAOI

Previous studies on land and natural resource use in the PAOI have focused on the upper Purari and the Pawaia people where detailed environmental and social baseline studies were undertaken as part of the Purari River (Wabo) Hydroelectric Scheme engineering feasibility studies for a proposed dam on the river in the early 1970s. A similar investigation was undertaken in 2012 as part of the environmental impact statement (EIS) for the Purari River Hydroelectric Project, however the reports are not publicly available.

Apart from these studies there have been studies on agricultural systems, e.g., (Hide *et al.*, 2002), recent anthropological publications for the coastal villages (Bell, 2006a, 2006b, 2009, Yeates, 2005) and historical anthropological studies (Williams 1924, 1940), nutritional studies (Hipsley, 1950) and studies on wildlife exploitation (Liem, 1983; Pernetta, 1983) and fish stocks (Haines, 1978). These and other studies are reviewed in the following sections where applicable to the PAOI.

In addition to this Upstream Land and Natural Resource Use Baseline Report, baseline reports have been prepared for this Project on the subjects of communities and demographics (Finlayson, 2017a), governance and economics (Finlayson, 2017b), and cultural heritage (Skelly, 2017), all which have some relevance to land and natural resource use. Detailed profiles of each of the villages within the PAOI have been prepared and are presented in a community directory (Finlayson, 2017a). The community directory includes maps of each village, outlining the residential boundaries and indicating the location of social infrastructure for each village.

## 4.2 BACKGROUND

The first people to utilize the resources of the Purari catchment were hunters and gatherers who arrived before 30,000 years ago, with subsistence agricultural practices (primarily swidden agriculture and possibly sago cultivation) beginning approximately 9,000 years ago, but in the upper catchment in the Wahgi Valley, located in the Western Highlands (Petr, 1983). The first people to utilize the resources of the southern lowlands of Papua New Guinea were also hunters and gatherers who arrived sometime before 13,000 years ago (David et al., 2007). Agricultural practices probably commenced at least 6,000 years ago in the Purari headwaters (Denham et al., 2003) but were a more recent development in the southern lowlands, probably approximately 2,900 years ago (Richards et al., 2016).

The level of resource use and associated impact would have had minimal impact on the PAOI, which was essentially a remote wilderness area until the arrival of Europeans in significant numbers in the 1870s. At the time of European contact, the Purari lowlands were observed to have moderately dense human settlements along some parts of the coast but much lower population densities in the hinterland, with inland peoples effectively uncontacted prior to World War II (1939-1945) (Warrlow, 1983).

Early ethnographic studies in the Gulf of Papua emphasized the widespread reliance on sago production, the universally low agricultural productivity, and the low protein intake of most people, with crab and shellfish collection generally more important that fishing (Holmes, 1924; Williams, 1924, 1940). What little was known of inland people suggested that they were essentially nomadic, with no strong agricultural traditions apart from sago production, and a heavy reliance on hunting over fishing. These impressions were supported by early assessments of the nutritional status of lower Purari and Kikori populations (Hispley, 1950; Hamilton, 1955).

When the Australian Government took administrative control in the 1900s, the Papuan area including the lower Purari was viewed as an under-populated but potentially resource rich area. Plantation establishment was promoted by the Australian Administration as a means of attracting white settlers to help develop British New Guinea and Papua (Lewis, 1996). One of the first to plant coconuts in the Orokolo Bay area was Robert Mawson, father of the famous Antarctic explorer, who was granted a lease at Kavauvau in 1906. Subsequent developments included an expansion of the copra industry with Kerema as the primary route for exports and the establishment of local timber industries with sawmills at Baimuru. Village coconut plantations for copra productions were also enthusiastically promoted by the Australian Administration, and several plantations had been established by 1922. A sawmill was established in 1922 on the Wame River about 1.4 km east of Ara'ava village. The sawmill was continuously in operation until 1955 (Maher, 1961). In 1925 and 1926 a Mr. Treolar constructed trading and copra-making facilities at three sites in the delta, at Kaimari, and in Koriki territory near Kinipo village and at the mouth of the Aevei River within the Maipua land. The business model involved buying copra from village-owned plantations, making copra and shipping it to Port Moresby by boat. This and similar businesses were short lived and the Australian Administration encouraged the village-based plantation owners to continue making copra as a village-owned business, however most of these initiatives were unsuccessful and copra production had mostly ceased by World War II.

In 1946 Tom Kabu, famed for his Indigenous modernization movement (Bell, 2006a), established the Sago Company, exporting traditionally made sago to Port Moresby from Hevesea (located between Ara'ava and Kairimai) on the banks of the Wame River, however this venture failed because the shipping companies were not willing to take 'native produce'. Although the company purchased the schooner *Ena* from the Australian Royal Navy to avoid the shipping constraint, the boat burnt at the docks in Port Moresby and was beyond repair. A coconut plantation was also established at Hevesea (possibly at the site now occupied by the Kapuna Health Centre) under the direction of Tom Kabu. The location was chosen because it was opposite the Port Romilly sawmill where there were wharf facilities to access shipping. Tom Kabu was also employed by the London Missionary Society (which later established Kapuna Health Centre) to establish a small copra making company on Urika Island in the Purari delta in the 1950s and had also established rubber plantations (Yeates, 2005). Once the Tom Kabu movement collapsed, the Australian Administration was able to reassert its

control and began to advance economic development of the area by again promoting the planting of coconut palms for copra production (Anon, 1965).

Further attempts to develop commercial activities focused on potential exploitation of the abundant Purari fish stocks and crocodile populations (Haines and Stevens, 1983; Pernetta and Burgin, 1983). Despite these efforts, the Purari lowlands remain one of the least developed parts of Papua New Guinea, with minimal commercial activity and lower than average social, educational and health services.

## 4.3 SUBSISTENCE LIVELIHOODS

Existing information on subsistence livelihoods is available for five of the seven language groups in the PAOI; Pawaia, Kaimare, Koriki, Iare and Orokolo. There is no prior information on subsistence livelihoods for the Ahia and Maipua language groups. These language groups are represented in the PAOI by a single village, and in neither case, has there been any relevant prior study.

### 4.3.1 Pawaia subsistence livelihood

The subsistence activities of the Pawaia were loosely characterized by various contributors to the Purari River (Wabo) Hydroelectric Scheme feasibility studies in the mid- to late-1970s, including Warrilow (1983) and Toft (1983). These sources emphasized the universal reliance on cultivated sago production and consumption among the Pawaia, the limited scale and variety of garden products, and the gathering of most other foods and useful commodities from within the forested landscape. Fishing was found to be of limited significance.

The Pawaia produced their sago from small plantations dispersed along the banks of the Purari River and its tributaries, and in elevated swamps. Sago production was done by family groups who spent one or two weeks in a temporary camp at one of their sago sites. Women performed most of the work of sago production, with men providing security and pursuing protein through hunting, fishing and the setting of traps and snares. A typical family spent about 60% of the year in sago camps, with sago starch from one palm lasting for up to ten weeks for the average family (Petr, 1983).

Pawaia gardens were small, temporary and widely dispersed along the main waterways. After initial clearing and planting efforts, there was little maintenance. The main crops were cooking bananas, taro, cassava, and yam. Tree crops such as breadfruit and Okari nut trees were also planted and these continued to produce crops long after abandonment of the garden itself. Domestic pigs receive scant mention but were probably kept in small numbers in sago plantations, as described by Hughes (1970) for nearby regions. The pattern of subsistence recorded from the Pawaia living around Wabo in the mid- to late-1970s is likely to have been widespread among all Pawaia villages throughout the PAOI but with increased time allocated to fishing among villages in the downriver part of the tribal territory and perhaps a greater reliance on natural rather than planted sago.

### 4.3.2 Kaimare and Koriki subsistence livelihood

The subsistence activities of Koriki and Kaimare villages living in the mangrove zone of the Purari delta were described by various early visitors to this area, including participants on the New Guinea Nutrition Survey Expedition of 1947 who visited Korovake, a Koriki village located between the Purari and Pie Rivers (Hipsley, 1950). This locality was revisited during the Purari River (Wabo) Hydroelectric Scheme feasibility studies, with quantitative studies of sago production (Ulijaszek and Poraituk, 1981) and the contribution of mollusks in the subsistence diet (Ulijaszek, 1980; Poraituk and Ulijaszek, 1980). Haines (1978) reported a short-term quantitative study of fishing activities at the near-coastal Koriki village of Barea, near Ikinu.

These studies documented a heavy reliance in all villages on sago, with women conducting the bulk of the work, a much lesser effort devoted to gardening, and the primary importance of crabs and shellfish rather than fish as protein sources, even following the quite late introduction of nylon gill nets into this area. Domestic pigs and chickens were kept in these villages but seemed to contribute little to the day-to-day diet.

### 4.3.3 Iare subsistence livelihood

Based on the literature reviewed, the Iare people have received much less attention than the other language groups. Haines' (1978) study of fishing activities included the inland Iare village of Ravikoupora, situated just above the limits of tidal influence, near Mapaio. Bell (2005) conducted anthropological research over several years (commencing in 2000) among the Iare people living at Mapaio village. This doctoral thesis includes a generalized account of subsistence activities over a 'typical' week; it contains useful information on the seasonality of some resources and practices, and provides an anthropological perspective on local perceptions of human relationships with the natural world. Gardens were more important than in the more coastal Koriki and Kaimare villages but sago still represented the major carbohydrate source, with women performing the bulk of the processing after initial felling of palms by men.

### 4.3.4 Orokolo subsistence livelihood

Frank Williams, government anthropologist in the Territory of Papua, carried out studies among the 'Western Elema' of Orokolo Bay, and less intensively, throughout the Purari delta, between 1923 and 1937 (Williams, 1924, 1940). While these studies were chiefly focused on aspects of social organization and ceremonial life, they contain useful information on traditional subsistence practices. Additional information on food production and nutrition was provided by Hamilton (1955) who visited Orokolo Bay and Kerema as part of a nutrition survey of Gulf Province.

Williams' accounts describe a heavy reliance on planted sago, with the plantations located close to the villages in the coastal beach plains. Gardens were also placed nearby to the villages, so that most activity could be undertaken during day trips. Gardens were larger and fenced against pigs, and usually constructed as communal (clan-based) resources, with family areas set out within the overall garden. Common garden crops were taro, sweet potato, sugar cane,

pumpkin, cassava, pineapple and leaf vegetables, and citrus were grown in addition to breadfruit and paw (Hamilton, 1955). Unlike the other villages, men and women shared more evenly in the labor of sago production, whereas gardening was done almost entirely by men. Fishing and collection of other marine resources was done by men and women, using hook and line and various scoop nets and barricade systems, but without the modern advantages of gill nets.

The gathering of crabs and shellfish provided the bulk of protein intake, with fishing producing lesser returns. Hunting for wild pigs and cassowaries occurred in the inland forests, with ceremonial needs stated to outweigh economic necessity for these items. Similarly, the large numbers of domestic pigs kept in Orokolo villages were rarely consumed except on special occasions and were a primary expression of wealth and the exchange of pigs "a means of cementing friendship, of maintaining proper relations between kin" (Williams, 1940). Chickens were kept in lower numbers. Hamilton (1955) concluded that the diet of Orokolo villages was better than that of other groups living in the Purari delta due to the greater ease of producing sago, the abundant and varied garden crops, and the ready availability of fish and shellfish from the ocean.

### 4.4 COMMUNITY-BASED COMMERCIAL FISHERIES

Reports from the 1940s and 1950s describe minimal commercial activity through most of the Purari delta villages and most disposal of surplus was carried out through traditional processes of exchange and reciprocal gifting. By contrast, the Orokolo villages were, by that time, already integrated to varying degrees into the cash economy of the copra industry. In 1955 Hamilton noted that many people were spending less time on gardening and more on copra production, and were purchasing store foods on an occasional basis.

Attempts were made during the mid- to late-1970s to early-1980s to establish larger-scale commercial fisheries in the lower Purari, motivated by a desire by local and national governments to enhance regional economic development. During this period, various programs trialed the use of village freezers, mobile freezer barges, industrial-scale smoke houses and the export of live crabs (Stevens, 1980; Haines and Stevens, 1983). Most of this activity came to be centered on Baimuru, resulting in export over several years of frozen barramundi, threadfin salmon, and shark, and both live mangrove crabs and frozen crab meat. High costs of air transport to markets was identified as a major impediment to this facility, even in the early 1980s, but local disputes over access to resources and the distribution of benefits was also a likely cause of failure (Stevens, 1980; Haines and Stevens, 1983).

Commercial trade in crocodile skins in the Purari area was reviewed by Pernetta and Burgin (1983). Occasional sales were probably made through Kerema and Kikori from early times but larger effort was prompted by passage of the *Crocodile Trade (Protection) Bill 1974.* This bill shifted the national emphasis from hunting to farming of crocodiles. Assisted by support from a United National Development Program (UNDP) / Food and Agriculture Organization of the United Nations (FAO) project commencing in 1977, there was a rapid uptake of crocodile farming practices through the Purari catchment. A survey in 1979 recorded 489

captive crocodiles held in 11 villages including Wabo, Avavu, Apiope and Maipenairu (Pernetta and Burgin, 1983). Most of the skins were sold to Evara Trading based in Baimuru, with estimated trade of 20–30 skins per month. Declines in the number of captive crocodiles were already noted in 1983 and today, there are very few captive crocodiles in the area but exactly when this situation was reached is not reported.

## 4.5 COMMERCIAL ACTIVITIES

The major commercial activity in the PAOI was the copra industry, established in the early 1900s, and promoted widely by the Australian Administration in the 1960s (Anon, 1965), with many of the coconut plantations remaining in production until at least the late 1970s, after which deterioration in the road to Kerema prevented transport. It is not clear why the road was not maintained, however this may have occurred after the country's independence was obtained. It is also not known what proportion of the copra production was by village-owned plantations or managed by Port Moresby based companies. However, plantation managers often employed people from the Orokolo area who may have also been employed on similar plantations in the Vailala and Kerema areas (Lewis, 1996).

A commercial prawn fishing operation has been active in the waters off Orokolo Bay and the mouths of the Purari delta since the early 1970s (Gwyther, 1983) but the catch is not processed locally. By-catch of fish and sharks is occasionally purchased by residents of Orokolo villages (and possibly others) who take outriggers to the fishing vessels and obtain fish either by purchase or exchange for other local products.

Current activities include forestry leases, mining exploration licenses and petroleum prospecting licenses that are described in Section 6.1.3.

# 5 APPROACH AND METHODS

## 5.1 GENERAL APPROACH

This study was designed to describe land tenure systems and characterize patterns of land and natural resource use of importance to villages and industry across the landscape of the PAOI. The primary means of assessment was as follows:

- Bibliographic review involving a desktop review of existing literature.
- An assessment of spatial datasets, focusing on vegetation and identifying major land use units where practicable.
- Community level data collection involving focus group discussions (FGDs) and key informant interviews.
- Household level data collection involving the detailed surveying of individual households.
- Ecosystem services (flora and fauna - provisioning) community level data collection and field assessment of flora resources using a rapid rural appraisal approach (RRA). RRA is an internationally applied, systematic but flexible way of obtaining information from local (rural) people in a limited period of time.
- Incorporation of data from other Project related studies where applicable, e.g. vegetation mapping spatial data.
- Informal discussion with landowners during surveys.
- Interviews with various PNG Government departments such as:
    a. Gulf Provincial Government and Provincial Administration, including representative from Kikori District and the Baimuru and Ihu Rural LLGs.
    b. PNG Forest Authority (Kerema).
    c. Gulf Economic Development Authority.

## 5.2 LIMITATIONS

Data collection for the study was subject to the following survey limitations:

- Lack of recent imagery for some villages located on the Riverway's outside of PRL-15 and the export pipeline corridor.
- Limited time in some villages sometimes preventing the identification of exact areas of resource use/resource harvesting, cultural sites and examples of natural resource use practices where these were located distances away from villages. Some plant names were recorded in local language only, without identification of the life form or species that the names relate to.
- Community meetings for land and natural resource use were subject to male gender bias with generally few female respondents, despite encouragement by interviewers. This is a common limitation issue across

Papua New Guinea in relation to land and natural resource use meetings and reflects cultural protocols.

### 5.3 DATA SOURCES

The following data and spatial datasets were used:

- Excel summary tables compiled from the social baseline community and household surveys (ERIAS Group 2016a, 2016b).
- LiDAR imagery (TOTAL, 2016).
- Forest Inventory Mapping System (updated for PRL-15 and the export pipeline corridor FIMS).
- Papua New Guinea Resource Information System (PNGRIS).
- Papua New Guinea Forest Authority forestry concessions mapping.
- Special Purpose Agricultural Business Leases (SABLs) mapping, with addition of the Purari SABL.
- Ecological zones – derived for the Upstream Terrestrial Biodiversity Baseline Report.

The spatial datasets are used throughout the report in the various mapping figures apart from PNGRIS, which was reviewed only.

### 5.4 COMMUNITY AND HOUSEHOLD SURVEYS AND ECOSYSTEM SERVICES INTERVIEWS

Information for this baseline study was collected via community and household surveys and ecosystem services interviews. A summary of the field program is provided in Table 5-1.

**Table 5-1 Field program**

| Survey | Date | Survey | Description |
|---|---|---|---|
| Community survey | 7/5/2016 -2/6/2016 and 20/8/2016 – 25/8/2016 | Social Baseline | Community based interviews using the land and natural resource use social instrument |
| Household survey | 17/8/2016 – 12/9/2016 | Social Baseline | Household interviews using the household survey questionnaire, including questions specific to land and natural resource use |
| Ecosystem services interviews | 29/1/2016 - 16/2/2016 and 1/7/2016 – 18/7/2016 | Biodiversity Phase 1 and Phase 2 | Plant resource interviews and field assessment of plant resources. Observations and aerial survey of land use.<br>Fauna resource interviews and informal discussions during camp-based biodiversity surveys |

The community and household surveys were undertaken using dedicated questionnaires and the ecosystem services interviews used semi-structured questionnaires and incorporated extensive informal discussion. These survey

instruments are provided in Appendix A. A summary of the surveys conducted by village is provided in Table 5-2.

## Table 5-2 Locations of surveys and meetings

| Village | Language group | Community survey – LNR KII (Sections A-L) | HH survey and # households | Ecosystem services (flora) survey | Ecosystem services (fauna) survey |
|---|---|---|---|---|---|
| Evara | Ahia | X | 14 | X | X |
| Aivai | Iare | X | 9 | X | X |
| Aumu | Iare | X | - | - | - |
| Avavu | Iare | X | - | X | - |
| Kaevaria | Iare | X | 10 | - | - |
| Kapai 2 | Iare | - | 16 | - | - |
| Maipenairu | Iare | X | 18 | - | - |
| Mapaio | Iare | X | - | - | - |
| Mapaio Fish Camp | Iare | - | 3 | - | X |
| Aiere | Kaimare | - | 6 | - | - |
| Mariki | Kaimare | X | 17 | - | - |
| Upaia | Kaimare | X | 13 | - | - |
| Akoma | Koriki | X | 11 | - | - |
| Ara'ava | Koriki | X | - | - | - |
| Ikinu | Koriki | X | - | - | - |
| Kairimai | Koriki | X | 19 | - | - |
| Kairu'u | Koriki | X | 10 | - | - |
| Apiope | Maipua | X | 16 | - | - |
| Ere | Orokolo | X | 13 | - | - |
| Harevavo | Orokolo | X | 30 | - | X |
| Hepere | Orokolo | X | - | - | - |
| Herekela | Orokolo | - | 21 | X | - |
| Huruta | Orokolo | X | - | - | - |
| Iuku | Orokolo | X | 24 | X | - |
| Kaivukavu | Orokolo | X | - | - | - |
| Kavava | Orokolo | X | - | - | - |
| Kilavi | Orokolo | X | 15 | - | - |
| Larihairu | Orokolo | X | - | X | - |
| Marea | Orokolo | X | - | - | X |
| Mareke | Orokolo | X | - | - | - |
| Oru, Lariau, Herakela | Orokolo | X | - | - | X |
| Paevera | Orokolo | X | 15 | X | - |
| Poroi 1 | Pawaia | - | 5 | - | X |
| Poroi 2 | Pawaia | X | 14 | X | - |
| Poroi 3 (Suarido) | Pawaia | - | 5 | - | - |
| Subu | Pawaia | X | 2 | - | - |
| Subu2 | Pawaia | X | 7 | X | X |
| Ura | Pawaia | X | 12 | X | - |
| Wabo | Pawaia | X | 22 | X | X |
| Wabo Station | Pawaia | - | 7 | - | - |

X = Yes, - = No. HH = Household

Interviews were also conducted with the following Government officials:

- Miai Larelake, Provincial Legal Officer, Gulf Administration.
- Baker Maeva, Director, Law and Justice, Gulf Administration.
- Javen Evera, Provincial Forestry Officer, PNG Forest Authority.

### 5.4.1 Community and household surveys

The community surveys provided the necessary information to (i) identify sampling criteria for the selection of villages in which household surveys would be conducted, and (ii) estimate the number of households to be surveyed in each village.

Results of the community surveys indicated that people speaking a common language shared a similar history, and people residing in the same ecological zone practiced similar activities on a day-to-day basis. The language group and ecological zone were therefore identified as key determinants of current lifestyles and social behavior, and used as the key criteria on which village selection was based. Due to similarities within and between villages, it was deemed adequate, due to low variability in response to many social characteristics, for the household survey to be conducted in a sample of villages and to include a sample of households from each survey village.

The villages included in the household surveys were therefore purposively selected to ensure a stratified sample of villages from (i) each language group and (ii) each ecological zone. Only two villages from the Kaimare language group are within the PAOI, so the nearby village of Mariki was included in the villages in which household surveys were conducted. Similarly, as Maipenairu and Kapai 2 were deemed to be culturally significant for the Iare language group, and are located near the PAOI, they were included in the Iare villages in which household surveys were conducted.

While the PAOI included 39 villages and one Government station, 27 villages (including Wabo Station and the villages of Mariki, Maipenairu and Kapai 2) were included in the household surveys. The intention was to survey at least 30% of the households in each community, with the proportion of households surveyed increasing in villages with fewer households. The households selected from within each village were selected systematically from a village map and list of households prepared from information collected during the community level surveys.

A detailed data collection program was formulated, in consultation with TEP PNG, based on the assumption that:

- The community survey team would have sufficient team members to complete all surveys in a village within 3 or 4 hours.
- The household survey team would have sufficient team members to complete between 20%-30% of households in the majority of villages in one day.

Data collection occurred between May and September 2016.

The team assembled for the community level surveys included six expatriate and five PNG consultants. The team assembled for the household surveys included two expatriate and one PNG consultant and eight PNG researchers. The PNG researchers were generally anthropology students (or recent graduates) from the University of Papua New Guinea.

Several team members have worked extensively in Gulf Province before. PNG consultants were involved in survey design to help ensure the survey instruments were appropriate in the cultural context. The inclusion of PNG consultants also ensured that many of the team were fluent in both Tok Pisin and Motu.

All team members participated in detailed pre-survey training programs that aimed to:

- Familiarize team members with the Project and the PAOI.
- Provide a detailed understanding on the reason for collecting social baseline data, and the importance of collecting accurate data.
- Ensure all team members understand all questions they may be required to ask, and how they should be asked.
- Ensure all team members understand their responsibility to check each questionnaire to ensure it is complete and legible, before moving on to the next task.
- Ensure all team members are aware of the health and safety requirements of the Project and TEP PNG.
- Ensure all team members are not only recording data but able to contribute to the knowledge base and provide insight to the potential social impacts of the Project.

#### *5.4.1.1 Community survey implementation*

TEP PNG Community Affairs (CA) officers conducted survey awareness approximately two weeks prior to the community level surveys, and again, one or two days before the surveys were scheduled in each village. Awareness materials were prepared by ERIAS Group, in consultation with TEP PNG, to be used by CA officers when providing awareness in each survey village on the EIS/ESHIA process and the SBS.

Following arrival in each village, a meeting with village members was held and a tok save (explanation) provided by TEP PNG and the SBS team. As part of the tok save:

TEP PNG:

- Introduced ERIAS Group as an independent organization, engaged by TEP PNG to conduct the EIS/ESHIA.
- Indicated that the purpose of the visit was for the SBS.

The SBS team:

- Introduced individual team members.
- Outlined the need for TEP PNG to prepare an EIS.

- Outlined the contents of the Social Impact Assessment.
- Outlined why it was important to collect social data.
- Confirmed that participation in any survey was voluntary.
- Confirmed that the information collected would be presented in a public report but names of individuals would not be included in the report.
- Confirmed that a summary of the information collected would be returned to the village.
- Outlined the various surveys, including the land and natural resource use key informant interviews (KIIs) that the team would like to conduct.
- Sought agreement from those present in the meeting that they were happy with the work and willing to cooperate.

Following the tok save the SBS team commenced the various focus group discussions (FGD) and KIIs and commenced mapping of houses, village infrastructure and other points of interest. The team generally completed the surveys in less than half a day, which allowed two villages to be completed on a single day when logistical arrangements allowed.

#### *5.4.1.2 Household survey implementation*

CA officers conducted awareness approximately two weeks prior to the household survey, and again, one or two days before the survey was scheduled for each village.

Following arrival in each village, a brief meeting was held with village members and a tok save provided by TEP PNG and the SBS team (reiterating the information presented on the previous occasion, as outlined above). The selected households were then identified, and surveys commenced. Households were only surveyed if one or more adults from the house were present and willing to participate in the survey. If household members were absent or otherwise occupied, a replacement household was identified. Generally, this was the nearest household to the one that needed to be replaced. One full day was generally required to complete the household surveys in each village.

### 5.4.2 Ecosystem services interviews

#### *5.4.2.1 Flora resources*

To further identify important plant resources and associated vegetation of significance to villages, a flora resources assessment (provisioning services) was made for 11 villages comprising the Pawaia, Iare, Ahia, and Orokolo language groups. The villages assessed are identified in Table 5-2. For each village assessed, two days were spent in the village - one day for the community discussion and one day for the field visit.

The assessment was based on a rapid rural appraisal (RRA) approach as follows:

- Introductory awareness meetings were held with community leaders prior to the survey to describe the study objectives and to obtain their consent for participation in the study.

- Semi-structured interviews (SSIs) were completed for each village. The group participants were based on availability at the time of arrival in each village; however, women and older men/women were invited to join the groups if underrepresented. This was done to reduce gender bias and to include elderly participants who typically have a better recollection of customary uses and traditional names of plants. The questions (see Appendix A) were designed to discuss key aspects of plant based provisioning ecosystem services in relation to:
    - Determining where plant resources are harvested.
    - Determining if specific forest areas are more important than others for collecting plants.
    - Determining how readily available plant resources are and if some resources are harder to find than others. (Availability and abundance/scarcity were based on qualitative responses reflecting the interviewee's perception only).
    - Determining relative labor (time) input for collecting different categories of plant resources. (Relative labor time was based on qualitative responses reflecting the interviewee's perception only).
    - Identifying food security plants and types of land resources (e.g. high ground, swamps, riverbanks) that are used for growing food crops when in drought or other natural disaster.
    - Identifying perceived threats to plant resources if any.
- An assessment of within-village uses based on a walkthrough survey of each village to identify plants used in house construction and domestic uses.
- An assessment of forest-based plant resources with the participation of representatives from each community, based on a field assessment of forest resources for a specific forest type or types, characteristic of the area.
- Identification of plant resources taxon to at least genus level where practicable.

For each plant species with an identified use, a record was made of the scientific name, its local language (tok ples) name, and its use. The spelling of local language names was based on the spellings provided by the local guides and rendering plant names phonetically. The plant resources were classified into one of the following categories:

**Domestic**: A broad range of uses including plants used for house matting, bowls, and brooms, bark fibers for weaving bilums, and plant exudates used for glue and candles.

**Hunting/fishing**: Plants used as fishing lines, plants for making animal traps, plants that produce seasonal fruit favored by animals which are good hunting sites (hunting trees), and plants that provide poison for killing fish.

**Cultural**: Plants that may have some spiritual significance, plants that are used in sorcery and plants used for making traditional clothes such as grass skirts.

**Firewood**: Trees that are preferred for cooking, or other plants used as smoldering matches. General firewood species were not assessed to ensure sufficient time was available for the assessment of the other categories.

**House construction**: Plants that are used for house posts, rafters, walls and roof thatch (e.g. palms and grass), and plants used for tying down roofing and rafters such as rattan canes.

**Medicinal**: Any plant that has a medicinal use when used orally, externally or spiritually.

**Food**: Any part of a plant that can be eaten, which ranges from fern shoots to Cycad seeds, and trees that are left to rot to provide a habitat for edible larvae.

**Canoe/raft**: Trees and other plants that are used to construct dugout canoes, outriggers and rafts.

#### *5.4.2.2 Fauna resource group and key informant discussions*

In addition, targeted group discussions were conducted at nine villages on fauna resources. Although the intent of these meetings was to conduct small focus-group discussions, the number of participants varied greatly and in some instances a substantial proportion of the total community was involved. These meetings were used to obtain more detail on the pattern of use of certain fauna resources and to gain perspectives on why particular resources were used at what time of year.

Individual discussions were held with key informants. These discussions were opportunistic and took place in a variety of contexts. Some occurred at biodiversity field camps while working and traveling with local assistants and guides. Others took place during casual meetings with residents who came through a field camp during their own travels or during social interaction where the camp was near a village.

Tok ples names were recorded for animals encountered during the terrestrial biodiversity surveys. No attempt was made to record the cultural significance of particular animals as this knowledge is often clan-specific and the more significant information is unlikely to be revealed to an outsider or in a context where members of multiple clans are present. For some of the principal game animals, general questions were asked about food proscriptions but the responses were usually complex and variable, in line with experiences elsewhere in Papua New Guinea (Whitehead, 2000), including of the specialists involved in this study.

## 5.5 PROTOCOLS USED AND DEFINITIONS

### 5.5.1 Terminology

River system terms referred to herein include the following:

**Purari system** – The main Purari River channel and connected tributaries.

**Purari River basin/catchment** – A catchment 33 670km$^2$ in size that occupies a considerable portion of the central and southern part of mainland Papua New Guinea. It lies between the Kikori and Vailala rivers and extends from the highest mountain of Papua New Guinea, Mount Wilhelm to the Gulf of Papua.

**Purari River delta** – A large area of low, flat depositional land within the Purari River catchment where the Purari River main channel branches into several smaller distributary channels before flowing into the Gulf of Papua.

**Vegetation** – Vegetation types are referred to in the text using a set of Forest Inventory Mapping System (FIMS) equivalent terms (refer Appendix B). A full list of FIMS vegetation types present within the PAOI is presented in the Upstream Terrestrial Biodiversity Baseline Report.

### 5.5.2 Definitions

Animal resource and to some extent plant resource use among the villages of the PAOI are difficult to partition into traditional categories such as subsistence vs artisanal vs commercial, and is also difficult to categorize according to either methods of acquisition or gender responsibilities and contributions. Most households throughout the PAOI obtain their plant and animal food direct from the natural environment and most are more or less self-sufficient. For many households, commercial activity tends to be opportunistic, being related to the disposal of surplus, rather than a regular and necessary aspect of life. Technologies are mostly quite simple and many natural resources are harvested in a variety of different ways, even within a single community. Only a few animal resources are actively managed, although many others are subject to 'passive' management by avoidance of overharvesting. Moreover, while hunting/harvesting activities are certainly planned, they are also inherently opportunistic, and many trips end up being multi-purpose involving fishing, hunting, sago harvesting, plant resource collecting and garden crop harvesting and maintenance.

For this report, a somewhat arbitrary division is drawn between animal resources that are *actively managed* (e.g. pigs, chickens, farmed fish and crocodiles) and those that are *passively managed*. Among the latter group a further division is made between animals that are obtained by 'fishing' and those that are obtained by 'hunting' or 'collecting'.

**Fishing** is defined as the acquisition of animal resources from the aquatic environment. Fishing takes place in each of the marine, estuarine and freshwater environments of the PAOI and the range of animal groups acquired through fishing includes scalefish, sharks and rays, aquatic mammals (dolphins and dugong) and reptiles (turtles and crocodiles), squids and octopi, and crustaceans (crabs, prawns and shrimps). The fishing technology used in the PAOI includes nets and weirs, baskets and snares, bow and arrow, line and hook, and the use of poison.

**Hunting and collecting of fauna** is defined as the acquisition of animal resources from the terrestrial environment or from the interface of the terrestrial and aquatic environment (e.g. exposed tidal mudflats). These activities usually involve less specialized technology—typically bare hands and a string bag or

basket, less often a bow and arrow, an axe or bush knife. Two more specialized 'tools' are the snares set for terrestrial vertebrates and the trained dogs that play an important role in active hunting.

**Aquaculture** is defined as the production of aquatic resources under artificial or highly managed conditions. Examples might include rearing of fish in artificial ponds and the establishment of oyster colonies on artificial frames.

**Commercial** activities are defined as any exchange of animal resources for cash. Unfortunately, this definition fails to capture either the role of bartering (i.e., exchange of goods of approximately equal value as a cash-free capital transaction) or the role of reciprocal gifting (where 'values' are modulated by social capital and balances are achieved over longer time frames) which is a traditional mechanism for reinforcing relationships and for insuring against future hardship (Minnegal and Dwyer, 2000).

**Community** activities insofar as they relate to animal exploitation are difficult to define and quantify. Large-scale whole-of-community enterprises appear to be lacking within any of the surveyed villages. On the other hand, many activities certainly are undertaken on a communal basis, most likely involving groups of related men, women or families. More detailed studies would be required to understand the intricacies and implications of these relationships.

### 5.5.3 Other protocols

Photos used in this report were taken during field survey work conducted in May 2016, unless stated otherwise.

Current conversion in this report has been done at PGK 1.00 = US$0.32 = Euro 0.29 (28 October 2016).

# 6 BASELINE CHARACTERIZATION

## 6.1 LAND TENURE AND DISTRIBUTION PATTERNS

### 6.1.1 Background

Customary land tenure systems in Papua New Guinea have been developed over many generations. Tenure systems provide a safety net that has helped ensure the vast majority of Papua New Guineans have had access to adequate subsistence resources, despite changes in population, resources and technologies.

The existence of customary land tenure systems was recognized early on by the British and German colonial administrators and measures were taken to prevent the wholesale alienation of land from Indigenous people (Farran, 2011). Customary land ownership has legal recognition in Papua New Guinea and customary land cannot be sold (Anderson, 2010). This stems from the understanding that present landholders are the custodians of the land for future generations (Farran, 2011).

At the country's gaining of independence in 1975, 97% of PNG's land area remained under customary ownership (National Strategic Plan Taskforce, 2010), an estimate derived from work undertaken by A. Lakau of the PNG University of Technology in 1991 (refer Armitage, 2001). With 88% of PNG's population living in rural areas,[1] most of the population still resides on their customary owned land, where they have a right to live and a means to produce.

Not surprisingly, given the ethnic and language diversity in Papua New Guinea, customary owned land is held and managed by a range of different customary groups. However, what is common among these groups is that this form of ownership is recorded in local knowledge and tradition, and recounted orally, rather than within a system of government records. A detailed description of the settlement history, languages and clan affiliations of the people of the PAOI is provided in the Upstream Community and Demographics Baseline Report (Finlayson, 2017a; Part 14 of ESBS Dossier).

There is no legal requirement for the registration of customary land in Papua New Guinea. However, informal land dealings and transactions are common in many parts of the country and may include either leasing or outright sale of customary land (Department for Community Development, Department of Justice and Attorney General, 2008). These transactions are most common near urban areas and are essentially unregulated.

Land ownership recognition has also become more important in rural areas, where securing land rights or rights to the benefits derived from land can provide economic opportunities, for example, from logging or other extractive industries, lease rental payments, government compensation payments or other financial benefits. This link to economic opportunities is placing added pressure on landowners, causing conflict and requiring new strategies to manage land

[1] An estimate based on analysis of 2011 National Census data (Jones & McGavin, 2015, p.7).

disputes (Farran, 2011). In the PAOI, there is no knowledge of any customary owned land having been sold in the past. However, land has been leased for logging purposes, and a Special Agriculture and Business Lease (SABL) has also been acquired by a group known as the Purari Development Association. These leases are discussed in Section 6.1.3.

In the PAOI, land ownership is vested in clans. A clan is a group of families with a common ancestor or common lineage. A clan will identify themselves and their customary owned land through oral histories, including genealogies, stories, beliefs, customs and practices. In the PAOI, members of one clan may reside in several villages, although these villages will be affiliated to only one tribe or language group.

### 6.1.2 Land tenure

All the land in the PAOI is customary owned, except for Wabo Station and Muro Mission, which has been alienated. Clan boundaries are distinguished by natural geographic features, such as large trees or a group of trees, streams, hills and lakes. Clan boundaries extend over streams and beaches and into the ocean. While clan leaders can identify clan boundaries, and reaffirm these boundaries by talking about the history of the land and/or boundary markers, clan boundaries are not necessarily permanent. Clan boundaries may change over time (although change may occur over many generations) as people relocate in response to change in population and/or the level of resources available.

Clan land generally includes (i) common areas of land in which all clan members can fish, hunt and collect other resources, and (ii) specific land areas allocated to families where people will live and make gardens. The areas allocated to families are most often the more fertile areas of land where gardens can be grown, and because of this fact, are generally near where villages have been established. Whereas clan land may extend over hundreds of square kilometers, the area that is allocated to specific families is likely to comprise only a small proportion.

Clan members need to hunt or fish or extract other resources from their clan land on a periodic basis to (i) help maintain the recognition that it is their land and (ii) ensure nobody else is encroaching on their land. Similarly, within the clan, families need to use the land allocated to them to ensure their ongoing right to the land. This is most commonly undertaken by making food gardens. Planting sago (or other plants that have subsistence or economic benefits) is also a method to identify land ownership and help strengthen ownership or user right links between generations.

### 6.1.3 Land rights

#### *6.1.3.1 Customary land rights*

Village life revolves around subsistence, social relationships and social obligations, all of which are tied to land, which provides for the majority of subsistence, provides social identity and provides meaning to social obligations (Jones & McGavin, 2015). Rights over land access and use are, therefore, of fundamental concern to village societies (Jones & McGavin, 2015).

People from other clans, or other parts of Papua New Guinea, are generally able to pass freely in the open ocean and in large rivers, such as the main tributaries within the Purari river system. However, all other land (including beaches, near-shore areas of the ocean and smaller rivers) is owned by a specific clan and permission is needed for any 'outsider' to enter.

In the PAOI, men are primarily the custodians of the land and are responsible for decisions regarding land use and management. Women are generally expected to marry into another clan and receive access to her husband's land. Depending on factors such as the proximity to the women's clan land and her relationship with her family and her husband's family, she may continue to exercise some user rights in her family land, or she may relinquish these and shift entirely to her husband's land. If divorced, she will most likely return to her original family and access land there (although this will depend on factors such as the period married before being divorced, the relationship with both families, and land availability).

Men who marry into a clan will need to rely on land given to them by their wife's father or brothers. In the PAOI, this occurs most often when a male teacher or health worker is assigned to a particular village and marries there. He may choose to stay there permanently, and in doing so, will seek permission to access land from his wife's clan or family. Again, when land is allocated to men or women who are not from the clan, the land will be assigned in terms of user rights, not ownership. Furthermore, the user rights will generally be clearly defined in what can and what cannot be undertaken on the land. At the same time, considerable care must be taken when generalizing, as the PAOI contains seven distinct tribes or language groups. Even in local systems, the structure of inheritance and group organization can be based on complex and fluid principles rather than rigid rules (Commonwealth of Australia, 2008).

During the SBS, women were asked if they were allocated land for their use. The response to this question is shown in Table 6-1.

**Table 6-1 Villages in which women are allocated land for their use (number of responses)**

| Language group | Often | Sometimes | Rarely | Never |
|---|---|---|---|---|
| Pawaia | 2 | 0 | 0 | 3 |
| Ahia | 1 | 0 | 0 | 0 |
| Koriki | 1 | 1 | 0 | 2 |
| Iare | 2 | 1 | 0 | 2 |
| Kaimare | 0 | 1 | 0 | 0 |
| Maipua | 1 | 0 | 0 | 0 |
| Orokolo | 8 | 5 | 0 | 0 |
| **TOTAL** | **15** | **8** | **0** | **7** |

Source: ERIAS Group 2016a. Note: no response was obtained from two villages.

As shown in Table 6-1 the responses were quite polarized, even among the same language groups. Overall, women from 50% of the responding villages indicated that they were often allocated land for their use, women from 27% were

sometimes allocated land for their use, and women from 23% were never allocated land for their use. This different response may reflect the level of understanding of the question, or the interpretation of 'allocated land'. While women will not generally be allocated land on an indefinite basis, they will generally be allocated land on which to garden for a two to three-year period. Although allocated land for gardening, the use of land has generally been allocated to a male representative of the clan and the clan retains overall ownership.

Land ownership and allocation across the PAOI is complex and varied. Often if a combination of conditions exists, a variation to the 'usual' situation of land ownership and allocation is determined. For example, at Evara, a woman may hold exclusive user rights over land if there are no males in the family and she is first born whereas at Mariki, it is the responsibility of the male family leader to allocate family land to each family member but that family land can remain the woman's only until her son takes it over. Table 6-2 shows a simplistic outline of land ownership and women's user rights but it must be noted that it was not the objective of the land and natural resources use baseline study to determine land ownership or user rights (this is the role of the Social Mapping and Landowner Identification process and Land Investigation Report).

## Table 6-2 Land ownership and use

| Village | Language group | Ecological zone | Land tenure system | Land ownership | Exclusive user rights for women |
|---|---|---|---|---|---|
| Evara | Ahia | DSP | Patrilineal[2] | Individual males[3] | Yes[4] |
| Aivai | Iare | DSP | Clan allocation[5] | Family units | Yes |
| Kaevaria | Iare | DSP | Patrilineal | Individual males | Yes |
| Mapaio | Iare | DSP | Patrilineal | Individual males[6] | Yes[7] |
| Aumu | Iare | M | Patrilineal | Individual males | No |
| Maipenairu | Iare | M | Clan allocation | Family units | No |
| Mariki | Kaimare | M | Clan allocation | Family units | Yes[8] |
| Upaia | Kaimare | M | Patrilineal | Individual males | Yes |
| Ara'ava | Koriki | DSP | Patrilineal | Individual males | Yes |
| Kairimai | Koriki | DSP | Patrilineal | Individual males | Yes |
| Akoma | Koriki | M | Patrilineal | Individual males | Yes |
| Ikinu | Koriki | M | Patrilineal | Individual males | No |
| Kairu'u | Koriki | M | Patrilineal | Individual males | Yes |
| Apiope | Maipua | M | Patrilineal | Individual males | No |
| Harevavo | Orokolo | SECc | Patrilineal | Individual males | No |
| Iuku | Orokolo | SECc | Patrilineal | Individual males | No |

[2] Land is passed from father to son/s through generations.
[3] Generally refers to land being held by the father and passed to the eldest son who allocates user rights to other family members.
[4] First born females have exclusive user rights only if no males
[5] Land is allocated to family units by the clan.
[6] Individual males primarily; females where no males exist
[7] Exclusive user rights when single; once married, rights go to family
[8] Only in event of husband's death and only until land is passed to son; if no son, back to clan leader.

| Village | Language group | Ecological zone | Land tenure system | Land ownership | Exclusive user rights for women |
|---|---|---|---|---|---|
| Kaivukavu | Orokolo | SECc | Patrilineal | Individual males | No[9] |
| Kavava | Orokolo | SECc | Patrilineal | Individual males | No |
| Larihairu | Orokolo | SECc | Patrilineal | Individual males | No |
| Marea | Orokolo | SECc | Patrilineal | Individual males | No |
| Mareke | Orokolo | SECc | Patrilineal | Individual males | Yes |
| Oru, Lariau, Herakela | Orokolo | SECc | Patrilineal | Individual males | No |
| Avavu | Orokolo | SECi | Patrilineal | Individual males | No |
| Ere | Orokolo | SECi | Patrilineal | Individual males | No |
| Hepere | Orokolo | SECi | Patrilineal | Individual males | Yes |
| Huruta | Orokolo | SECi | Patrilineal | Individual males | No |
| Kilavi | Orokolo | SECi | Patrilineal | Individual males | No |
| Paevera | Orokolo | SECi | Patrilineal | Individual males | No |
| Poroi 2 | Pawaia | MPH | Clan allocation | Family unit | Yes |
| Subu | Pawaia | MPH | Clan (males) allocation | Male clan members10 | Unsure |
| Subu2 | Pawaia | MPH | Clan (males) allocation | Male clan members | No |
| Ura | Pawaia | MPH | Patrilineal | Individual males | No |
| Wabo | Pawaia | MPH | Patrilineal | Individual males | Yes |

Source: ERIAS Group 2016a.

#### *6.1.3.2 Forestry leases*

As shown in Table 6-3, leaders form 83% of the villages surveyed indicated that the village contained one or more ILGs. Around half of the villages were represented by both a landowner association and a landowner company. As discussed further in the Upstream Governance and Economics Baseline Report (Finlayson, 2017b), there is a long history of complaints involving the logging industry and landowners have very little influence over logging operations once the agreements are signed. There are various disputes between landowners (or alleged landowners) of Vailala Block 3 and between landowners and Frontier Holdings Limited. At least three cases are currently before the courts (Provincial Forestry Officer, pers. Comm., 17 August, 2016).

As shown in Figure 6-1, the PAOI comprises two logging operations.

Frontier Holdings Limited has a FMA and is currently logging in Vailala Block 3, which is southeast of the Purari River and covering an area of 196,200 ha. Various clans from the Pawaia, Ahia, Iare and other language groups signed the Timber Rights Purchase (TRP). Frontier Holdings is expected to shift operations into Vailala Block 2 in the near future, which is covered by the same timber permit.

Turama Forest Industries has a FMA for Baimuru Block 3, which lies to the northwest of the Purari River and covers an area of 320,960 ha (including all of

[9] Except in extreme cases where there are no males in the family.
[10] Family boundaries are not demarcated.

PRL-15). The FMA was signed in 1995 by various clans from the Pawaia, Koriki, Iare and other language groups. Logging has not commenced in Baimuru Block 3, but Turama Forest Industries has until 2045 to extract logs.

Although the specific details of the FMAs are not available, various benefits are to be paid to the landowners based predominantly on the value of logs extracted. Although the customary owners can continue to use the land, logging companies have the right to build roads and other infrastructure to support their operations and to extract logs.

The logging industry is regulated by the *Forest Act 1991*. Clans that are the landowners of the logging areas have been organized into Incorporated Land Groups (ILGs) for the payment of royalties. The landowners have also generally established a Landowner Association – to represent landowners in any discussions with the government and developer, and a Landowner Company – to identify and progress business opportunities arising from the logging operations. The number of villages within the PAOI with ILGs, landowner associations and landowner companies, is shown in Table 6-3.

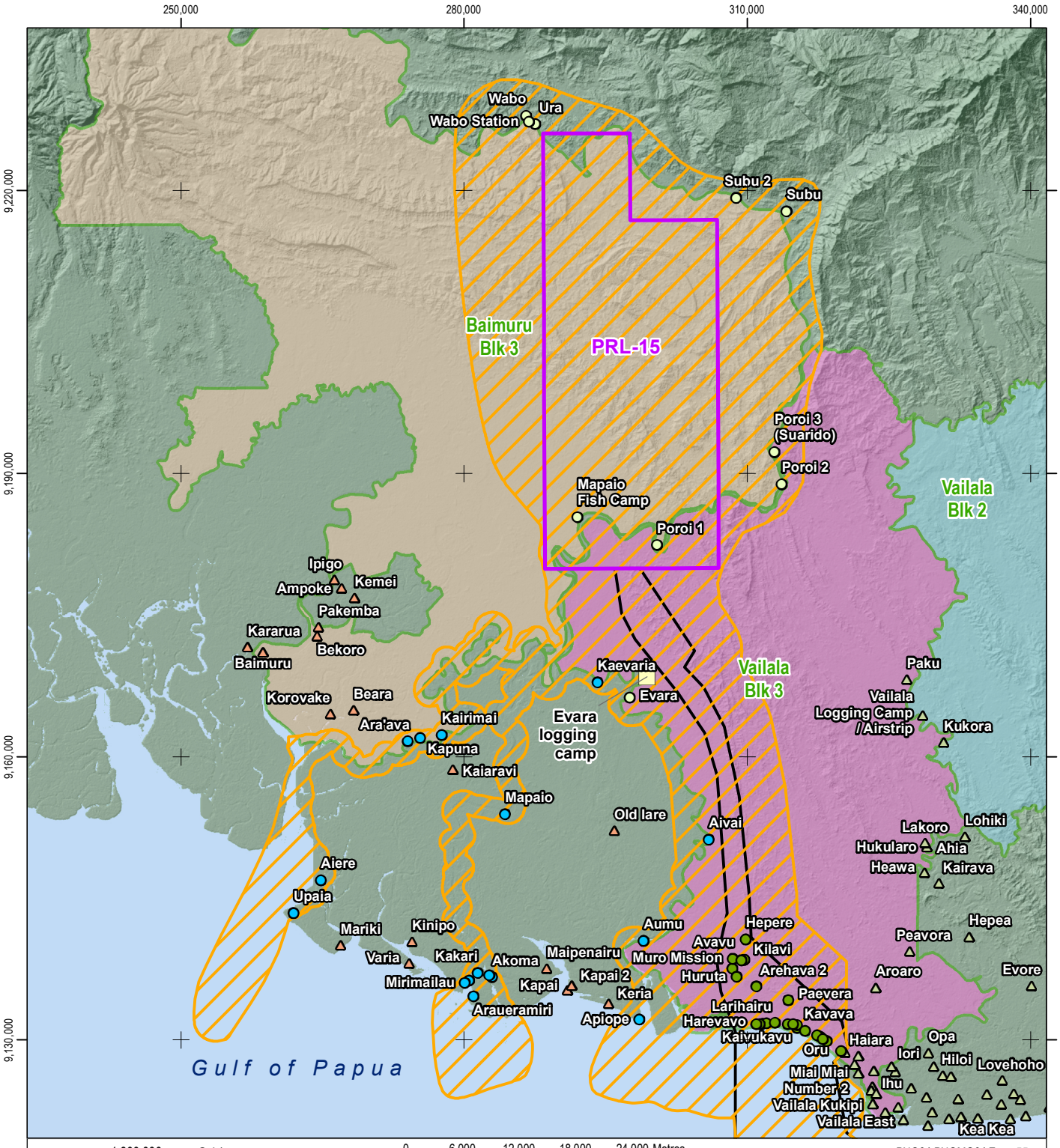
As shown in Table 6-3, leaders from 83% of the villages surveyed indicated that the village contained one or more ILGs. Around half of the villages were represented by both a landowner association and a landowner company.

As discussed further in the Upstream Governance and Economics Baseline Report (Finlayson, 2017b; Part 15 of the ESBS Dossier), there is a long history of complaints involving the logging industry, and landowners have very little influence over logging operations once the agreements are signed. There are various disputes between landowners (or alleged landowners) of Vailala Block 3, and between landowners and Frontier Holdings Limited. At least three cases are currently before the courts (Provincial Forestry Officer, pers. com., 17 August 2016).

## Table 6-3 Villages with resource project organizations

| Language group | Villages with ILGs (%) | Villages with landowner associations (%) | Village with landowner companies (%) |
|---|---|---|---|
| Pawaia | 71 | 57 | 43 |
| Ahia | 100 | 100 | 100 |
| Koriki | 100 | 100 | 75 |
| Iare | 100 | 50 | 17 |
| Kaimare | 100 | 33 | 100 |
| Maipua | 100 | 100 | 0 |
| Orokolo | 69 | 15 | 23 |
| **All villages** | **83** | **46** | **40** |

Source: ERIAS Group 2016a.




**SCALE:** 1:600,000 @ A4

0 6,000 12,000 18,000 24,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

N

**Towns and Villages**

**Project Affected Communities**
- PRL-15
- Export pipeline corridor
- Riverways

**Host LLG Communities**
- Baimuru Rural
- Ihu Rural

Evara logging camp

**Logging concessions**
- Baimuru Blk 3
- Vailala Blk 2
- Vailala Blk 3

Upstream project area of influence

**Proposed Facilities**
- Pipeline export route corridor
- PRL-15 License

*Note, not all communities have been verified in the field
**Note, language group does not represent land ownership
***Note, no logging license for areas not covered by license

# TITLE: Logging Concessions

## FIGURE: 6.1

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79447 **REVISION:** C

**DATE:** 11/04/2017

**DATA SOURCES:**
Language Groups, villages, PRL-15, logging concessions, Evara logging camp, hillshade supplied by ERIAS and TOTAL (2015-2016). Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017).

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#### *6.1.3.3 Special agriculture and business leases*

The Purari Development Association, a landowner umbrella group, was granted a special agricultural and business lease (SABL) for an area of 656,034 ha in 2010. As shown in Figure 6-2, this area stretches from the Papuan coast to the Gulf Province border with Simbu and Eastern Highlands and includes PRL-15.

It was intended that a SABL would be granted for an area of land that the government leases from the customary owners, and the government sub-leases this land to a developer for an agreed agricultural or other business activity. The entire process is intended to be underpinned by broad consultation with and consent by the customary landowners.

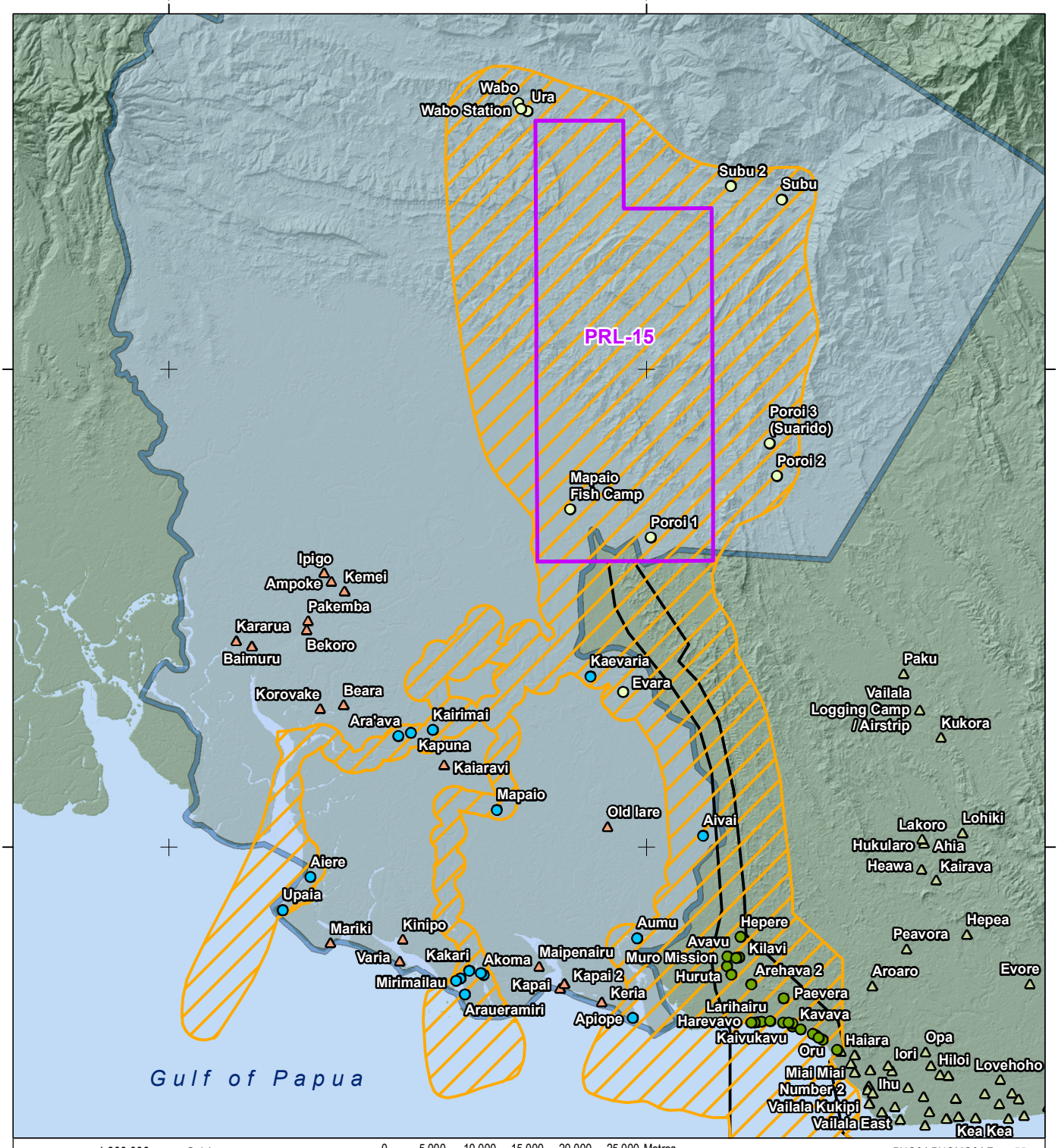
Irregularities in the allocation of SABLs across Papua New Guinea, which covered 12% of PNG's land mass (Allen & Monson, 2014) led to an SABL Commission of Inquiry (COI) from 2011 to 2013.

As articulated in the Final Report of the COI, a clear process has not been developed for issuing SABLs since they were introduced in the 1970s (Numapo, 2013). The process of issuing a SABL is managed by the Department of Lands and Physical Planning (DLPP) and involves the Department of Provincial and Local Level Government Affairs (DPLLG), the Department of Agriculture and Livestock (DAL), the PNG Forest Authority, the CEPA and provincial governments. The COI found widespread abuse, fraud, lack of coordination between agencies, failures and incompetence of government officials to ensure compliance, accountability and transparency within the SABL process from application stage to registration, processing, approval and granting of the SABL (Numapo, 2013). This included deliberate breaches of legislative requirements, instances of undue political pressures, and numerous instances of incompetence, failure, inaction and lack of commitment by officers of government agencies to properly and diligently carry out their statutory functions (Numapo, 2013). The COI recommended that SABLs that were issued under irregular circumstances should be rectified or nullified, and any person or entity implicated in unlawful activity should be prosecuted (Numapo, 2013).

Several irregularities were identified during the COI about the granting of the SABL to the Purari Development Association including a lack of consultation with landowners in the area, the absence of required documentation, the granting of an SABL over both existing forest management and wildlife conservation areas, and no development since the SABL was granted in 2010 (Allen & Monson, 2014).

#### *6.1.3.4 Exploration licenses*

The PAOI overlaps with a number of mining and petroleum licenses listed in Table 6-4. Mining licenses are shown in Figure 6-3.




**SCALE:** 1:600,000 @ A4

0 5,000 10,000 15,000 20,000 25,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Towns and Villages**

**Project Affected Communities**
- PRL-15
- Export pipeline corridor
- Riverways

**Host LLG Communities**
- Baimuru Rural
- Ihu Rural

- Special Agriculture and Business Lease (SABL)
- Upstream project area of influence

**Proposed Facilities**
- Pipeline export route corridor
- PRL-15 License

N

*Note, not all communities have been verified in the field
**Note, language group does not represent land ownership

# TITLE: Purari Special Agriculture and Business Lease (SABL)

## FIGURE: 6.2

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79446 **REVISION:** C

**DATE:** 11/04/2017

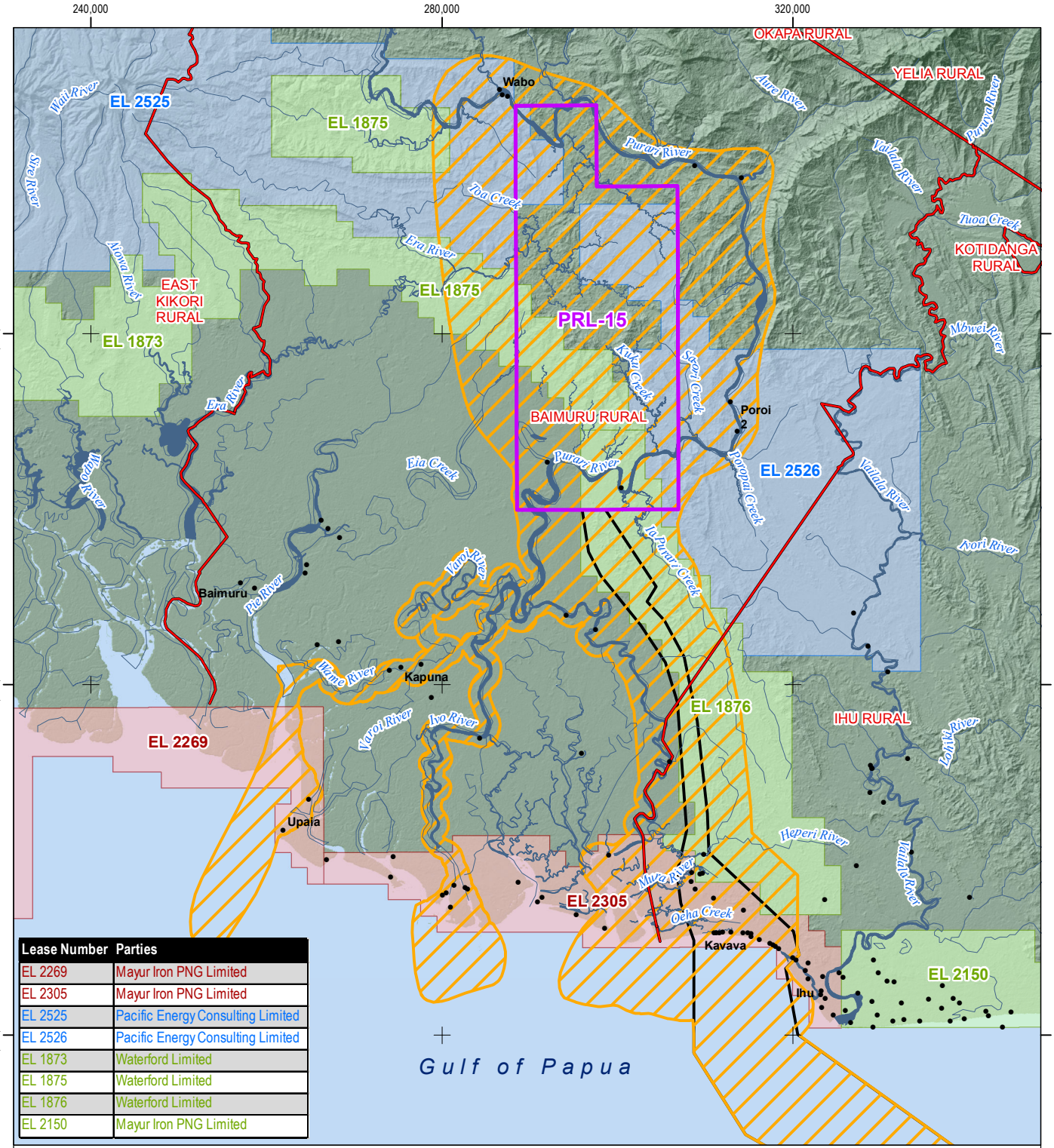
**DATA SOURCES:**
Towns and villages, rivers, PRL-15, hillshade supplied by ERIAS and TOTAL (2015-2016). Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). SABL digitised from Survey Plan (2016).

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| Lease Number | Parties |
|---|---|
| EL 2269 | Mayur Iron PNG Limited |
| EL 2305 | Mayur Iron PNG Limited |
| EL 2525 | Pacific Energy Consulting Limited |
| EL 2526 | Pacific Energy Consulting Limited |
| EL 1873 | Waterford Limited |
| EL 1875 | Waterford Limited |
| EL 1876 | Waterford Limited |
| EL 2150 | Mayur Iron PNG Limited |

**SCALE:** 1:650,000 @ A4

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

- Towns and villages
- Local level government boundaries
- Waterways
- Waterbodies
- PRL-15
- Upstream project area of influence
- Export pipeline corridor

**Exploration licence**
- Active
- Application
- Pending renewal

N

*Note, not all Host LLG Communities have been verified in the field.*

**TITLE:** Mining Leases in PAOI

**FIGURE:** 6.3

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-80033 **REVISION:** C

**DATE:** 8/05/2017

**DATA SOURCES:**
Towns and villages, waterways, waterbodies, export pipeline corridor, PRL-15, hillshade supplied by ERIAS Group and TOTAL (2015-2016). LLG boundaries from HDX and then spatially adjusted to align with background and coastal boundaries removed. Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). Exploration licence supplied by Mineral Resources Authority (2017).

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**Table 6-4 Mining and petroleum licenses in the PAOI**

| License | License number | Parties | Status | Start date | Expiry date |
|---|---|---|---|---|---|
| ***Petroleum*** | | | | | |
| PPL | 338* | Kina Petroleum Ltd | Active | 31 January 2017 | 31 January 2022 |
| PPL | 563^ | Hillsborough Ltd | Active | - | - |
| PPL | 581* | Kina Petroleum Ltd | Active | 31 January 2017 | 31 January 2023 |
| ***Mining*** | | | | | |
| EL | 2269** | Mayur Iron PNG Limited | Active | 14 May 2014 | 13 May 2018 |
| EL | 2305** | Mayur Iron PNG Limited | Active | 14 May 2014 | 13 May 2018 |
| EL | 2525** | Pacific Energy Consulting Limited | Application | - | - |
| EL | 2526** | Pacific Energy Consulting Limited | Application | - | - |
| EL | 1873** | Waterford Limited | Pending renewal | 15 May 2012 | 14 May 2016 |
| EL | 1875** | Waterford Limited | Pending renewal | 15 May 2012 | 14 May 2016 |
| EL | 1876** | Waterford Limited | Pending renewal | 15 May 2012 | 14 May 2016 |
| EL | 2150** | Mayur Iron PNG Limited | Pending renewal | 18 December 2012 | 17 December 2016 |

PPL = Petroleum Prospecting License; APPL = Application for Petroleum Prospecting License; EL = Exploration License
Sources: * Port Moresby Stock Exchange Limited (2017). ^ Department of Petroleum and Energy (2016) ** Mineral Resources Authority (2017)

### 6.1.4 Land registration

DLPP maintains a register of customary land that is officially registered and alienated land. Although it has been possible to convert customary land to individual freehold since 1963, under the *Land (Tenure Conversion Act) 1963*, the PAOI does not include any alienated land, with the exception of Muro Mission and Wabo Station.

The alternative approach to commercializing land (without alienation) is to lease the land. The first step is land registration[11] (Anderson, 2010). The most common approach to do this in Papua New Guinea has been to seek official recognition of the landowners through a process of forming an ILG. The process and potential benefits of an ILG are described below.

> *Incorporated land groups are the usual mechanism for representing landowners, and they are often used to capture the economic benefits of resource developments. The process of incorporation is set out in the* Land Groups Incorporation Act 1974*. The process for incorporating a land group in Papua New Guinea begins with preparing a constitution, which is simply the rules that govern the incorporated land group. The constitution must include such details as the name of the group and the name of its custom, the qualifications for membership of the group, the nature of the controlling body of the group, and the procedures for settling disputes. After a process for hearing comments or objections, the group can be registered with the Registrar of Incorporated Land Groups and legally incorporated.*

[11] The Customary Land Act does not provide statutory timeframes for land registration. First an application is assessed then advertised (for up to 90 days) before any objections are resolved and a Certificate of Title is issued.

*Incorporation has proved to be an effective mechanism for customary landowning groups to participate in Papua New Guinea's formal economy. As legal entities incorporated groups can make commercial deals with investors or developers involving the use of the groups' land and manage the income generated. For example, an incorporated land group is free to invest the income from a mining or forestry project in a new business, to use the income to fund a community project, or to distribute the income among the members of the group. The most important feature of incorporation in Papua New Guinea is that decisions can be made within a customary framework (Commonwealth of Australia, 2008).*

Despite the upbeat perspective provided above, Papua New Guinea has faced numerous problems in its quest to secure the rights of customary landowners while simultaneously stimulating economic development by providing increased access to customary land. In 2005, the Government embarked on the National Land Development Program, which led to the establishment of a National Land Development Task Force (the Task Force), which was asked to prepare recommendations for:

- Improving the system of land administration.
- Improving the land dispute settlement process.
- Developing a framework for maximizing the development potential of land held under customary tenure.

As a result of the report by the Task Force, several amendments to the *Land Groups Incorporation Act 1974* and the *Land Registration Act 1981* came into effect in March 2012:

- The first, in response to the proliferation of ILGs over the 20 years, and various shortcomings in terms of representation and management, was an amendment to the Land Groups Incorporation Act, which imposes tighter regulation on all ILGs and requires compliance by March 2017.
- The second, in an effort to both secure customary land rights, and help facilitate development of customary land, was an amendment to the Land Registration Act, which enabled the 'voluntary' registration of customary land.

Despite the above changes, there is still no clear process for registering customary land in Papua New Guinea. What should occur, as preliminary steps when a developer is seeking to use customary land, is outlined below:

- The developer should seek consent from the customary landowners to enter the land and assess the suitability of the land for the proposed activity.
- The developer, customary owners and DLPP, working with Provincial Lands Officers, should jointly mark proposed land boundaries.
- All customary landowners should be identified.
- Information should be provided to customary owners – in a manner and timeframe that allows informed and detailed discussion – informing them

of the proposed development (including timeframe) and the proposed compensation or benefits that will be derived from the project.

DLPP, working with Provincial Lands Officers, should work in close collaboration with customary landowners, to help protect their rights and ensure due process is followed. For large projects, it may be in the interests of the customary owners to seek expert, independent advice, before entering any agreements.

If the customary owners agree to further consider the proposed development, then:

- ILG members should be educated on the roles and responsibilities of the ILG and ILG's board of directors.
- An ILG should be established (with constitution and registry of members) and directors appointed.
- Consultation should occur among ILG members in regard to the allocation and management of benefits.
- Further consultation should occur with the developer and government agency responsible for the development, to ensure customary landowners are fully informed of the proposed development and its impacts, project benefits and dispute resolution mechanisms.

The end products should include (i) an ILG, and (ii) a Development Agreement between the ILG, government and developer, with all ILG members fully aware of its contents.

It is understood that neither the forestry leases nor SABL discussed in Section 6.1.3 followed the process as described above.

### 6.1.5 Land related disputes and land dispute settlement

#### *6.1.5.1 The formal land dispute process*

The formal land dispute system is articulated in the *Land Disputes Settlement Act 1975*. As described by Oliver & Fingleton (2008) (Figure 6-4):

*The Act sets out three stages for the attempted settlement of disputes over customary land. Stage one is compulsory mediation by a local land mediator[12]. If mediation does not settle the dispute, stage two allows for the dispute to be taken to a Local Land Court for arbitration. A Local Land Court comprises a Local Land Magistrate[12] as chairman and either two or four land mediators. The court has wide powers under the Act to reach a settlement between the parties, but if no agreement can be reached it can impose settlement.*

> *Mediated settlements are evidence of land rights but they do not bind the parties (unless approved by a Local Land Court), whereas arbitrated settlements do bind the parties. The Local Land Court is also authorized to*

[12] Land mediators and land magistrates are local persons with high social standing and respect. No formal qualifications are required although it is expected that literacy is a requirement (to be able to complete written documents).

*deal with other matters 'inextricably involved' with the land dispute before it. In general, disputes cannot be taken further than the Local Land Court, but the Act does allow a limited right of appeal (against a Local Land Court's decision) to the Provincial Land Court (stage three). Grounds for appeal are confined to errors of jurisdiction, decisions made contrary to natural justice or cases of manifest injustice.*

*The Act is largely administered by the Provincial Land Disputes Committee for the province concerned, lawyers are in general excluded from appearing in Land Court hearings and the Land Courts are not bound by any laws other than the Act itself or any other Act expressly applied to them. In special circumstances, under Section 4 of the Act the national government may declare that a land dispute should be settled by some means other than those provided by the Act. Such special circumstances include that the dispute is longstanding and previous attempts at mediation have failed, or the dispute has already resulted in serious breaches of the peace. This section of the Act was included as a 'safety valve' to help resolve intractable cases.*

Although the Land Disputes Settlement Act largely replaced the role of the Land Titles Commission with that of the Land Courts[13], the Act provides that the Head of State may still refer disputes to the Land Titles Commission under particular circumstances. It has become common practice for the Head of State to direct the Land Titles Commission to hear disputes regarding extractive resource developments on customary land, especially cases that involve the identification of landowners (Allen & Monson, 2014). This has included disputes associated with the Hides and the South-East Gobe oil and gas projects, the Kainantu gold project and the Ramu nickel project (Allen & Monson, 2014).

#### *6.1.5.2 Land disputes in the PAOI*

During the SBS, village leaders indicated that land disputes had occurred in 27 villages surveyed (79%) within the past decade. A total of 57% of villages had land disputes between two parties from within the village, and these were generally minor disputes over gardening land or sago, and easily resolved. Sixty percent of villages indicated that land disputes had also occurred with clans from other villages. These disputes often focused on land boundaries and generally involved some kind of benefits or potential future benefits, such as logging royalties, land rental for a communication tower, land rental for an airstrip, or potential benefits from sand mining.

Different clans may not agree on a land boundary but choose to discuss this over a period extending several years. However, generally once the land is recognized as having a potential monetary value, either from the extraction of logs, gas or other minerals, clans will vigorously defend their land boundaries.

[13] The Lands Court has for all intents and purposes replaced the Land Title Commission. However, in the case of particular complex or difficult extractive industry development projects for mining and oil and gas, the National Government can, and still does use the Land Title Commission over the Land Courts to resolve issues

Land disputes in the PAOI can be categorized as one of the following:

- Disputes between two people (from the same or different clans) from the same village.
- Disputes from two people (or clans) from different villages.
- Disputes between local people (or clans) and an external party, such as a logging company (which usually relates to environmental damage or logging benefit entitlements).

The process for dispute resolution is shown in Figure 6-4 and described below.

Disputes from within the village are addressed by the village leaders, which may include the councilor, traditional leaders, church leaders and members of the village court. They will attempt to resolve the dispute first through mediation. If this fails, then they will refer the case to the village court. A land mediator may or may not be involved, as there are only four land mediators in each local level government (LLG) area.

For disputes involving parties from different villages, the councilors of the disputing villages will coordinate a meeting and attempt to resolve the dispute through mediation. Again, if this fails, the case will be referred to a joint sitting of village court officials from both villages. Again, a land mediator may or may not be involved.

Apart from the Pawaia villages, where there is generally an absence of village court magistrates and land mediators, the village court system appears to be relatively active in the PAOI. However, if land disputes cannot be resolved then the parties may take their dispute to a local land court hearing, which will include a magistrate and at least two land mediators, and if the dispute can still not be resolved, it could go to the provincial land court (Oliver and Fingleton, 2008)[14].

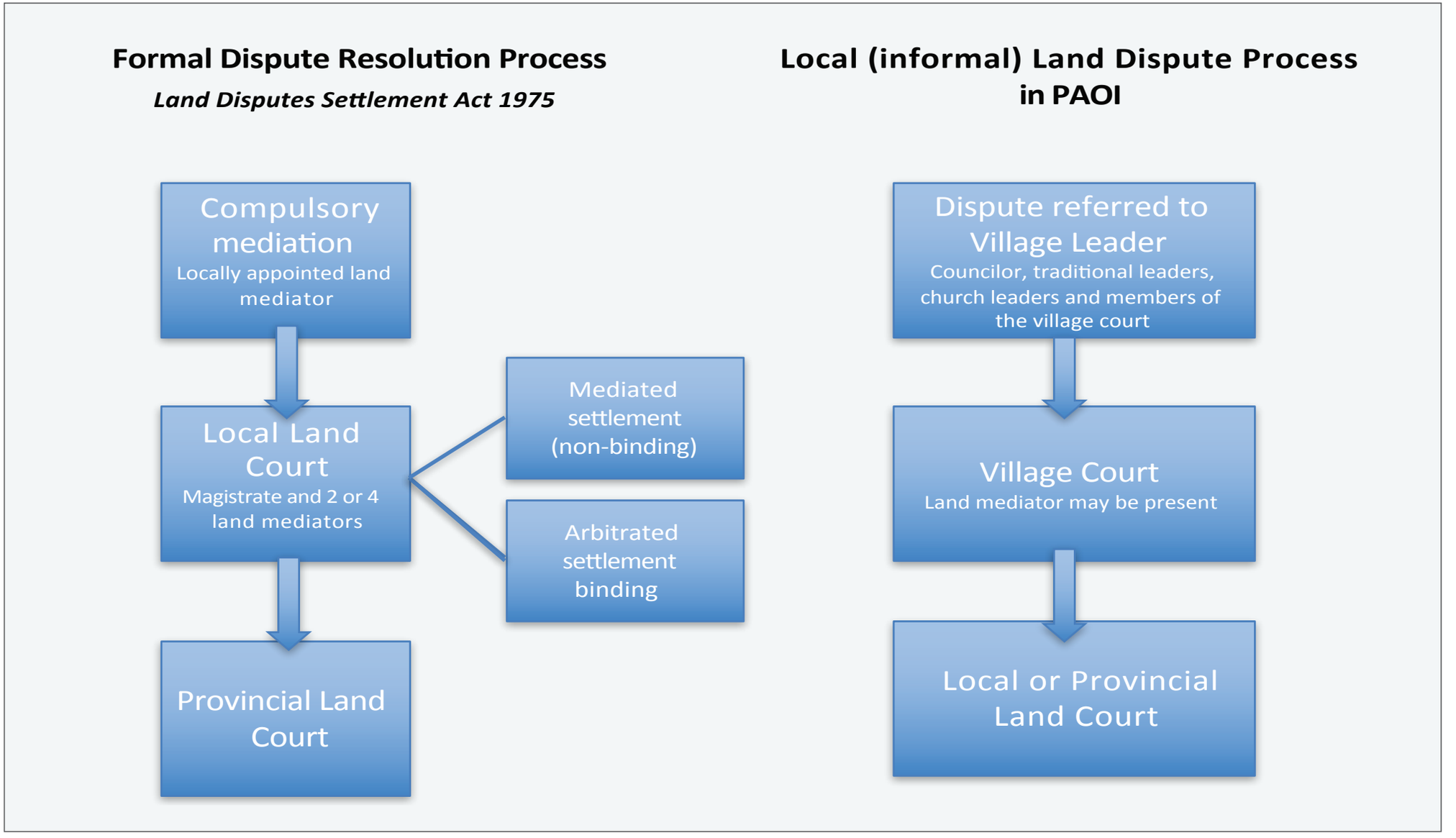
Disputes involving an external entity such as a logging company are more likely to be handled in the courts. The major difference between this approach and the local process is that, unlike the local process, mediation is not a desired outcome (there is only a winner and a loser), and the parties have legal representation.

## 6.2 LAND AND NATURAL RESOURCE SETTING

The PAOI is located in the Purari River basin through which PNG's third largest river flows, the Purari River (Petr, 1983). The Purari River basin is a high rainfall humid tropical environment that forms part of the Purari catchment. The upstream terrestrial and freshwater portion of the PAOI covers approximately 269,393 ha of the Purari River catchment, which encompasses a wide variety of land resources (vegetation types) as well as freshwater ecosystems. It includes extensive areas of hill forest, alluvial forest, freshwater swamp forest and globally important mangroves (Ellison, 1997), tidal flats and estuaries, freshwater

[14] Many people will not have the money to involve lawyers and will seek to have disputes sorted out locally (by the land mediators). However, some people with access to money (eg. with some sort of foreign backing) might try to use lawyers to defend their position.

**FIGURE 6.4**

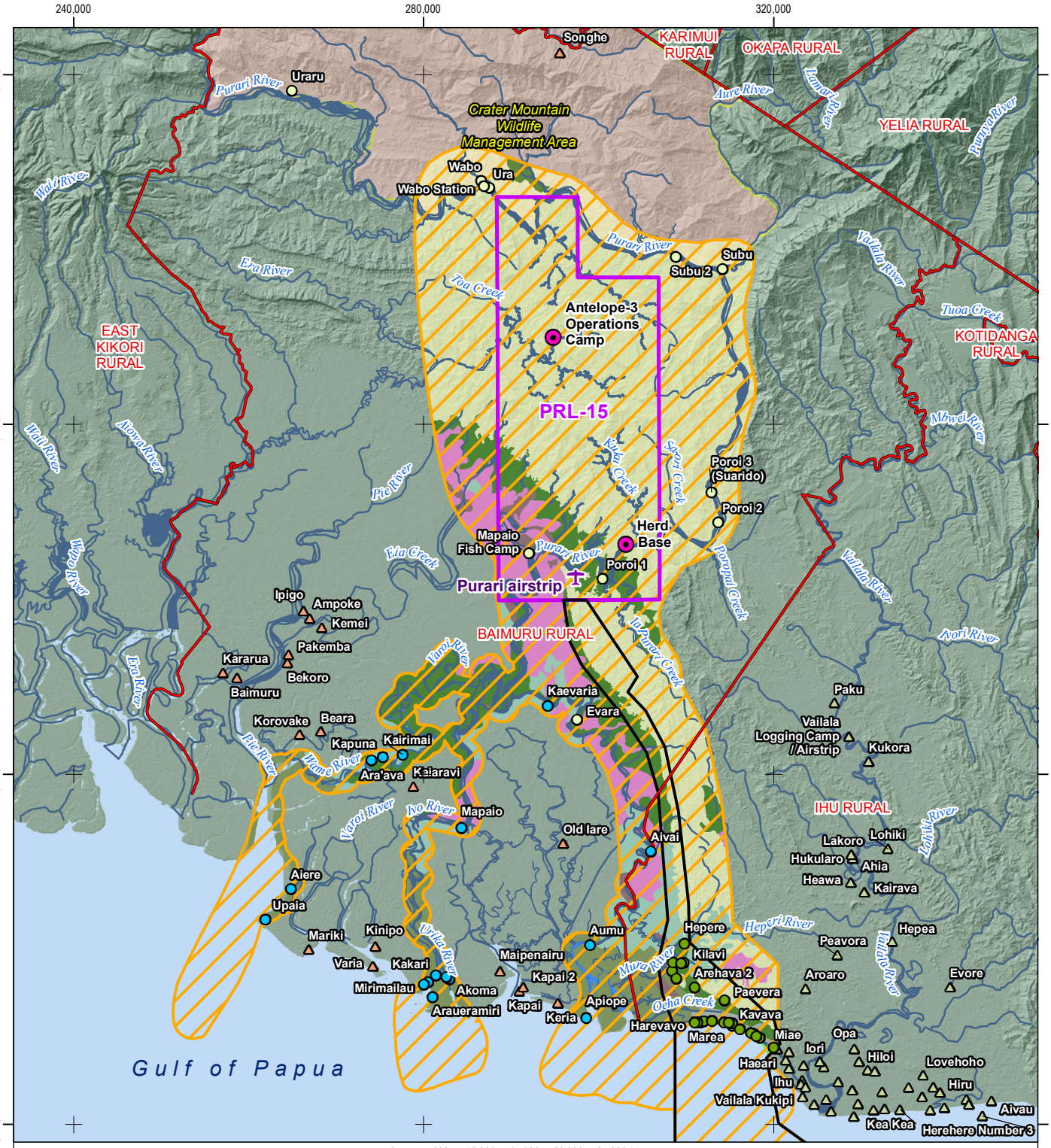

Formal Dispute Resolution Process
Land Disputes Settlement Act 1975
Compulsory mediation
Locally appointed land mediator
Local Land Court
Magistrate and 2 or 4 land mediators
Mediated settlement (non-binding)
Arbitrated settlement binding
Provincial Land Court
Local (informal) Land Dispute Process in PAOI
Dispute referred to Village Leader
Councilor, traditional leaders, church leaders and members of the village court
Village Court
Land mediator may be present
Local or Provincial Land Court

swamps and lakes, hundreds of river kilometers. Forests (78%) are the dominant land resource in the PAOI followed by wild stands of sago (9%) and mangroves (7%). The remainder comprises grassland and herb land, and areas dominated by anthropogenic land use (villages, subsistence agriculture, abandoned coconut plantations and planted sago) and ocean. A breakdown of the natural resources is provided in Table 6-5 and shown in Figure 6-5.

Some of the resources have been extensively modified from their natural condition by anthropogenic activities, which are predominantly large-scale industrial logging and oil and gas developments, clearing for settlements, subsistence agriculture (food gardens and sago planting) and historical clearing for coconut plantations in coastal areas. Logging by the Rimbunan Hijau (RH) company Frontier Holdings has resulted in extensive degradation in the hill forests south of the Purari River and to a lesser extent in the alluvial forest. Degradation from logging has facilitated more intense secondary disturbances such as clearing to create subsistence gardens. Approximately 1% of the PAOI has been deforested for subsistence agriculture and village settlements, with clearing for subsistence agriculture occurring mostly in the coastal Orokolo Bay area.

Resource use by the customary landowners within the PAOI is dominated by agricultural activities and associated subsistence hunting, fishing and harvesting of a variety of plant-based resources important for livelihoods and wellbeing (primary nutrition). This pattern of resource use is typical of the lowlands of Gulf Province and the lowlands of the country's mainland. For most people in rural Papua New Guinea, agriculture fills their lives, physically, culturally, socially and nutritionally, and particularly in the highlands (e.g. Western Highlands Province), economically where commercial agriculture provides a significant amount of food for the urban population and earns a significant amount of foreign exchange. This is not the case in Gulf Province. However, subsistence agriculture for food production is the most important part of the country's agriculture. It provides most of the food consumed in the country, an estimated 83% of food energy and 76% of protein (Bourke and Harwood, 2009). The sustenance produced from subsistence agriculture comes from hundreds of food crops, and husbandry of domestic animals (mostly pigs and chickens), and is supplemented by bush meat, fruit and nut crops and greens (edible leaves and new shoots) harvested from forests. This is the only known form of agriculture in the PAOI.

Unlike the highland provinces, the lowlands are still subject to relatively low agricultural pressure as is reflected by the relatively small areas of forest conversion to agricultural use across the PAOI, except for the coastal Orokolo villages where there has been extensive forest loss between the coast and the foothills to the north. Moreover, Gulf Province has the lowest agricultural pressure on land resources compared to all the other mainland provinces and therefore its land resource potential has not been assessed fully for agricultural potential (Hanson *et al.*, 2001).




**SCALE:** 1:650,000 @ A4

0 5,000 10,000 15,000 20,000 25,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Towns and Villages**

**Project Affected Communities**
- PRL-15
- Export pipeline corridor
- Riverways

**Host LLG Communities**
- Baimuru Rural
- Ihu Rural

- Local level government boundaries
- Waterways
- Waterbodies
- PRL-15
- Crater Mountain Wildlife Management Area
- Upstream project area of influence
- Export pipeline corridor

**Natural Resources**
- Alluvial forest
- Grassland/herbland
- Hill forest
- Littoral forest
- Mangrove
- Rivers & lakes
- Subsistence land use and villages
- Swamp forest
- Wild sago

**Existing Facilities**
- Base camp
- Purari airstrip

N

*Note, not all Host LLG Communities have been verified in the field.*

# TITLE: Natural Resources in the PAOI

## FIGURE: 6.5

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79903 **REVISION:** C

**DATE:** 2/05/2017

**DATA SOURCES:**

Facilities, town and villages, rivers, airstrip, export pipeline corridor, PRL-15, hillshade supplied by ERIAS Group and TOTAL (2015-2016). LLG Boundaries from HDX and then spatially adjusted to align with background and coastal boundaries removed. Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). Natural resources supplied by Howard Roger (2017).


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T:\Projects\ER\002 Elk Antelope LNG Project EIS-ESHIA\Work Requests\R_097 - LNR Mapping\ER\002-R_097-79903-Figure 6.5-C.mxd

## Table 6-5 Dominant natural resources in the PAOI

| Resource | Area (ha) | % |
|---|---|---|
| **Forest** | | |
| Hill forest | 159,483 | 59 |
| Alluvial forest | 32,477 | 12 |
| Swamp forest | 18,979 | 7 |
| Littoral forest | 97 | <1 |
| **Total** | **211,037** | **78** |
| **Other** | | |
| Wild stands of sago woodland | 25,332 | 9 |
| Mangrove | 18,453 | 7 |
| Grassland/herbland | 3,164 | 1 |
| Subsistence land use and villages | 1,729 | 1 |
| Rivers and waterbodies | 9,679 | 4 |
| Total | **58,357** | **22** |
| Ocean^ | 231,589 | |
| | | |
| **Total forest and other (excluding ocean)** | **269,393** | **100** |

*Resource categories and area (ha) derived from FIMS mapping units based on vegetation mapping terminology and coded for resource type.
**Wild stands of sago woodland are those dominated by sago rather than being a component of other vegetation types. These are termed Swamp woodland under the vegetation mapping terminology.
^Ocean portion of the PAOI covers the area from the Purari River to Caution Bay near Port Moresby.

### 6.2.1 Ecological zones and fauna resources

To characterize the heterogeneity of natural resources across the PAOI, the ecological zones developed for the Upstream Terrestrial Biodiversity Baseline Study were used. Each zone only partly overlaps the PAOI, however the ecological zones provide a guide to the natural environment around each of the surveyed villages, which has a significant influence on their day-to-day activities, and is a logical basis for a summary of the major landforms and vegetation formations. Table 6-6 indicates which villages from each language group occur in each ecological zone in the PAOI.

#### *6.2.1.1 Middle Purari Hills*

The Middle Purari Hills ecological zone covers 47% of the PAOI and is dominated by hill forest. It underlies the northern three quarters (75.8%) of PRL-15 including the entire Elk-Antelope gas field. The Middle Purari Hills comprise an extensive area of low (mostly peaking below 300 m above sea level), closely spaced foothills that have been formed by the faulting and folding of mostly sandstone and mudstone but with limestone along the Kereru Range and in the extreme northwest where it contacts the Purari River, as shown in Figure 6-7.

#### *6.2.1.2 Southeast Hills*

The Southeast Hills ecological zone covers 9% of the PAOI. The Southeast Hills underlie the eastern 40% (84.3km) of the export pipeline corridor south of PRL-15, and 2.6% of PRL-15 in its extreme southeast.

This ecological zone includes the uplifted landforms east of the Purari River that drains into the Delta Swamps and Plains or into the Vailala River. Elevation ranges from below 10 m asl on the floodplains alongside the lower reaches of the Vailala River to more than 350 m asl in the north on the ridge separating the Vailala River and Purari River catchments. Most of the land, however, is below 200 m, including many of the prominent ridge systems and all areas within the proposed export pipeline corridor.

The landform character of the Southeast Hills differs most markedly from the Middle Purari Hills in having large areas of alluvial plains and back swamps interspersed among the ridges. These are most extensive in the east in the Vailala River catchment and in the southern half of the Purari River catchment.

#### *6.2.1.3 Delta Swamps and Plains*

The Delta Swamps and Plains ecological zone covers 26% of PAOI. It extends 30–40 km southwest from the base of the Middle Purari Hills to the marine tidally influenced Mangroves ecological zone, and 70–80 km northwest from the Southeast Coast ecological zone to the Era River and the southeast edge of the volcanic landform foothill slopes of Mount Favenc.

The central east of the Delta Swamps and Plains, around the point at which the Purari River flows from the Middle Purari Hills, underlies 21.6% of PRL-15 in its southwest corner, including most of the proposed central processing facility (CPF), logistics base and airstrip area (79.9%). South of PRL-15, the southeast rim of this ecological zone underlies the western half of the proposed export pipeline corridor. The Delta Swamps and Plains also include the freshwater sections (inland from the mangroves) of the barge transport routes along each of the Purari River's three distributaries.

The Delta Swamps and Plains is a recent alluvial landform composed of sediments (mud, silt, sand and gravel) deposited primarily by the Purari and Era rivers. Together with the Mangroves ecological zone it comprises the easternmost component of a much larger depositional system that stretches west and south along the Gulf of Papua to include the Kikori, Turama and Fly River deltaic systems (Thom and Wright, 1983). Elevation ranges from below 5 m asl to above 60 m asl on a few isolated foothills near the base of the Middle Purari Hills.

#### *6.2.1.4 Mangroves*

The Mangroves ecological zone consists of the coastal section of the aggrading delta landform that is under marine tidal influence. Covering 10% of the PAOI, mangroves extend up to 25 km inland and span a coastal front of more than 50 km between Port Romilly and the Southeast Coast ecological zone (Plate 6-1).

The Mangroves ecological zone encompass the coastal approach of the westernmost section of the export pipeline corridor and the near-coastal sections of the barge transport routes along each of the Purari River's three distributaries.

In a regional context, the Mangroves ecological zone forms the eastern part of the largest area of mangroves in Papua New Guinea, stretching west along the coast for approximately 150 km to the mouth of the Omati River (Percival and Womersley, 1975, Saulei and Beehler, 1993). This region is characterized by the

broadest coastal band of mangroves found anywhere in Papua New Guinea, at their widest point extending inland nearly 50 km from the deltaic front at the mouth of the Kikori River.

#### *6.2.1.5 Southeast Coast*

The Southeast Coast ecological zone overlaps just 2% of the PAOI. It spans approximately 18 km of the coastline east from the Mangroves ecological zone to the mouth of the Vailala River, and extends inland approximately 10 km to the border of the Delta Swamps and Plains.

The Southeast Coast ecological zone encompasses most of the coastal approach of the export pipeline corridor south from Kilavi village.

This ecological zone is centered on 'beach ridges and plains' landform units. The beach ridges and plains landform is composed of seaside sands, originally deposited near the mouth of the Vailala and other rivers further east along the coast, and moved northwest by longshore currents (driven by the southeast trade winds) to form an aggrading series of sub-parallel beach ridges with intervening swales and plains. The sand ridges are most prominent near the coast, with relict features gradually decreasing in height inland to form a level or gently undulating sandy plain.

Because of its location, this zone contains the widest range of fauna habitats. Inland, it adjoins with the Mangroves and Southeast Hills ecological zones, and has extensive areas that have been modified by land use including coconut and betel nut palm plantations and clearings for subsistence agriculture. Seaward, it includes the regionally unique coastal habitats of Orokolo Bay, including the beach and swash zone habitats, and the in-shore and offshore marine habitats.

**Table 6-6 Villages according to language group and ecological zone**

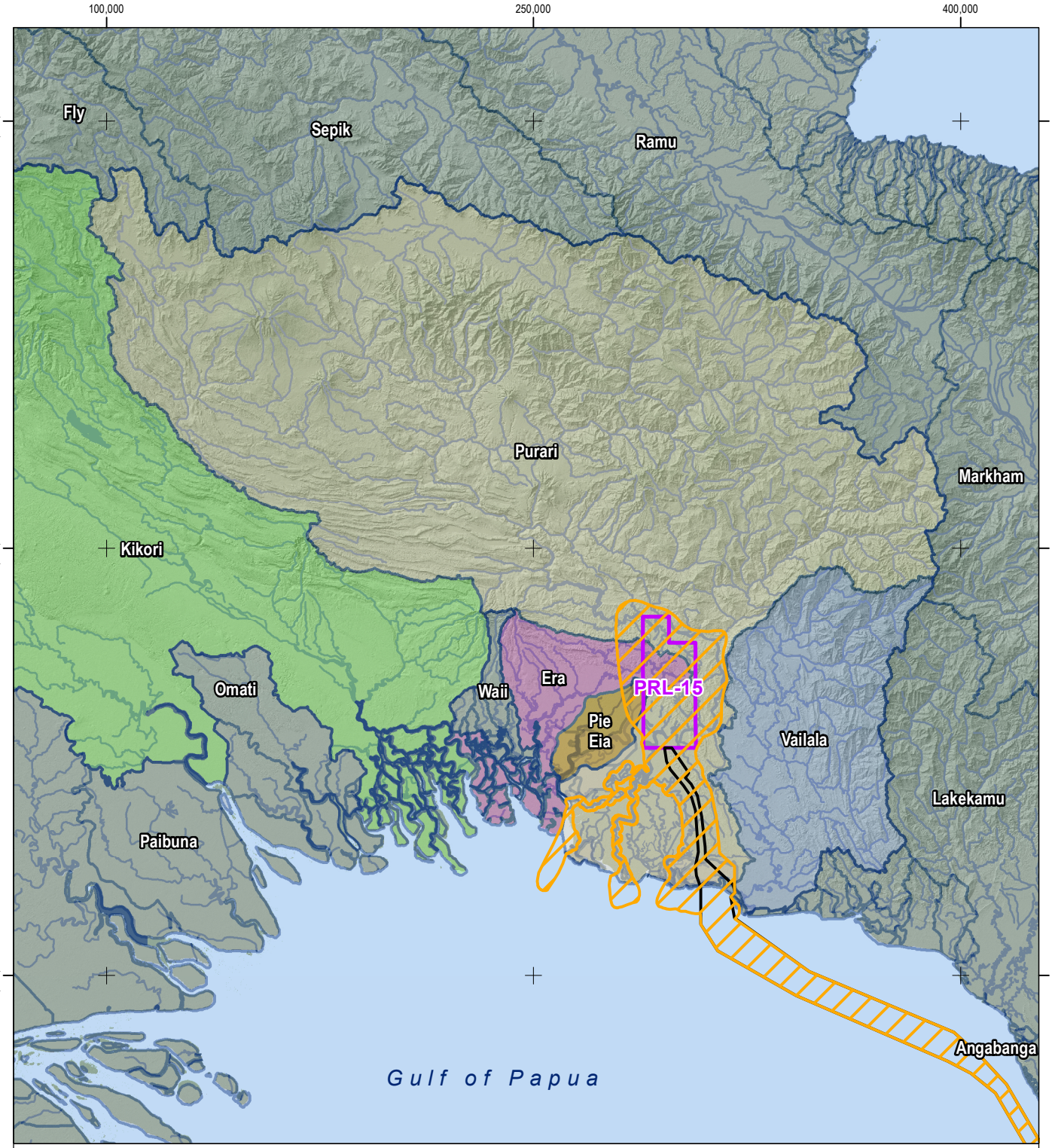
| Language group | Village | Ecological zone |
|---|---|---|
| Ahia | Evara | Delta Swamps and Plains (DSP) |
| Iare | Aivai | Delta Swamps and Plains (DSP) |
| | Aumu | Mangroves (M) |
| | Kaevaria | Delta Swamps and Plains (DSP) |
| | Kapai 2 | Mangroves (M) |
| | Maipenairu | Mangroves (M) |
| | Mapaio Fish Camp | Delta Swamps and Plains (DSP) |
| | Mapaio | Delta Swamps and Plains (DSP) |
| Koriki | Akoma | Mangroves (M) |
| | Ara'ava | Delta Swamps and Plains (DSP) |
| | Kairimai | Delta Swamps and Plains (DSP) |
| | Kairu'u | Mangroves (M) |
| | Ikinu | Mangroves (M) |
| Maipua | Apiope | Mangroves (M) |
| Pawaia | Poroi 1 | Delta Swamps and Plains (DSP) |
| | Poroi 2 | Middle Purari Hills (MPH) |
| | Poroi 3 | Middle Purari Hills (MPH) |
| | Subu | Middle Purari Hills (MPH) |
| | Subu 2 | Middle Purari Hills (MPH) |
| | Ura | Middle Purari Hills (MPH) |
| | Wabo & Wabo Station | Middle Purari Hills (MPH) |

| Language group | Village | Ecological zone |
|---|---|---|
| Orokolo | Arehava 2 | Southeast Coast (SEC) |
| | Avavu | Southeast Coast (SEC) |
| | Ere/Kilavi | Southeast Coast (SEC) |
| | Harevavo | Southeast Coast (SEC) |
| | Hepere | Southeast Coast (SEC) |
| | Herekela | Southeast Coast (SEC) |
| | Hururu | Southeast Coast (SEC) |
| | Huruta | Southeast Coast (SEC) |
| | Iuku | Southeast Coast (SEC) |
| | Kaivukavu | Southeast Coast (SEC) |
| | Kavava | Southeast Coast (SEC) |
| | Lariau | Southeast Coast (SEC) |
| | Larihairu | Southeast Coast (SEC) |
| | Marea | Southeast Coast (SEC) |
| | Mareke | Southeast Coast (SEC) |
| | Oru | Southeast Coast (SEC) |
| | Paevera | Southeast Coast (SEC)/Southeast Hills (SH)[15] |
| Kaimare | Aiere | Mangroves (M) |
| | Mariki | Mangroves (M) |
| | Upaia | Mangroves (M) |

## Plate 6-1 Mangroves along the lower Purari River



[15] For the purposes of this report data for Paevera, which is located on gentle terrain on the edge of the Southeast Hills ecological zone, adjacent to the Southeast Coast ecological zone, has been analyzed as part of Southeast Coast ecological zone due to widespread use of natural resource across the alluvial plains. It is considered to have similar patterns of terrestrial land use to the other inland Orokolo villages, e.g., Ere and Kilavi




**SCALE:** 1:2,000,000 @ A4

0 20,000 40,000 60,000 80,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

- Waterways
- Waterbodies
- Upstream project area of influence

**Proposed Facilities**

- Pipeline export route corridor
- PRL-15 License

**Catchments**

- Era
- Kikori
- Pie Eia
- Purari
- Vailala
- Other

N

# TITLE: Purari River Basin

## FIGURE: 6.6

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79443 **REVISION:** D

**DATE:** 10/04/2017

**DATA SOURCES:**

Rivers, PRL-15, Pipeline export corridor, hillshade supplied by ERIAS and TOTAL (2015-2016). Catchments downloaded from World Resources Institute (2017) and aligned with data from Iain Woxvold supplied (2016).

Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017).

**CLIENT:**

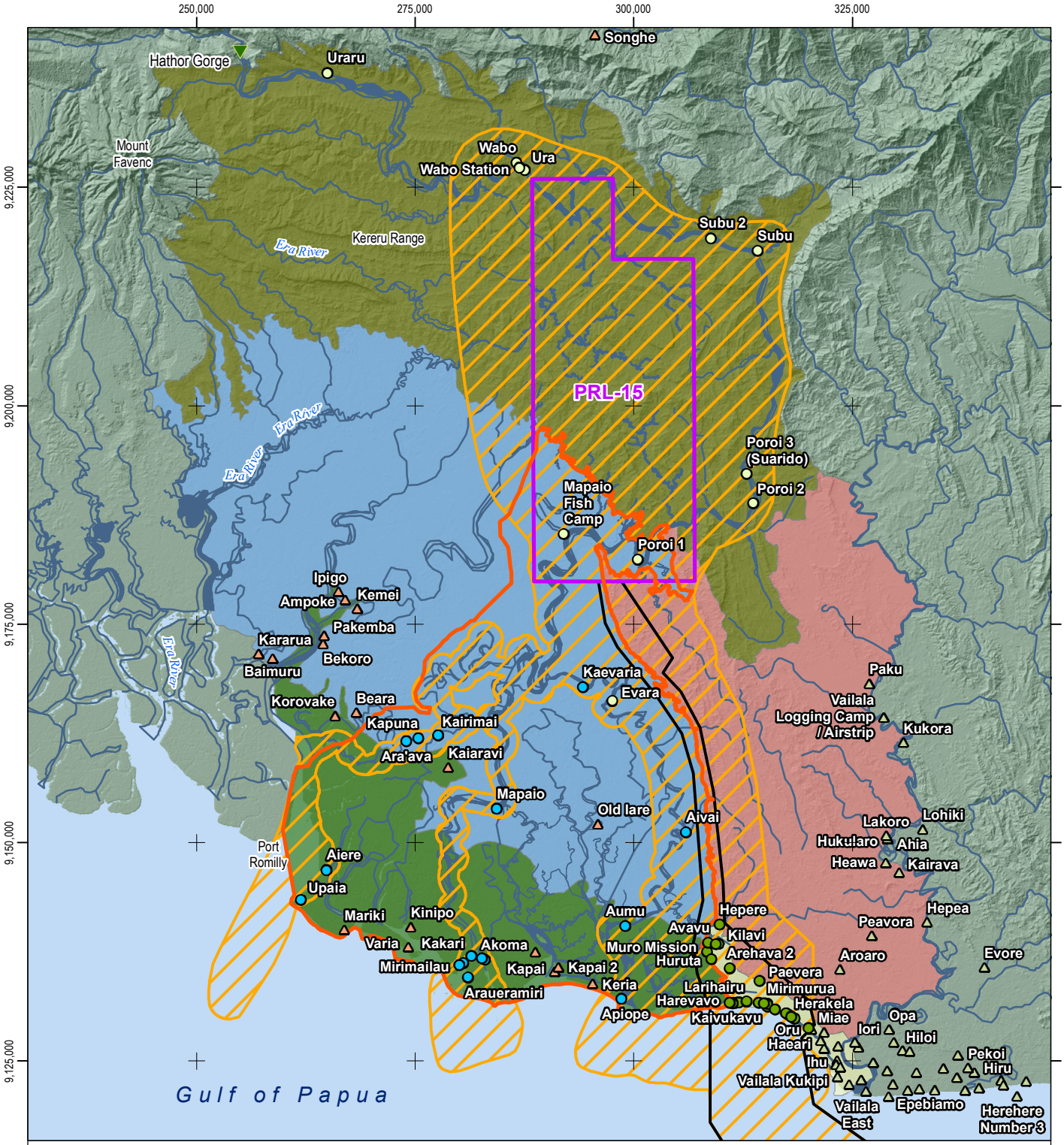
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**SCALE:** 1:650,000 @ A4

0 6,500 13,000 19,500 26,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Towns and Villages**

**Project Affected Communities**
- PRL-15
- Export pipeline corridor
- Riverways

**Host LLG Communities**
- Baimuru Rural
- Ihu Rural

**Ecological Zones**
- Delta swamps and plains
- Mangroves
- Middle purari hills
- Southeast coast
- Southeast hills

- Hathor Gorge
- Waterways
- Waterbodies
- Purari River Delta
- Upstream project area of influence

**Proposed Facilities**
- Pipeline export route corridor
- PRL-15 License

N

*Note, not all communities have been verified in the field

# TITLE: Ecological Zones and Purari River Delta

## FIGURE: Figure 6.7

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79442 **REVISION:** D

**DATE:** 11/04/2017

**DATA SOURCES:**

Language Groups, villages, rivers, PRL-15, Direct project area of influence, hillshade supplied by ERIAS and TOTAL (2015-2016). Ecological Zones supplied by Iain Woxvold (2016). Purari River Delta by Mipela GeoSolutions (2017).
Hathor Gorge by Geoview.
Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017).

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### 6.2.2 Rivers and lakes

The PAOI is in a high rainfall, humid tropical environment that forms part of the Purari River catchment that extends from Mt Wilhelm (4510 m asl) on the borders of Madang, Jiwaka and Simbu provinces to the Gulf of Papua. Rainfall reaches a peak in the foothills with over 8,000 mm per year that drains into the Purari River which discharges into the sea (Petr, 1983). The high rainfall environment of the Purari River catchment is the source of hundreds of kilometers or rivers and creeks, many of which traverse the PAOI. There are few lakes in the PAOI, other than the PRL-15 oxbow wetlands (Plate 6-2), which forms part of the Delta Swamps and Plains ecological zone.

## 6.3 AGRICULTURE

### 6.3.1 Subsistence agriculture

Subsistence agriculture is usually classified into just two basic categories, distinguished by food resources that are produced by human action and those that are collected, foraged or extracted (Kennedy, 2012). In this section, food resources that are produced by human action are discussed and how they vary amongst language groups, villages and ecological zones, where data or field observations suggest important baseline differences. Food resources produced by human action across the PAOI primarily consist of swidden agriculture and sago cultivation. These are discussed in the following sections.

**Plate 6-2 PRL-15 oxbow wetlands**



Land for subsistence agriculture is located in different areas for each village. It is not located in a regular modern agricultural layout but appears sporadic, reflecting suitable soil, individual clan boundaries and fallow period. However, food crops are typically grown in one of the following sites:

- Recently cleared forest or regrowth, particularly where alluvial soils are present.
- Logging gaps in alluvial forest.
- Along river banks in small forest clearings.
- Across the beach ridge and plain landforms in the inland Orokolo area (Southeast Hills).
- Shoreline sand dunes.
- Small nipa palm clearings on raised mounds.
- Beside or in the backyard of houses on compost beds.

However, it is only in the inland Orokolo area where there has been extensive disturbance for subsistence agriculture including sago cultivation. Across the beach ridge and plains most remnant vegetation has been cleared and the area is primarily gardens and planted sago (between Lariau and Larihairu remnant coconut plantations extend up to 200m in from the beach); further inland, across disturbed alluvial forest and to a lesser extent hill forest, large gardens (occasionally sago) have been established.

#### *6.3.1.1 Swidden agriculture (bush gardens)*

Swidden agriculture refers to the clearing and burning of vegetation where, typically, forest is cleared to create space to plant a variety of common crops including staple root vegetables, greens and fruit. The clearing may be used for as little as four months to a maximum of one year due to rapid decline in soil fertility, before moving to another cleared area. Typical crops planted in the bush gardens throughout the PAOI include sweet potato, taro, cassava, cooking bananas, sugarcane, pumpkin, sweet corn, the green leafy vegetables aibika and aupa, peanuts, snake bean, Chinese cabbage, pitpit, eggplant, cucumber, ginger, chilies, passion fruit, paw paw, pineapple, and watermelon.

Bush gardens are made throughout the PAOI and occur on hill sides, along the banks of the Purari River and other waterways, in logged-over alluvial forest and extensively across old sand dunes in coastal areas, and occasionally in small cleared patches of nipa palms in the Mangrove ecological zone where crops are planted on raised mounds. Bush gardens vary in size but are mostly less than 0.5 ha, and are largest in the inland Orokolo area and at their smallest along the banks of the middle Purari River where the Pawaia live, and in the nipa palm clearings of the Mangrove ecological zone. The Pawaia gardens are often squeezed into the fertile margins of the Purari River and its tributaries, however there has been an increased use of hill sides for gardens by the Pawaians after severe floods in 2014 destroyed most of the bush gardens adjacent to the Purari River.

The larger and more widespread bush gardens that occur towards the coast are mostly located on extensive alluvial plains. A good example of this is at Avavu (inland Orokolo) where there are extensive areas of large gardens, many of which had been established after logging of the alluvial forest. The most intensive area of garden cultivation occurs across the beach ridge and plain complex of the Orokolo Bay hinterland where gardens and planted sago extend over at least 1,344 ha, where much of the original alluvial forest has been cleared. Other than some mangrove-lined creeks there is little remnant vegetation left in this area apart from occasional large useful trees.

#### *6.3.1.2 Agricultural systems*

Food resources that have been produced by human activities across the PAOI have been mapped across Papua New Guinea as different agricultural systems (Hide *et al.*, 2002). An agricultural system is identified when a set of similar agricultural crops and practices occur within a defined area. Six criteria are used to distinguish one system from another:

1. Fallow type (the vegetation which is cleared from a garden site before cultivation).
2. Fallow period (the length of time a garden site is left unused between cultivations).
3. Cultivation intensity (the number of consecutive crops planted before fallow).
4. The staple, or most important, crops.
5. Garden and crop segregation (the extent to which crops are planted in separate gardens, in separate areas within a garden, or are planted sequentially).
6. Soil fertility maintenance techniques (other than natural regrowth fallows).

Where one or more of these factors differs significantly and the differences can be mapped, then a separate system is distinguished. For the PAOI one main agricultural system appears to be applicable which is *Agricultural System No. 1 Subsystem No. 1 of 1* (Hide *et al.*, 2002). This agricultural system refers to coastal areas but also fits partly to the Pawaia of the middle Purari because of their dependence on cultivated sago and relatively small gardens.

Agricultural system No. 1 is an extensive system throughout the coastal region from the Gulf Province border with Western Province to just west of the Central Province boundary. Sago, from both planted and wild palms, is the major food, which is consistent with community and household survey responses and field observations throughout the PAOI. Moreover, evidence of cultivated sago was widespread. Only the community at Aivai (Iare language group) regarded garden food crops to be as important as sago; this appeared to reflect the limited availability of planted sago, and the physical difficulty of harvesting sago from wild sago stands.

For this agricultural system, the importance of cultivated food gardens varies from minimal to significant (providing as much as one third of food intake). It is

least important in the Mangrove ecological zone where there is little land to cultivate other than small clearings made in nipa palm stands or on coastal sand dunes (e.g. the villages Maipenairu, Mariki, Upaia, Akoma, Ikinu, Kairu'u and Apiope), and is most significant where there is greater access to raised land and beach plains such as the coastal and inland Orokolo villages. The inland Orokolo villages Paevera, Avavu, Huruta, Hepere, Ere and Kilavi have relatively large gardens in hill forest and logged-over alluvial forest respectively. However, this pattern of cultivation is not necessarily increased by living inland. For example, the Pawaia villages focus food production on cultivated sago and plant mostly small gardens adjacent to the Purari River, often close to their planted sago.

This agricultural system is characterized by the clearing of tall woody regrowth over 15 years old, which is burnt for new gardens apart from occasional shade/useful trees. This can include clearing of undisturbed primary forest too, which increasingly occurs as the demand for food production rises with population increase. A wide variety of crops are grown in the gardens, but cooking bananas, taro, sweet potato, cassava, Chinese taro, sugar cane, aibika, sweet corn, watermelon, cucumber and pineapples are widely planted (Plate 6-3). Inland, sweet potato is more likely to be planted as a staple in addition to cassava (Plate 6-4) but in coastal areas there appeared to be less planting of sweet potato but more planting of cassava and yam, often adjacent to the shoreline after fallows of short coastal grass species. Typically, only one planting is made before fallowing for a period of 15 years or more.

**Plate 6-3 A typical garden at Avavu with sweet potato, cassava, banana and betel nut palms and coconuts in the background**



**Plate 6-4 Cassava**



In addition to sago and food gardens, coconuts are planted throughout the PAOI and are an important staple food particularly when other foods are in short supply. Coconuts are more abundant in coastal villages and the inland Orokolo villages of Ere and Kilavi, partly reflecting historical planting for copra production. Here, they also provide food that help support large herds of domestic pigs.

Everywhere in the PAOI, gardening is of less significance than sago apart from at Kaevaria and Aivai. Kaevaria trades garden produce for much of their sago and Aivai mostly harvests sago from wild sago which has difficult access limiting the amount they can harvest. However, there is considerable variation in the relative importance of gardening. At one extreme, very few families may have gardens or cultivated areas per person may be minimal. At the other extreme, non-sago garden food may provide more than one third of food intake (Hide *et al.*, 2002).

The only notable anomaly to this agricultural system was the planting of rice at the inland Orokolo village of Avavu. However, dehusking the rice was problematic due to the lack of a rice mill so dehusking was carried out by beating the rice with bamboo sticks. Rice had also been trailed at Hurutu (inland Orokolo) but had failed.

Fishing and the collection of crabs and shellfish are also very important subsistence activities for this agricultural system as is hunting, particularly for inland locations. These activities are discussed in Sections 6.4 and 6.5.

#### *6.3.1.3 Sago*

The planting and harvesting of sago is the most important food production activity across the PAOI. Sago is the main staple food for all the villages and is also one of the most important famine foods together with coconuts since both are resilient to floods and drought. Sago is harvested from planted and wild sago stands (Plate 6-5) although harvesting from planted stands is more common and

preferred due to accessibility, and because favored cultivars are planted that have the best texture (less watery) and flavor. Sago is planted throughout the PAOI in three main types of locations that are easily accessed:

- Along the river banks of the Purari River and its tributaries from the limit of its salt tolerance in the lower Purari to beyond Wabo.
- On the margins of small creeks and swampy sites inland from the main rivers.
- Throughout the swales of the Orokolo hinterland beach ridges and plains complex.

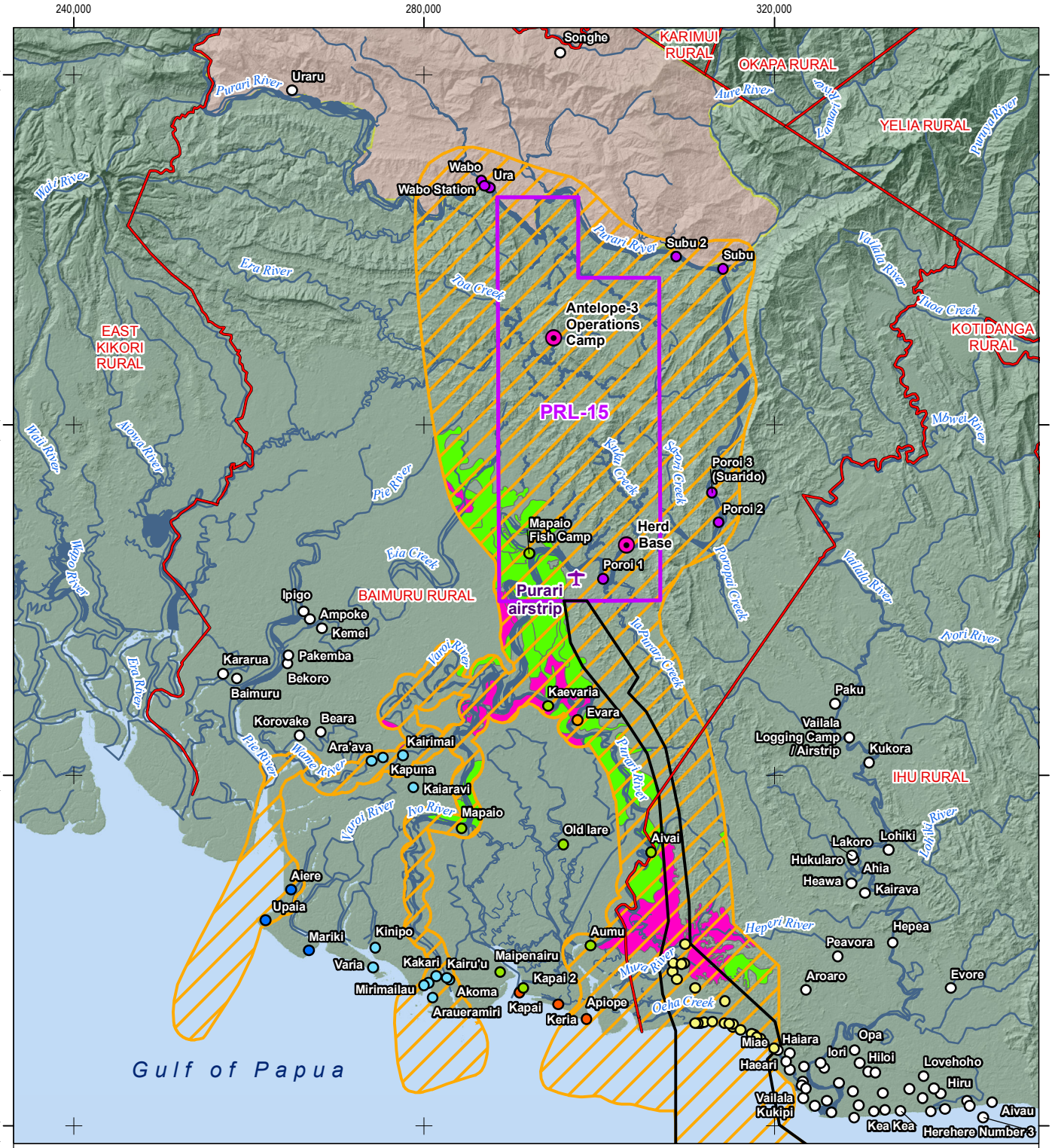
The river bank clearings are typically quite small comprising a few individual palms in various stages of development. These small sago gardens are owned and harvested by individual families who progressively clear adjacent areas each year so that they have an ongoing and adequate supply (Petr, 1983). The seedlings that are planted are collected as suckers from the base of harvested palms and transplanted into the new clearing. This is the main source of sago that is available to the Pawaians.

Planting on small creeks and small swampy sites is common throughout the PAOI where accessible to a community. The planting often consists of one or two palms only and is a supplement to the main source.

Planting across swales of the beach ridges and plains landform is unique to the Orokolo villages. The low-lying swales have been continuously planted with sago palms for generations and stands of sago palms are now extensive. The swales frequently flood in the wet season providing ideal habitat for growth provided the floodwaters are not contaminated with saltwater, which increasingly causes dieback in palms planted closer to the coast during the wet season.

The other main source of sago across the PAOI is the wild stands of sago which cover approximately 25,351 ha (9%) of the PAOI most of which occur within the Delta Swamps and Plains ecological zone. An additional 13,890 ha also contain sago but as a secondary component of the vegetation (Figure 6-8).

Yields of between 100 and 150 kg per sago palm are likely which are usually sufficient for a family for a month. Sago palm by-products are also widely used across almost all villages for roofing and building.




**SCALE:** 1:650,000 @ A4

0 5,000 10,000 15,000 20,000 25,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Towns and Villages**

**Language Group**

- A - Pawaian
- B - Kaimare
- C - Koriki
- D - Iare
- E - Orokolo
- F - Ahia
- G - Maipua
- Not verified

**Existing Facilities**

- Base camp
- Purari airstrip

- Local level government boundaries
- Waterways
- Waterbodies
- Upstream project area of influence
- PRL-15
- Export pipeline corridor
- Crater Mountain Wildlife Management Area
- Sago dominated vegetation
- Vegetation complex with sago

N

*Note, not all Host LLG Communities have been verified in the field.*

**TITLE:** Wild Sago

**FIGURE:** 6.8

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79904 **REVISION:** C

**DATE:** 2/05/2017

**DATA SOURCES:**

Facilities, town and villages, rivers, airstrip, export pipeline corridor, PRL-15, hillshade supplied by ERIAS Group and TOTAL (2015-2016). Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). Sago dominated vegetation and vegetation complex with sago (Howard Rogers 2017)

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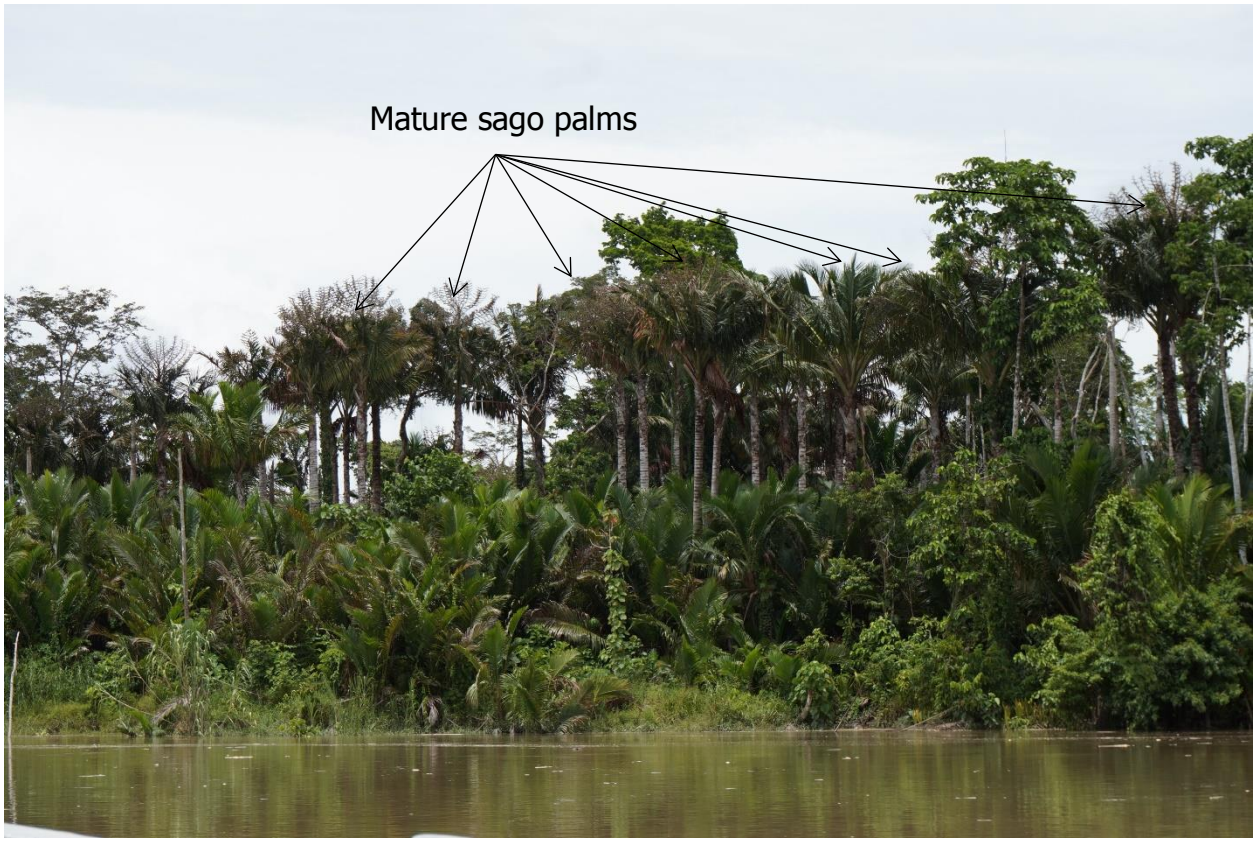
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**Plate 6-5 Mature sago growing along the banks of the Purari River**




### *6.3.1.4 Planted fruit and nut trees and palms*

In addition to sago and garden foods, a range of fruit and nut trees, which are extremely important in coastal and lowland areas as supplementary crops (Paijmans, 1976), are planted in villages throughout the PAOI. The main exception to this is for the coastal Orokolo villages of Harevavo, Marea and Kaivukavu where there appeared to be limited space and poor sandy soils for planting. Some of the trees also occur in forests but have been transplanted into villages and gardens. Of the trees listed in Table 6-7, Okari nut (Plate 6-6) and breadfruit are the most widespread tree species planted in villages. Okari nut is widely eaten and sold seasonally in local markets. The producing period is fairly constant from year to year and lasts two to four months. Nuts mature from about March at 4$^{o}$ south of the Equator and later at locations further south reflecting differences in day length associated with latitude (Bourke and Harwood, 2009). Nuts were observed to be mature in Wabo (7.4$^{o}$ south) in May, which appeared to be late in the season so nuts will mature slightly later towards the coast at approximately 7.9$^{o}$ south.

Breadfruit is an extremely important fruit tree that grows wild and is also grown in villages across the PAOI from seedlings or by propagating root cuttings or suckers. Both the fruit pulp and seeds are eaten in some varieties, but in others the seeds are only edible. The fruit is roasted or baked whole or cut up and boiled. Seeds, which are nutritionally more valuable, are usually roasted or boiled (Paijmans, 1976).

The most important tree species planted in coastal areas and inland Orokolo villages is coconut. Coconut is an important famine food, particularly in the wet season when food gardens and sometimes sago cannot be accessed due to flooding. The meat of the coconut can be eaten at all stages of development ensuring a food source throughout the year. Moreover, the milk of the green coconut is a refreshing drink that can be important during drinking water shortages.

**Table 6-7 Fruit and nut trees and palms planted in villages in the PAOI**

| Common name | Scientific name | Edible part | Comment |
|---|---|---|---|
| Okari nut | *Terminalia kaerbachii* | Nut | Widely planted in village and gardens |
| Bread fruit | *Artocarpus altilis* | Fruit and seed | Widely planted in village and gardens |
| Laulau | *Syzygium* sp. | Fruit | Planted in village |
| Tulip | *Gnetum gnemon* | New shoots eaten as greens | Occasionally planted in village and gardens. Forest tree. Grows in hill forest and alluvial forest. |
| Ton | *Pometia pinnata* | Fruit | Planted in village. Forest tree common in hill forest |
| Kumu musong | *Ficus wasa* | New shoots eaten as greens | Planted in village. Forest tree |
| - | *Ficus damaropsis* | Fruit | Planted in village. Forest tree |
| Coconut | *Coconus nucifera* | Nut | Planted in village and gardens |
| Guava | *Psidium gujava* | Fruit | Planted in village |
| Citrus (orange and lemon) | *Citrus* spp. | Fruit | Planted in village |

**Plate 6-6 Okari nut – the edible part is the white center**



**Plate 6-7 Washing tulip at Huruta village**



*6.3.1.5 Food importance*

Table 6-8 shows the importance of the main staple foods and vegetables across the PAOI. Those findings are compared with national survey data from Bourke & Harwood (2009) and observations made during the community surveys. It shows:

- Sago is the most important staple food across the PAOI. It was eaten by 97% of household survey respondents the day prior to the survey (i.e., 'yesterday') and by most households (79% or more) of every (100%) village.
- Cooking banana is the second most important staple in the daily diet across the PAOI, eaten by 70% of household survey respondents the day prior to the survey and by some households (31% or more) from every (100%) village. It is an important crop in high rainfall areas in Gulf Province such as the Pawaia villages, and many of the riverways villages and Orokolo villages, particularly on the better alluvial soils across the Delta Swamps and Plains ecological zone. It is grown by 96% of rural people in Papua New Guinea except those living at high altitudes.
- Green leafy vegetables were eaten by 61% of respondents and by some (10% or more) households from all (100%) villages. This category is likely to include pumpkin tops, aibika and aupa.

- Sweet potato was eaten by 33% of respondents from all but three villages (Subu, Upaia and Kairu'u) the day prior to the household survey, making it the most important root crop in the PAOI. It is grown by 99% of villages in Papua New Guinea.
- Cassava was commonly grown throughout the PAOI and was the second most important root crop together with sweet potato. It is grown by more than half the population in Papua New Guinea but it is only the most important food for 1% of rural people.
- Taro was eaten by 22% of respondents from 74% of villages across the PAOI, making it the third most important root crop. It is grown by 95% of villages in Papua New Guinea (albeit only being the most important food for 6% of the population).
- Yam was not commonly grown crop across the PAOI, whereas 60% of the population in Papua New Guinea grow yam. Only 4% of households from less than half of the villages had eaten yam the day before the household survey.
- Pumpkin was widely eaten (at all but four villages) but at a relatively modest percentage (20%) of households and corn was only eaten by 6% of respondents across only 45% of villages the day before the survey. However, this may reflect the more seasonal production of corn compared to pumpkin.

**Table 6-8 Respondents who had eaten staple foods and vegetables 'yesterday' (% of households)**

| Village | Language group | Ecological zone | n | Sago (%) | Cooking banana (%) | Green leafy vegetables (%) | Sweet potato (%) | Cassava (%) | Taro (%) | Pumpkin (%) | Peanuts (%) | Corn (%) | Yam (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | 14 | 79 | 86 | 79 | 36 | 29 | 14 | 21 | 14 | 7 | 7 |
| Kaevaria | Iare | DSP | 10 | 90 | 90 | 70 | 40 | 40 | 30 | 20 | 10 | 0 | 0 |
| Mapaio Fish Camp | Iare | DSP | 3 | 100 | 100 | 100 | 100 | 67 | 33 | 67 | 0 | 33 | 0 |
| Aivai | Iare | M | 9 | 100 | 89 | 78 | 33 | 78 | 33 | 56 | 0 | 0 | 11 |
| Kapai 2 | Iare | M | 16 | 100 | 31 | 50 | 31 | 19 | 6 | 31 | 0 | 0 | 0 |
| Maipenairu | Iare | M | 18 | 100 | 44 | 67 | 17 | 28 | 11 | 6 | 0 | 0 | 0 |
| Aiere | Kaimare | M | 6 | 100 | 67 | 33 | 17 | 17 | 17 | 17 | 0 | 0 | 17 |
| Mariki | Kaimare | M | 17 | 94 | 41 | 29 | 6 | 29 | 0 | 6 | 0 | 0 | 0 |
| Upaia | Kaimare | M | 13 | 100 | 31 | 23 | 0 | 54 | 0 | 0 | 0 | 0 | 0 |
| Kairimai | Koriki | DSP | 19 | 100 | 63 | 53 | 21 | 37 | 11 | 26 | 0 | 5 | 5 |
| Akoma | Koriki | M | 11 | 100 | 36 | 27 | 18 | 27 | 9 | 18 | 0 | 0 | 0 |
| Kairu'u | Koriki | M | 10 | 100 | 40 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Village | Language group | Ecological zone | n | Sago (%) | Cooking banana (%) | Green leafy vegetables (%) | Sweet potato (%) | Cassava (%) | Taro (%) | Pumpkin (%) | Peanuts (%) | Corn (%) | Yam (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apiope | Maipua | M | 16 | 100 | 75 | 19 | 25 | 25 | 0 | 19 | 0 | 0 | 0 |
| Harevavo | Orokolo | M | 30 | 100 | 73 | 33 | 20 | 20 | 17 | 13 | 3 | 7 | 10 |
| Herakela | Orokolo | SEC | 21 | 100 | 81 | 57 | 24 | 10 | 29 | 5 | 0 | 10 | 5 |
| Iuku | Orokolo | SEC | 24 | 100 | 79 | 54 | 21 | 21 | 42 | 4 | 0 | 4 | 13 |
| Ere | Orokolo | SEC | 13 | 92 | 100 | 92 | 46 | 54 | 54 | 46 | 0 | 15 | 15 |
| Kilavi | Orokolo | SEC | 15 | 100 | 93 | 100 | 53 | 13 | 53 | 27 | 7 | 0 | 0 |
| Paevera | Orokolo | SEC | 15 | 100 | 80 | 80 | 20 | 20 | 40 | 27 | 7 | 7 | 0 |
| Poroi 1 | Pawaia | DSP | 5 | 100 | 60 | 20 | 80 | 20 | 0 | 0 | 0 | 0 | 0 |
| Poroi 2 | Pawaia | DSP | 14 | 93 | 71 | 86 | 79 | 43 | 21 | 14 | 14 | 7 | 0 |
| Poroi 3 | Pawaia | DSP | 5 | 100 | 60 | 60 | 40 | 0 | 0 | 20 | 20 | 0 | 0 |
| Subu | Pawaia | MPH | 2 | 100 | 100 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subu 2 | Pawaia | MPH | 7 | 100 | 86 | 100 | 57 | 71 | 29 | 14 | 14 | 14 | 29 |
| Ura | Pawaia | MPH | 12 | 92 | 83 | 92 | 50 | 33 | 58 | 25 | 25 | 0 | 8 |
| Wabo | Pawaia | MPH | 22 | 95 | 64 | 100 | 41 | 45 | 36 | 18 | 9 | 14 | 9 |
| Wabo Station | Pawaia | MPH | 7 | 86 | 71 | 86 | 29 | 71 | 57 | 14 | 57 | 29 | 0 |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SEC = Southeast Coast, DSP = Delta Swamps and Plains, MPH = Middle Purari Hills. n = no. of households
Source: ERIAS Group 2016b.

#### *6.3.1.6 Division of labor*

Labor inputs for agricultural tasks across the PAOI are partly gender specific although in practice there is some sharing of tasks, and particularly in coastal villages there appeared to be a higher input of men into some labor-intensive tasks such as sago processing. In contrast, in the remote Pawaia villages, more traditional division of labor appeared to be prevalent.

Men are generally responsible for heavier work, such as clearing forest regrowth for garden cultivation and harvesting and transporting sago logs. Women are typically responsible for planting and harvesting of crops and the extremely labor-intensive processing of sago (Plate 6-8). The division of labor based on the percentage of positive responses of each village within the individual language groups for the two weeks prior to the survey is presented in Table 6-9. Overall the data does not show the clear distinction between labor input by men and women for the different tasks although a higher percentage of women (63%) are involved in sago making compared to men (42%). Sago processing was observed at several locations throughout the PAOI and men were not observed assisting in the processing other than in the coastal Orokolo villages, however men assist with felling the sago palms and setting up the sago processing equipment which may account for the relatively high proportion of male involvement in sago

processing. Moreover, it is normal for gender roles in the various stages of production to vary (Hide *et al.*, 2002).

For garden clearing and planting, on average, men (56%) mostly had a higher percentage involvement than women (44%) apart from the Maipua language group where men and women were equally involved (38%), however this language group was represented by one village only. There was a high participation of Koriki men from the Delta Swamps and Plains ecological zone at 82%, with 55% of women involved in clearing and planting gardens. Male participation in garden maintenance was also high amongst Koriki people from the Delta Swamps and Plains but in this instance, women's participation was equal (73% each), and not as high as the highest women's participation rate which was the Pawaia women from Middle Purari Hills villages (79%). The lowest participation rate for garden clearing and planting was for the Koriki people in the Mangrove ecological zone where only 36% of men and 21% of women participated. The Koriki women from the Mangrove ecological zone had, however, amongst the highest participation rates in sago harvesting at 74% (with the Orokolo inland and Pawaia Delta Swamps and Plains people, 75% each), which may reflect the low availability of land to make gardens for the Koriki who live in the Mangrove ecological zone (Akoma, Ikinu and Kairu'u).

**Plate 6-8 Woman making sago**



**Table 6-9 Division of labor for agriculture (mean of percentage of positive responses from household survey)**

| Language group | Ecological zone | n | Clearing/ planting garden (%) | Garden maintenance (%) | Harvest garden produce (%) | Harvesting fruits/nuts (%) | Making sago (%) |
|---|---|---|---|---|---|---|---|
| **MALE** | | | | | | | |
| Ahia | DSP | 14 | 43 | 64 | 71 | 29 | 36 |
| Iare** | M + DSP | 53 | 48 | 66 | 64 | 37 | 32 |
| Kaimare | M | 36 | 53 | 61 | 68 | 35 | 64 |
| Koriki | M | 21 | 36 | 52 | 42 | 31 | 39 |
| Koriki | DSP | 19 | 82 | 73 | 55 | 64 | 36 |
| Maipua | M | 16 | 38 | 63 | 56 | 6 | 31 |
| Orokolo | SECc | 64 | 63 | 69 | 63 | 37 | 57 |
| Orokolo | SECi | 54 | 61 | 68 | 79 | 43 | 70 |
| Pawaia | MPH | 67 | 65 | 69 | 73 | 42 | 50 |
| Pawaia | DSP | 7 | 71 | 57 | 71 | 29 | 0 |
| **FEMALE** | | | | | | | |
| Ahia | DSP | 14 | 29 | 64 | 64 | 29 | 64 |
| Iare** | M + DSP | 53 | 51 | 67 | 73 | 38 | 56 |
| Kaimare | M | 36 | 37 | 36 | 51 | 36 | 68 |
| Koriki | M | 21 | 21 | 47 | 57 | 26 | 74 |
| Koriki | DSP | 19 | 55 | 73 | 73 | 64 | 82 |
| Maipua | M | 16 | 38 | 50 | 50 | 19 | 63 |
| Orokolo | SECc | 64 | 27 | 38 | 44 | 31 | 61 |
| Orokolo | SECi | 54 | 61 | 73 | 77 | 57 | 75 |
| Pawaia | MPH | 67 | 73 | 79 | 80 | 47 | 75 |
| Pawaia | DSP | 7 | 43 | 43 | 43 | 0 | 14 |

*Values are mean values for each language group based on the number of villages within each language group.
**Iare excludes Mapaio Fish Camp
n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Note: Language groups are listed more than once when villages within those language groups occur in different ecological zones.
Source: ERIAS Group 2016b.

## 6.3.2 Livestock use and production

The only domestic livestock encountered in the PAOI were pigs and chickens; both are kept to some extent in all sampled villages. Ducks were reportedly introduced to Baimuru (just west of the PAOI) in 1979 (Stevens, 1980), as part of an integrated waste-management plan linked to the fish processing plant, however ducks were not mentioned by any respondent. It is also likely that cattle farming occurred at some point during the long history of Muro Mission; if so, there has been no wider adoption of this practice across the PAOI.

### *6.3.2.1 Pigs*

Williams in 1940 described the Orokolo village pig as "the living symbol of wealth, or as much wealth itself as the shell armlets, frontlets, and pendants which are given in exchange for him when he is killed" (Williams, 1940). Today, domestic pigs are valued commodities throughout the PAOI and it appears that they are still reared primarily for reasons other than consumption—for payment of bride price or compensation, for presentation during ceremonies, or for exchange for other items of value such as a canoe (Plate 6-9). However, domestic pigs now have an additional, strictly monetary value that can be

realized through sale as live animals or as butchered meat; the market for such commodities can be local or extend far beyond the village or district.

Some villagers avoid contact with pigs due to religious affiliation with the Seventh-day Adventist (SDA) Church. The presence of an SDA Church or SDA church membership was recorded for each of Apiope, Kaevaria, Kapai 2, Kavava, Kaivukavu, Maipenairu, Mapaio, Marea, Mareke and Subu but in no case was this affiliation common to all members of the community.

Pig husbandry practices are broadly similar throughout the PAOI. Rates of pig ownership differ strikingly between the coastal and delta villages and the villages located further inland.

**Plate 6-9 Piglets in Harevavo**



A negative aspect of village-based pig husbandry is the damage they can do to gardens and therefore, gardens located close to the villages are fenced to reduce damage. Formerly these were communal structures with strong external fences and small internal barricades to mark each household's allotment. Today each family builds gardens in a separate area through individual or smaller group effort; these are rarely fenced and, consequently, are probably more prone to pig damage. The reason for this change in gardening practices is not known. More remotely positioned gardens are typically unfenced and these often suffer damage from both wild and domestic pigs.

The highest rates of pig ownership and the largest herds were reported in the Kaimare, Koriki and Maipua villages located on the coast and in the Mangroves ecological zone (Table 6-10, Appendix C). In these villages pig ownership is not ubiquitous but occurs by more than 60% of households (as high as 70% in Koriki villages), with average herd sizes usually between 5 and 6 (but as high as 9 in the Maipua village of Apiope. Occasionally, herds of 15–25 were recorded but these represent a degree of specialization that is unusual in the PAOI.

The lowest rates of pig ownership, rarely above 10% of households, were recorded among the Iare villages living along the Purari River above the marine tidal influence in the Delta Swamps and Plains ecological zone. The Ahia village of Evara and some Pawaia villages had no pigs at all.

**Table 6-10 Domestic pig ownership**

| Language group | Ecological zone | n | % of households with pigs | Maximum # pigs per herd | Average # pigs per herd* |
|---|---|---|---|---|---|
| Ahia | DSP | 14 | 0 | 0 | 0.0 |
| Iare | M | 34 | 24 | 5 | 1.9 |
| Iare | DSP | 22 | 5 | 1 | 1.0 |
| Kaimare | M | 36 | 64 | 25 | 5.5 |
| Koriki | DSP | 19 | 11 | 1 | 1.0 |
| Koriki | M | 21 | 71 | 17 | 5.4 |
| Maipua | M | 16 | 63 | 25 | 9.3 |
| Orokolo | SECc | 75 | 44 | 18 | 5.8 |
| Orokolo | SECi | 43 | 21 | 6 | 5.6 |
| Pawaia | DSP | 5 | 0 | 0 | 0.0 |
| Pawaia | MPH | 69 | 43 | 6 | 1.7 |

*Average number of pigs per herd is for pig owners only
n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

### *6.3.2.2 Chickens*

Chicken husbandry has a long history in the PAOI, with brief mentions by Williams (1940) for the villages of Orokolo Bay and by Toft (1983) for Pawaia villages. For Orokolo, Williams (1940) reported that chickens were outnumbered by pigs and that they were reared only for "the pot", with most people expressing "revolt from the idea of eating a hen's egg" – an unusual reaction given the likely consumption at the time of eggs of bush fowl, turtles and crocodiles. However, Hamilton (1995) made a similar observation for villages in the lower Kikori catchment.

Chicken keeping has increased in popularity and the majority of households across the PAOI now keep chickens (42–86%). Today, the eggs as well as the birds are regularly consumed.

Households that keep small numbers of chickens generally leave them to roost beneath the house. Households with much larger number of chickens usually have a well-made chicken-house and fenced yard in which they are enclosed at

night. All chickens are free-ranging within the village and surrounding gardens and scrub. The minimal level of management of the Purari chicken flocks is not conducive to any stock improvement through introduction of higher yield varieties (Quartermain, 2001, 2004). Current practices thus do not represent a basis for more intensive systems of meat (or egg) production.

In the PAOI, the lowest rates of chicken husbandry were recorded in the Pawaia villages from the Middle Purari Hills ecological zone (42%) and Koriki villages from the Mangroves zone (48%), and the highest rates in the Kaimare villages (83%) and the Ahia village of Evara (86%) (Table 6-11). It is interesting to note that the Pawaia villages located in the Delta Swamp and Plains zone, had higher rates of chicken husbandry (80%), compared with their Middle Purari Hills relatives, mentioned above. Koriki villages had the biggest and smallest average flock sizes with 9.1 amongst villages in the Delta Swamp and Plains zone and 22.8 amongst villages in the Mangrove zone. Average flock size across the PAOI was 14 birds.

**Table 6-11 Chicken ownership**

| Language group | Ecological zone | n | % households with chickens | Maximum # chickens per flock | *Average # chicken flock |
|---|---|---|---|---|---|
| Ahia | DSP | 14 | 86 | 50 | 10.3 |
| Iare | M | 34 | 74 | 52 | 17.4 |
| Iare | DSP | 22 | 73 | 38 | 16.8 |
| Kaimare | M | 36 | 83 | 30 | 9.4 |
| Koriki | DSP | 19 | 58 | 23 | 9.1 |
| Koriki | M | 21 | 48 | 30 | 22.8 |
| Maipua | M | 16 | 75 | 35 | 15.8 |
| Orokolo | SECc | 75 | 60 | 30 | 9.2 |
| Orokolo | SECi | 43 | 72 | 64 | 12.6 |
| Pawaia | DSP | 5 | 80 | 30 | 15.8 |
| Pawaia | MPH | 69 | 42 | 115 | 10.7 |

*Average no. of chickens per flock is for chicken owners only.
n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS, 2016b

### *6.3.2.3 Livestock importance*

Domestic pigs are considered to have only moderate to high importance amongst only Kaimare (Mangrove zone) and Orokolo (Southeast Coastal zone) villages. Ahia, Iare, Koriki and Pawaia (in Delta Swamps and Plains zone) consider domestic pigs to be of very low importance (Table 6-12).

All villages across all language groups and ecological zones consider chickens to be of moderate to very high importance, especially amongst Kaimare villages.

**Table 6-12 Domestic livestock importance* among the villages**

| Language group | Ecological zone | Domestic pig importance | Chicken importance | Crocodile 'farming' importance |
|---|---|---|---|---|
| Ahia | DSP | very low | high | negligible |
| Iare | DSP | very low | moderate | negligible |
| Iare | M | low to moderate | moderate to high | negligible |
| Kaimare | M | moderate to high | high to very high | negligible |
| Koriki | DSP | very low | moderate | negligible |
| Koriki | M | moderate | moderate | negligible |
| Maipua | M | moderate | high | negligible |
| Orokolo | SECc | low to high | moderate to high | negligible |
| Orokolo | SECi | low to moderate | moderate to high | negligible |
| Pawaia | DSP | very low | high | negligible |
| Pawaia | MPH | low to moderate | moderate to high | negligible |

*Importance does not reflect the potential social capital of pig ownership, e.g. pigs might be even more important in villages where few people keep them.
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b

#### *6.3.2.4 Rearing of non-domesticated animals*

Several kinds of wild animals are occasionally reared from juveniles until large enough to sell or consume. The most common are cassowaries and cuscuses, with crocodiles and wallabies also occasionally reared. Smaller birds are also sometimes kept, with a proportion of these sold.

**Cassowaries**

Cassowaries are highly valued as components of bride price, compensation payments, and as cooked meat served at special events (Plate 6-10). They have a significant monetary value, especially if they can be sold to clients in Port Moresby or localities in the highlands where cassowaries are now very scarce and in high demand.

Juvenile cassowaries are obtained by killing or chasing off the adult male that hatches them from the egg and then stays with the young until they reach independence. They become habituated to a primary carer and readily adapt to village life, feeding on food scraps and foraging close to the village. When they get large enough to be potentially dangerous, they are housed in a pen.

Data from the household surveys indicated that 16 of the 354 surveyed households were rearing a total of 22 cassowaries (Table 6-13). Most had a single cassowary but two households at Iuku had two and six birds respectively under their care. Captive cassowaries were reported in villages representing four of the seven language groups and located across the full range of terrestrial habitats, from coastal villages to the inland Pawaia villages.

**Plate 6-10 Juvenile cassowaries are seen foraging within villages**



## Crocodiles

Crocodiles captured live can be penned and reared to increase their sale value for skins and meat (Plate 6-11). Size at capture is immaterial, at no age do they habituate to their keeper.

Only six out of 354 household respondents reported the keeping of captive crocodiles (Table 6-13). All were residents of either Iare or Kaimare villages. Two households at Aiere had two crocodiles each but the other four households had one only.

## Cuscuses

Cuscuses captured as young weaned animals are sometimes kept in rattan or wooden cages and fed on fruit (Plate 6-12). They are partly treated as pets but the majority end up being sold or consumed by the owner. Cuscus fur is used for traditional body decoration and for the production of woven bags (*bilums*) in many PNG societies and some individuals are probably purchased for this reason. The potential market for such sales very likely extends outside of the local villages. From the household surveys, six respondents kept a total of seven captive cuscuses (Table 6-13).

**Plate 6-11 Crocodile kept in disused water tanks in villages in the PAOI**

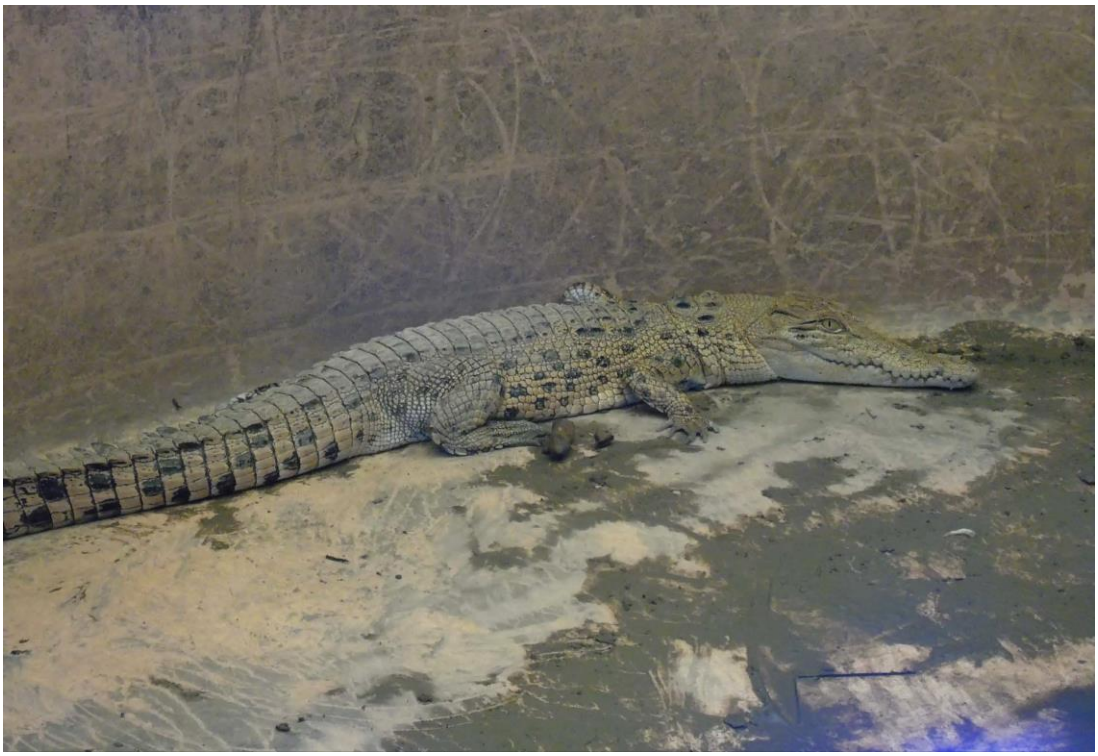


**Plate 6-12 Cuscuses are kept in cages at households within the PAOI**



## Other birds

Small numbers of cage birds are kept in villages across the PAOI (Table 6-13). Examples recorded during the household survey included cockatoos and other parrots, pigeons (Plate 6-13) and doves. These were mostly kept as cage birds and treated as pets but some are sold, this is probably opportunistic and infrequent. More regular trade may occur but remain undisclosed (see Section 6.3.3.3).

**Plate 6-13 A range of birds, like this pigeon, were kept by households across the PAOI**



**Table 6-13 Ownership of other captive wildlife**

| Village | Language group | Ecological zone | n | # of cassowary keepers (# of birds) | *Other wild birds (kind) | No of cuscus keepers (# cuscuses) | # of crocodile keepers (# crocodiles) |
|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | 14 | 1 | - | - | - |
| Kaevaria | Iare | DSP | 10 | 1 | - | - | - |
| Mapaio FC | Iare | DSP | 3 | - | 1 (P) | - | 1 |
| Aivai | Iare | DSP | 9 | 3 | 1 (C) | - | - |
| Kapai 2 | Iare | M | 16 | - | - | 1 | 1 |
| Maipenairu | Iare | M | 18 | 3 | - | - | 1 |
| Aiere | Kaimare | M | 6 | - | - | - | 2 (4) |
| Upaia | Kaimare | M | 13 | - | - | 1 | 1 |

| Village | Language group | Ecological zone | n | # of cassowary keepers (# of birds) | *Other wild birds (kind) | No of cuscus keepers (# cuscuses) | # of crocodile keepers (# crocodiles) |
|---|---|---|---|---|---|---|---|
| Kairimai | Koriki | DSP | 19 | - | - | 2 | - |
| Kairu'u | Koriki | M | 10 | - | - | 1 | - |
| Apiope | Maipua | M | 16 | - | - | 1 (2) | - |
| Iuku | Orokolo | SECc | 24 | 2 (8) | - | - | - |
| Kilavi | Orokolo | SECi | 15 | 1 | - | - | - |
| Paevera | Orokolo | SECi | 15 | - | 1 (D) | - | - |
| Poroi 2 | Pawaia | MPH | 14 | 2 | - | - | - |
| Poroi 3 | Pawaia | MPH | 5 | 2 | - | - | - |
| Subu 2 | Pawaia | MPH | 7 | 1 | - | - | - |
| Wabo Station | Pawaia | MPH | 7 | - | 1 (P) | - | - |
| **Total** | | | **354** | **16** | **354** | **6** | **6** |

C = cockatoos; D = doves; P = other parrots.
n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

#### *6.3.2.5 Division of labor and benefits*

Labor and benefits are both difficult to measure in the case of domestic livestock. Labor is divided among numerous tasks that are spread through the life of the animals, with some continuous (e.g. feeding) and some one-off (e.g. castration, culling and butchering) or irregular (e.g. fencing) inputs. Benefits include the consumption of meat but also the material benefits that might come from sale and the even more nebulous benefits associated with fulfillment of customary and other social obligations. Data herein relates only to consumption (treated here) and sale (treated in Section 6.3.3.2).

#### *6.3.2.6 Division of labor*

Casual discussions and observations suggest that responsibility for pig husbandry is shared by men and women in all villages, though women perform the majority of the day-to-day tasks. Orokolo men claimed to be responsible for the construction of fences around gardens.

The day-to-day tasks associated with chicken keeping (cleaning of sleeping areas, supplementary feeding) also appear to be performed primarily by women in all villages, although the construction of any special pens or enclosures is more likely done by men.

#### *6.3.2.7 Division of benefits*

Domestic pig meat is consumed at similar rates in all villages, regardless of the dramatic contrasts in the rate of local pig keeping. This likely reflects the effective mechanisms for sharing and exchange within and between villages, as well as the more recent purchasing power of villages that have higher-than-average earnings from paid work.

Despite the ubiquity of chicken keeping (Plate 6-14) across all villages, the rate of consumption of chicken meat and eggs is not particularly high. Consumption of chicken meat and eggs appears to be most prevalent in the Pawaia, Kaimare,

Koriki and Orokolo villages and lowest among the Ahia, Iare and Maipua villages. Chickens, like pigs, appear to be more commonly used as items of social capital than items for regular consumption. However, this does not explain the relatively low rate of consumption of eggs.

When data is pooled across all villages, there is no overall gender bias in the consumption of any domestic animal products—pig meat was eaten the day before the household survey by 9% of men and 8% of women, chicken meat by 4% of men and 2% of women, and chicken eggs by 7% of men and 6% of women.

**Plate 6-14 Chicken – a common source of protein across villages of the PAOI**



### 6.3.3 Community-based commercial activities

Community-based commercial activities are common throughout the PAOI but are mainly associated with selling betel nut, sago, fish, mud crabs and a range of common garden vegetables, coconuts and pigs and chickens. There is also some minor trade in crocodile skins and meat, Pandanus mats, kwila logs for house posts and occasionally canoe trees are sold.

#### *6.3.3.1 Plant-based commercial activities*

The four most important community-based commercial activities for plant-based natural resources based on income are selling betel nut, sago, surplus garden produce and coconuts. The main source of betel nut is from the inland Orokolo villages and Evara (Ahia language group) where dense stands of the betel nut palm have been planted. Average annual household incomes for these villages exceed PGK 4,000 (US$1,280). Betel nut sales are also important for other villages, particularly the Orokolo (Southeast inland zone) and Ahia villages. Evara

also had the highest annual household income from sago sales, which is sold in 5 or 10 kg blocks. A range of other items derived from natural resources are also commonly sold, including mustard (fruit of the *Piper betel* vine) for chewing with betel nut, mats and small bilums made from Pandanus and occasionally sedge, bush tobacco (Plate 6-15), canoe trees, house posts and rarely copra.

**Plate 6-15 Tobacco and betel nut at Ura village**



Average annual household incomes are provided for the different language groups in Table 6-14 which suggest levels of participation in the cash economy in relation to the sale of community based production of natural resources are uneven, reflecting different levels of surplus and resource availability.

**Table 6-14 Average annual household income (PGK) from important plant based products**

| Language group | Ecological zone | Betel nut | Sago | Garden produce | Coconuts |
|---|---|---|---|---|---|
| Ahia | DSP | 4140 | 3374 | 1800 | - |
| Iare | M | 970 | 940 | 2235 | 820 |
| Iare (Mapaio Fish Camp) | DSP | - | 1740 | 700 | - |
| Kaimare | M | 1436 | 720 | 1300 | 1200 |
| Koriki | M | 563 | 598 | 135 | 400 |
| Koriki | DSP | - | 1056 | 976 | - |
| Maipua | M | 1857 | 651 | 935 | - |
| Orokolo | SECc | 1420 | 650 | 1018 | 1620 |
| Orokolo | SECi | 4996 | 1073 | 720 | 720 |
| Pawaia | MPH + DSP | 2045 | 988 | 803 | 1260 |
| Pawaia (Wabo Station) | MPH | 2291 | - | 4105 | - |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

### *6.3.3.2 Domestic livestock based commercial activities*

## Pigs

Sale of pigs was sometimes mentioned as a significant source of village income Table 6-15), though it always ranked below the sales of garden produce, fish/seafood and sago, e.g., by the coastal Orokolo villages, while in others sale of pigs was not rated at all, e.g., all the inland Orokolo villages. Residents of Apiope (Maipua) mentioned opportunistic sales of domestic pigs to barge crews, and at Evara (Ahia) pig meat is sold at the nearby logging camp. There was only one record of significant annual earnings (PGK 9,360 or US$2,995), by a respondent at Kairimai (Koriki), but this probably relates to the sale of wild pig meat. A summary of commercial pig sales data is provided in Table 6-15.

The low incomes derived from sale of domestic pigs seems at odds with the number of pigs reared in some villages, especially among the coastal Orokolo. However, it is consistent with statements made during village discussions to the effect that the primary value of domestic pigs is not as a commercial resource but as a means of fulfilling customary obligations including bride price, compensation payments and contributions to ceremonial occasions.

**Table 6-15 Income from domestic pigs**

| Language group | Ecological zone | Significant source of income village | Prices for pig meat (PGK) – various quantities | Prices for sale of whole pig (PGK) | Annual earnings (PGK) | Villages rating income from pigs below other sources |
|---|---|---|---|---|---|---|
| Ahia | DSP | No | 120 & 1,000 (Evara) | - | - | No |
| Iare | M | No | - | - | - | - |
| Iare (Mapaio Fish Camp) | DSP | No | 12 | - | - | - |
| Kaimare | M | Yes | 300 (Aiere & Upaia) | - | - | Mariki |
| Koriki | M | No | - | - | - | - |
| Koriki | DSP | Yes | 150 | | 1,820 & 9,360 | Ara'ava |
| Maipua | M | No | - | - | - | Apiope |
| Orokolo | SECc | No | 50 | 300 - 500 | - | Iuku, Mareke, Kavava |
| Orokolo | SECi | No | 50 (Paevera) | - | - | - |
| Pawaia | MPH + DSP | No | 250 (Ura) | - | 3,640 (Ura) | - |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b

## Chickens

The stated importance of chicken sales as a commercial activity varied amongst villages, from no importance to a significant source of income. The household

survey indicated that 8.2% of households in the two weeks prior to the survey sold chickens with average earnings of PGK 44 (US$14). Each chicken probably sells for PGK 10 (US$3.20) and most sales appear to be opportunistic. Only two households reported significant annual earnings from chicken sales, one at Kairu'u (Koriki) with PGK 760 (US$243) and one at Upaia (Kaimare) with PGK 2,400 (US$768). These figures probably reflect efforts by a few households to commercialize the production of chickens, as inferred also from the statistics on flock size.

#### *6.3.3.3 Community-based commercial activities based on hunted and collected animal products*

Residents of all villages engage in some opportunistic sales or exchanges of hunted and collected animal foods with other members of their own or nearby villages. Markets also provide venues for sales of bushmeat (especially wild pig and cassowary), crabs and shellfish. Locally, one of the best opportunities appears to be for supply to the various logging camps and Project barges that enter and exit via the Purari River channels. Other opportunities for sales are outside of the immediate area, including markets at Baimuru and further west in the Kikori River catchment. Bushmeat is usually smoked before transport to the more remote markets, while crabs and shellfish can be transported live.

Sale of bush meat, crabs and shellfish were mentioned as a significant source of income in many of the villages. Particularly in the near-coastal villages, women and youths consistently mentioned crabs and shellfish as one of the major opportunities for them to contribute to family incomes.

The household surveys produced both short- and long-term estimates of the revenue earned from the sale of hunted and collected animal products.

For the two weeks prior to the household survey, the greatest number of sales were of crabs, by 12% of households across the PAOI. Sales of bushmeat were reported by 4% of households, and of 'other river or marine products' (including shellfish) by 1.7% of households. The total revenue earned from sales of bushmeat and crabs were similar but bushmeat returned higher average income (PGK 96 or US$30.72) than crabs (PGK 29 or US$9.28) and 'other' products (PGK 21 or US$6.72). As expected, most sales of crabs and 'other river or marine products' were reported by residents of near-coastal villages. The highest earnings for bushmeat were reported at Evara, with most sales probably made to the nearby logging camp.

Significant annual revenue from bushmeat were reported by only six households with earnings of PGK 50 to PGK 1,820 (US$16.00 to US$582.40) and a total combined revenue across all villages of PGK 5,180 (US$1,657.60) or average of PGK 863 (US$276.16). For crabs, 25 vendors made a combined total of PGK 10,991 (US$3,517.12) or average of PGK 439 (US$140.48). One resident of Paevera village reported revenue of PGK 3,120 (US$998.40) from sales of sago cooked with sago grubs. None of these figures point to any significant widespread commercial gain from sale of bushmeat or other hunted or collected land animal resources. Local opportunities for sale of these foods are probably limited, as most residents have access to adequate resources of their own and

costs involved in travel to regional markets probably deter most potential vendors.

## Crocodiles

The present trade in crocodile skins is based entirely on hunted crocodiles, with only a very few animals held captive in villages across the PAOI. Sales are made either direct to businesses in Port Moresby or through intermediaries who purchase the skins locally and carry them to Port Moresby for resale. Prices depend on the size and quality of the skins but an average sized skin in good condition might be expected to sell for PGK 500 to PGK 600 (US$160 to US$192); animals that have been shot are often damaged and receive lower prices.

Only 9 out of 354 surveyed households reported significant annual sales from crocodile skins. Four of these, with sales of PGK 300 to PGK 800 (US$96 to US$256). The highest revenue was PGK 16,000 (US$5120), which probably derived from sale or 30 or more skins. The total revenue from crocodile skins amounts to annual sales of around 60 skins.

**Table 6-16 Reported annual earnings from the sale of crocodile skins**

| Village | Language group | Ecological zone | Gross income (PGK) | Business costs (PGK) | Profit (PGK) |
|---|---|---|---|---|---|
| Evara | Ahia | DSP | 1,620 | ns | 1,620 |
| Kaevaria | Iare | DSP | 2,800 | 500 | 2,300 |
| Maipenairu | Iare | M | 800 | 288 | 512 |
| Mariki | Kaimare | M | 1,200 | ns | ≤1,200 |
| Apiope | Maipua | M | 1,200 | 400 | 800 |
| Poroi 2 | Pawaia | MPH | 600 | 0 | 600 |
| Poroi 2 | Pawaia | MPH | 300 | 0 | 300 |
| Poroi 3 | Pawaia | MPH | 5,000 | ns | ≤5,000 |
| Wabo | Pawaia | MPH | 5,800 | 1000 | 4,800 |
| Wabo | Pawaia | MPH | 16,000 | ns | ≤16,000 |
| **All vendors** | | | **35,320** | | **≤33,132** |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
ns=not stated.
Source: ERIAS Group 2016b.

## Other animal commercial activities

Mud crab was harvested commercially from the Purari River delta for a short period in the late 1970s to early 1980s. The product was either sent out as live crabs (mainly to the highlands) or as processed (steamed and de-shelled) and frozen crab meat (Haines and Stevens, 1983). Already in 1983, the high cost of air freight to markets was identified as a major impediment to the venture (Stevens, 1980). Management of the venture was taken on in January 1981 by the Department of Primary Industry. Ultimately it failed, but its later history is not publicly reported. Haines and Stevens (1983) alluded to the difficulties of

reconciling a commercial venture of this kind with traditional systems of access to resources and distribution of benefits.

As reported above, the present trade in crocodile skins out of the Purari appears to be infrequent and based entirely on hunted crocodiles. Nevertheless, a few individual households earn significant revenue in this way. The current low level of trade contrasts with the situation in the late 1970s to early 1980s when, bolstered by national emphasis on the 'farming' of crocodiles and assisted by support from a United Nations Development Programme (UNDP)/Food and Agriculture Organization (FAO) project (see Pernetta and Burgin (1983) for details), captive crocodiles were held in 11 Purari villages including Wabo, Avavu, Apiope and Maipenairu. A total of 489 animals counted in 1979 (Pernetta and Burgin, 1983) and the majority of the skins were sold to Evara Trading based in Baimuru, with estimated trade of 20–30 skins per month. Declines in the number of captive crocodiles were already noted in 1983. At its peak, the annual trade in skins probably amounted to 240-360 skins, which, at today's value, would be worth PGK 120 to PGK 216,000 (US$38.40 to US$6,912).

The capture, captive maintenance and occasional sale of wild birds (and potentially of other native wildlife) were mentioned in Section 6.3.3.3. The few examples of such activities that came to light through use of the formal survey implements may not accurately reflect the scale of this trade. During the household survey there was awareness in many villages that some birds are protected under PNG law but a lack of clarity about the extent of such protection and its implications. In some cases, respondents indicated that harvesting of wild birds was performed only for customary usage but others made candid observations regarding the lack of local enforcement to restrict other usages. Bell (2006) mentioned trade in live birds out of the Purari area as one part of an emergent pattern of illegal activities that had developed, almost as an inevitable consequence, along with the regional engagement with the logging and resource development sectors. However, while Bell's perspective rings true in many respects, the trade in wild birds is likely minor.

## 6.4 FISHING AND AQUACULTURE

Where an aquatic resource is obtained most often by hunting and collecting, it is reported under this category rather than under fishing—this includes the aquatic mammals and reptiles (such as dolphins, dugongs, turtles and crocodiles). In common with many other hunted items, these animals also tend to be captured occasionally, whereas the general aim of fishing is to capture numerous individuals of any given kind. The gathering of turtle and crocodile eggs is also more appropriately reported as a result of collecting, as it involves no use of technology and takes place along the edge of the waterways rather than within them.

A significant body of information on the fishes and prawns of the Purari River and its delta was gathered during the 1970s as part of studies for the proposed Purari River (Wabo) Hydroelectric Scheme (Haines, 1978, 1983; Haines and Stevens, 1983; Stevens, 1980; Frusher, 1983; Gwyther, 1983). These studies provide information on the distribution, abundance, diet and breeding biology of numerous species, and represent a significant benchmark for more detailed

studies or monitoring activities in the future. This is particularly relevant in view of the local perception that fisheries stocks have declined over the past decade or so (see Section 6.4.1), as well as the reported evidence that the Purari River catchment has been invaded by a variety of introduced fish species (Haines 1978, 1983; Polhemus et al., 2004; Povlsen, 1993).

Fish in the Purari River catchment are relatively diverse by Papua New Guinea standards but there is a rapid decline in diversity inland from the coast. Haines (1983) listed 143 species from 58 families in the estuarine habitats but only 49 species from 24 families from the freshwater habitats.

Most fished resources are available year-round. However, a few fish species of the marine and estuarine habitats are only seasonally abundant, most notably threadfin salmon in the period April to July. Heavy seas during the period of the southeast trade winds (May to October) restrict fishing access in Orokolo Bay and to the river mouths of the lower Purari River delta.

Fishing activity in the PAOI is carried out primarily for family consumption or with a view to making local sales. Most activity is carried out by individuals or family units and the methods used are largely traditional, albeit with the addition of modern techniques and equipment including gill nets (Plate 6-16) and store-bought fishing line and steel hooks. Fishing is therefore considered to be subsistence and 'artisanal' in nature, rather than commercial, as they depend more on the skill of the individual than they do on the application of technology. Indeed, currently, there appears to be no true commercial fisheries activities operating within the PAOI, although commercial activities operating in the offshore marine environment do impinge in small ways on the economy of coastal villages (see Section 6.4.2).

There were no examples of aquaculture practices observed or noted in any village within the PAOI at the time of SBS surveying.

**Plate 6-16 Gill net fishing in mangroves**



### 6.4.1 Subsistence and artisanal practices

Information on contemporary fishing practices and productivity was obtained from the fauna group discussions, from the community and household surveys and from informal casual discussions and observations made during other survey components. Historical sources are also provided to emphasize changes through time.

Fishing is an important activity in all villages within the PAOI. It is one of the central pillars of the broader subsistence base and represents an important, widely accessible opportunity for income, including sales to staff and employees of various resource sector facilities. A community survey question concerning the motivation for fishing was answered in most villages to the effect that people fished primarily for commercial benefit, with consumption of the catch as a secondary motivation (Table 6-17; this is presented by village rather than by language group to more faithfully depict the variability of responses). However, this widespread response is at odds with data on the low volume of sales and the high frequency of consumption of fished foods (Table 6-18), which together indicate that most of the total catch is consumed within households rather than sold. Several factors probably contribute to this apparent anomaly. One is that many commodities are exchanged under bartering systems (e.g. fish exchanged for sago or garden vegetables) rather than sold for cash. While this would reasonably be regarded as part of a 'commercial' exchange and motivation, the 'cash equivalent' value of these exchanges is almost certainly not captured by the household survey that focused on cash earnings. A second may simply be a difference between hope and reality—a person who goes fishing may be motivated by the hope that they will be able to sell some or all of their catch, while the reality is that most people can catch fish for themselves, or if not, are willing to make do with some other food items.

Apart from along the coast of Orokolo Bay, where much of the activity is focused on the ocean, fishing activities primarily take place not in the main channel of the Purari River, but in its tributaries or in the network of interconnected channels. Because access to these habitats from a village usually involves travel of several hours or more, fishing often takes place in combination with other activities, including sago production and/or hunting. Travel to these locations is usually by paddle canoe and typically involves family groups, with men providing security to women in addition to actively participating in the tasks. Fishing grounds are mostly under customary ownership, although sections of the main channels of the Purari River and the coastal marine resources are said to be available to anyone within the local villages.

A variety of methods are employed, some fully traditional (e.g. use of poison vine (Plate 6-17), funnel traps and scoop nets), and others modified to incorporate new technologies (e.g. use of nylon line and steel hooks). A major contrast with the past is the widespread use across the PAOI of nylon gill nets (usually 5-7" among coastal villages but smaller sizes are now preferred among inland villages due to declining stock). Nets were not in local use prior to the 1940s (Williams, 1940) but were by the mid-1970s (Haines, 1978). In most habitats, gill nets are said to catch more fish for effort than any other method. Although they are in

high demand, ownership is still not extensive; nets are often damaged during use and can be difficult to repair, while new nets are expensive and not readily available. The small outriggers and Y-nets (Plate 6-18) used among the coastal Orokolo villages are traditional methods but today the outriggers are mainly used primarily to set gill nets, and secondarily, to fish in deeper water with hook and line. Several Orokolo Bay fishing practices described by Williams (1940: 18) are now rarely seen—wading in the shallows with bow and arrow and standing with bow and arrow on a platform mounted in the in-shore habitat—both of which were said to be ineffective.

**Plate 6-17 Poison vine used for fishing**



**Plate 6-18 Woman in Orokolo Bay fishing with Y-net**



Results from the household survey provide some insight into contemporary frequencies of use of the various methods in the different villages (Table 6-19). Gill nets, hook and line and scoop nets were all used at similar frequency across all villages, with between 40–60% of households reporting use of each method over the two weeks prior to the survey. Poison vine, an effective traditional method for obtaining fish and other aquatic animals from shallow water-bodies, was used less frequently (usually 10–20% of households) and at a similar rate across all villages. The combined values suggest that most households undertake some fishing activity on most days but that there is no single method that is used daily or even weekly.

Hook and line was marginally the preferred method in almost all villages, two exceptions being the villages in the Maipua and coastal Iare language groups where use of gill nets is slightly more common. Restricted ownership of gill nets probably accounts for some of the variation in use of this method. However, the relatively low value for the use of gill nets in the coastal Orokolo villages (21%) is probably a seasonal effect because the survey took place during season of 'heavy seas' when fishing from outriggers is dangerous. The extent to which any of the other values is influenced by seasonal factors is unknown.

No quantitative data on actual fish catches were obtained during this study. However, data on the regularity of consumption and sale of various kinds of fishes was gathered during the social baseline surveys, and other information on the composition of catches using various methods, was obtained from the ecosystem services interviews. Together, these semi-quantitative datasets suggest strong contrasts in the composition of captures in each of the major environmental zones, with sharks, sawfish and rays, barramundi, threadfin salmon and mullet common in catches in the marine and river mouth habitats, a changeover to dominance of black bass, emperors and many species of catfish in the estuarine and lower freshwater zones, and a major loss of diversity but the addition of eels in the freshwater headwater streams. Prawns are common throughout the system but there is a change in the species of prawns between the freshwater and estuarine and marine habitats. In many of the PAOI villages, people consume prawns more often than they do finfish or sharks (Table 6-20).

Perceptions regarding the adequacy of local fisheries to meet local needs vary among the villages and across the PAOI (Table 6-20). Villagers in Ahia and Koriki villages considered the local resources to be inadequate for their needs, as did some of the Pawaia villages. Irrespective of these formal responses to the community surveys, many people in the PAOI believe that boat and barge activity on the rivers has led to a reduction in fish stocks over the past decade or so, while a subset of people also suspect other factors such as chemical pollution. Many residents of the freshwater sections of the river believe that several fish species have undergone decline in numbers within this habitat, including barramundi and black bass. Over the same period residents report the spread of introduced fish species through the catchment, some of which are now regularly eaten. Additional information on fish population trends for the Purari River is given in the Freshwater and Estuarine Biodiversity Baseline Report (BMT WBM,

2017; Part 5 of ESBS Dossier). Possible impacts of fish disease are discussed in 6.6.2.

## Table 6-17 Motivation for fishing activity

| Village | Language group | Ecological zone | River fish/ shark | River prawn | Marine fish/shark | Marine prawns |
|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | C | C | I>C | - |
| Aivai | Iare | DSP | I>C | I>C | I>C* | - |
| Kaevaria | Iare | DSP | I>C | I>C | EXC | - |
| Mapaio | Iare | DSP | C | - | I>C* | - |
| Aumu | Iare | M | I>C | - | I>C* | - |
| Maipenairu | Iare | M | I>C | I>C | I>C | - |
| Mariki | Kaimare | M | I>C | - | I>C | - |
| Upaia | Kaimare | M | I>C | I>C | I>C | - |
| Ara'ava | Koriki | DSP | C | C | I>C* | - |
| Kairimai | Koriki | DSP | C | C | - | - |
| Akoma | Koriki | M | I>C | I>C | I>C | - |
| Ikinu | Koriki | M | C>I | - | C>I | - |
| Kairu'u | Koriki | M | I>C | I>C | I>C | - |
| Apiope | Maipua | M | I>C | I>C | I>C | - |
| Harevavo | Orokolo | SECc | I>C | I>C | I>C | - |
| Iuku | Orokolo | SECc | I | I | I>C | - |
| Kaivukavu | Orokolo | SECc | I>C | I>C | I>C | I>C |
| Kavava | Orokolo | SECc | I | I | I>C | I>C |
| Larihairu | Orokolo | SECc | I>C | - | I>C | I>C |
| Oru, Lariau, Herakela | Orokolo | SECc | I>C | I>C | I>C | - |
| Marea | Orokolo | SECc | I | - | I>C | - |
| Mareke | Orokolo | SECc | I | - | I>C | I>C |
| Avavu | Orokolo | SECi | I>C | I>C | I>C | - |
| Ere | Orokolo | SECi | I>C | I>C | I>C* | - |
| Hepere | Orokolo | SECi | I>C | I>C | - | - |
| Huruta | Orokolo | SECi | I>C | I>C | I>C* | - |
| Kilavi | Orokolo | SECi | I>C | I>C | I>C* | - |
| Paevera | Orokolo | SECi | I>C | I>C | - | - |
| Poroi 2 | Pawaia | MPH | C | C | - | - |
| Subu | Pawaia | MPH | - | - | - | - |
| Subu2 | Pawaia | MPH | I>C | I>C | - | - |
| Ura | Pawaia | MPH | C | C | - | - |
| Wabo | Pawaia | MPH | I>C | I>C | - | - |

• = Involves travel to coast
I = Income; C = Consumption
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016a.

## Table 6-18 Percentage of households that consumed selected fished foods during the two weeks prior to the household survey and the previous year

| Language group | Ecological zone | n | Two weeks before survey | | | Previous year | | |
|---|---|---|---|---|---|---|---|---|
| | | | Barramundi (%) | Shark (%) | Prawns (%) | Barramundi (%) | Shark (%) | Prawns (%) |
| Ahia | DSP | 14 | 57 | 7 | 93 | 93 | 50 | 86 |
| Iare | DSP | 22 | 50 | 9 | 91 | 77 | 9 | 95 |
| Iare | M | 34 | 50 | 32 | 88 | 79 | 56 | 88 |
| Kaimare | M | 36 | 64 | 53 | 94 | 83 | 86 | 97 |
| Koriki | DSP | 19 | 47 | 11 | 100 | 74 | 16 | 100 |
| Koriki | M | 21 | 57 | 52 | 100 | 71 | 76 | 100 |
| Maipua | M | 16 | 50 | 44 | 81 | 94 | 81 | 81 |
| Orokolo | SECc | 75 | 23 | 85 | 93 | 56 | 96 | 96 |
| Orokolo | SECi | 43 | 35 | 86 | 91 | 47 | 100 | 100 |
| Pawaia | DSP | 5 | 40 | 0 | 60 | 80 | 20 | 60 |
| Pawaia | MPH | 69 | 28 | 1 | 91 | 58 | 7 | 99 |
| **All villages** | | **354** | **40** | **40** | **44** | **92** | **67** | **60** |

n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills Source: ERIAS Group 2016b.

## Table 6-19 Effort devoted to fishing methods on the day before the household survey and the two weeks before the survey (% households)

| Language group | Ecological zone | n | Effort day before survey | | | | Effort two weeks before survey | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Gill net (%) | Hook and line (%) | Scoop nets (%) | Poison vine (%) | Gill net (%) | Hook and line (%) | Scoop nets (%) | Poison vine (%) |
| Ahia | DSP | 28 | 32 | 29 | 39 | 0 | 43 | 71 | 61 | 14 |
| Iare | DSP | 44 | 20 | 39 | 20 | 5 | 43 | 64 | 48 | 14 |
| Iare | M | 68 | 15 | 19 | 16 | 34 | 59 | 54 | 54 | 12 |
| Kaimare | M | 72 | 25 | 21 | 17 | 42 | 53 | 65 | 54 | 15 |
| Koriki | DSP | 38 | 13 | 42 | 29 | 29 | 24 | 66 | 45 | 16 |
| Koriki | M | 42 | 10 | 17 | 14 | 43 | 29 | 57 | 52 | 12 |
| Maipua | M | 32 | 47 | 19 | 9 | 38 | 53 | 44 | 25 | 16 |
| Orokolo | SECc | 150 | 9 | 21 | 15 | 25 | 21 | 49 | 40 | 10 |
| Orokolo | SECi | 86 | 6 | 16 | 10 | 23 | 33 | 52 | 43 | 21 |
| Pawaia | DSP | 10 | 0 | 30 | 10 | 0 | 10 | 50 | 20 | 0 |
| Pawaia | MPH | 138 | 15 | 33 | 18 | 4 | 39 | 70 | 45 | 19 |
| **All villages** | | **708** | **15** | **25** | **17** | **22** | **37** | **59** | **45** | **15** |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills Source: ERIAS Group 2016b

## Table 6-20 Perceptions of local resource status

| Village | Language group | Ecological zone | River fish / shark | River Prawn | Marine fish/shark | Marine prawns |
|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | < | < | > | - |
| Aivai | Iare | DSP | > | > | > | - |
| Kaevaria | Iare | DSP | < or > | > | - | - |
| Mapaio | Iare | DSP | < | - | = | - |
| Aumu | Iare | M | < or > | - | = or > | - |
| Maipenairu | Iare | M | > | > | > | - |
| Mariki | Kaimare | M | > | > | > | - |
| Upaia | Kaimare | M | > | > | > | - |
| Ara'ava | Koriki | DSP | < | < | > | - |
| Kairimai | Koriki | DSP | = | = | - | - |
| Akoma | Koriki | M | < | < | > | - |
| Ikinu | Koriki | M | = | - | = | - |
| Kairu'u | Koriki | M | < | < | < | - |
| Apiope | Maipua | M | = or < | = | < or > | - |
| Harevavo | Orokolo | SECc | > | - | > | - |
| Iuku | Orokolo | SECc | > | > | > | - |
| Kaivukavu | Orokolo | SECc | > | - | > | > |
| Kavava | Orokolo | SECc | = | = | > | > |
| Larihairu | Orokolo | SECc | > | - | - | - |
| Marea | Orokolo | SECc | > | - | > | - |
| Mareke | Orokolo | SECc | - | - | > | > |
| Oru, Lariau, Herakela | Orokolo | SECc | > | < | > | - |
| Avavu | Orokolo | SECi | - | > | - | - |
| Ere | Orokolo | SECi | - | > | > | - |
| Hepere | Orokolo | SECi | > | > | - | - |
| Huruta | Orokolo | SECi | = | - | > | - |
| Kilavi | Orokolo | SECi | > | > | > | - |
| Paevera | Orokolo | SECi | > | > | - | - |
| Poroi 2 | Pawaia | MPH | < | = | - | - |
| Subu | Pawaia | MPH | > | > | - | - |
| Subu2 | Pawaia | MPH | > | > | - | - |
| Ura | Pawaia | MPH | > | > | - | - |
| Wabo | Pawaia | MPH | > | > | - | - |

< = less than needed; equal sign = adequate for needs; > = more than needed; – = no data collected
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016a

## Fishing importance

Traditional fisheries are an important component of subsistence economies throughout the lowlands of Papua New Guinea, and especially so along the major river systems including the Purari, Kikori, Sepik, Ramu and Fly rivers. There appears to be no comparative data on either the productivity of these systems or on the contribution of fishing activities to people's diet, beyond some localized

and short-term studies, mostly carried out decades ago (e.g. Hipsley, 1950; Ulijaszek and Poraituk, 1983).

Fishing is clearly an important activity in all the villages within the PAOI. This represents a departure from the historical pattern reported for both coastal and inland villages (Hipsley, 1950; Williams, 1940; Toft, 1983) in which 'low tech' fishing methods (bow and arrow, poison vine) meant people made little use of the abundant fish resources of the larger waterways. This departure is probably most pronounced for the Pawaia people. The change in emphasis is probably due mainly to the introduction of new technologies including gill nets and more effective hooks and line. However, the cessation of tribal/clan conflict in the region has probably also lead to increased usage of the food resources of the waterways. An example of a successful fishing trip using an outrigger canoe is provided in Plate 6-19.

**Plate 6-19 Fishing catch from Orokolo Bay**



## Division of labor and benefits

The division of labor and benefits associated with fishing can be explored from data collected during the household survey.

All the major methods of fishing are performed by men, women and youths, albeit with varying degrees of emphasis (Table 6-21). In most villages, men make greater use of gill nets and much greater use of poison vine than women. Women make more use of scoop nets and baskets with which they can obtain large numbers of smaller aquatic organisms including crustaceans and fish. Hook and line are used evenly by men and women. The inland Koriki village (Kairimai)

is unusual in having more effort reported by women for all fishing methods. This anomaly only became apparent on analysis of the household questionnaires and any underlying reason is not evident from other data gathered during the survey.

While the scoop nets used preferentially by women are probably more labor intensive and may yield smaller catches than gill nets, they are probably more reliable and may provide a significant proportion of the aquatic protein consumed on a day-to-day basis. Poison vine is also a relatively reliable method and tends to yield small catches.

Data collected on foods eaten on the day prior to the household survey (Table 6-22) shows a tendency for male-biased consumption among the inland villages of scalefish (Iare, Pawaia) and shark (inland Orokolo). There was no female-biased consumption of any fish commodity identified. This pattern is consistent with the results reported by Ulijaszek and Poraituk (1983) for the Purari delta villages of Koravake (Koriki) and Mariki (Kaimare) where men consumed more than their proportional share of fished protein.

#### *6.4.1.1 Aquaculture*

Aquaculture in Papua New Guinea often involves the growing of fish in small village ponds. Such practices are becoming increasing common in the highlands provinces (Haines and Stevens, 1983; Povlsen, 1993). They are far less prevalent in the lowlands where many large fish are readily available in riverine or coastal waters, including feral populations of some of the same species used in highland aquaculture (e.g. Tilapia; West and Glucksman, 1976).

There were no examples of aquaculture practices in the PAOI.

**Table 6-21 Division of labor associated with fishing activities in the two weeks prior to the household survey (% households)**

| Language group | Ecological zone | n | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Gill net | Hook and line | Scoop nets | Poison vine | Gill net | Hook and line | Scoop nets | Poison vine |
| Ahia | DSP | 14 | 43 | 71 | 50 | 29 | 43 | 71 | 71 | 0 |
| Iare | DSP | 22 | 45 | 64 | 45 | 23 | 41 | 64 | 50 | 5 |
| Iare | M | 34 | 65 | 50 | 47 | 24 | 53 | 59 | 62 | 0 |
| Kaimare | M | 36 | 64 | 67 | 53 | 31 | 42 | 64 | 56 | 0 |
| Koriki | DSP | 19 | 16 | 58 | 32 | 26 | 32 | 74 | 58 | 5 |
| Koriki | M | 21 | 33 | 57 | 57 | 24 | 24 | 57 | 48 | 0 |
| Maipua | M | 16 | 63 | 38 | 31 | 25 | 44 | 50 | 19 | 6 |
| Orokolo | SECc | 75 | 27 | 47 | 23 | 19 | 16 | 52 | 57 | 1 |
| Orokolo | SECi | 43 | 30 | 63 | 33 | 42 | 35 | 42 | 53 | 0 |
| Pawaia | DSP | 5 | 20 | 60 | 0 | 0 | 0 | 40 | 40 | 0 |
| Pawaia | MPH | 69 | 41 | 75 | 41 | 33 | 38 | 64 | 49 | 4 |
| **All villages** | | **354** | **40** | **60** | **38** | **27** | **34** | **58** | **53** | **2** |

n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

**Table 6-22 Consumption of fished foods on the day before the household survey (% households)**

| Language group | Ecological zone | n women | n male | Scalefish | | Prawns | | Shark | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Men | Women | Men | Women | Men | Women |
| Ahia | DSP | 3 | 10 | 70 | 67 | 0 | 33 | 0 | 33 |
| Iare | DSP | 6 | 16 | 44 | 17 | 50 | 17 | 0 | 0 |
| Iare | M | 10 | 22 | 41 | 50 | 23 | 20 | 0 | 0 |
| Kaimare | M | 12 | 22 | 86 | 67 | 23 | 0 | 5 | 0 |
| Koriki | DSP | 2 | 17 | 47 | 100 | 35 | 50 | 0 | 0 |
| Koriki | M | 7 | 33 | 55 | 57 | 30 | 14 | 0 | 0 |
| Maipua | M | 8 | 8 | 88 | 88 | 13 | 25 | 0 | 25 |
| Orokolo | SECc | 36 | 46 | 65 | 53 | 22 | 28 | 26 | 33 |
| Orokolo | SECi | 14 | 28 | 36 | 21 | 7 | 7 | 21 | 7 |
| Pawaia | DSP | 3 | 2 | 50 | 0 | 0 | 0 | 0 | 0 |
| Pawaia | MPH | 11 | 58 | 53 | 27 | 29 | 36 | 0 | 0 |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

### 6.4.2 Community-based commercial activities

Residents of all villages engage in some commercial activity, usually involving opportunistic sales or exchanges with other members of their own or nearby villages. Markets also provide venues for sales of fish and prawns but some of the best prospects for sale involve travel to localities outside of the immediate area, including markets at Baimuru and further west in the Kikori catchment. Locally, one of the best opportunities appears to be for supply of the Evara logging camp and to the barges that enter and exit via the Purari channels. Fish is smoked before transport to the more remote markets. Sale of shark fins to Chinese buyers in Kerema and Port Moresby appears to be the only current export of fish products.

Despite the lack of any true commercial fisheries ventures, sale of fish and other seafood products is considered a significant source of income in many of the villages. In four villages, the sale of fish and seafood was ranked first as a source of village income—in the coastal Iare village of Aumu, in the costal Kaimare villages of Mariki and Upaia, and in the inland Koriki village of Ara'ava. In all other villages it was ranked lower, most often behind betel nut, processed sago and garden produce. Nevertheless, women and youths consistently identified fish and other seafood products as one of the major opportunities for them to contribute to family incomes.

The household surveys produced both short and long-term estimates of the revenue earned from the sale of fishery products. For the two weeks prior to the household survey, sales of fish were recorded in 27% of households across the PAOI, prawns in 10% of households, and of 'other river or marine products' (not including shellfish or crabs) in 2.5% of households (Table 6-23). Sales of fish were fairly evenly distributed among the villages, although the coastal Iare, inland Orokolo and some Pawaia villages had lower than average incidences of sales. The average revenue made by vendors during this two-week period was

PGK 63 (US$20.16) for fish, PGK 36 (US$11.52) for prawns and PGK 21 (US$6.72) for 'other products', with individual earnings up to PGK 600, PGK 500 and PGK 40, respectively (US$192, US$160, and US$12.80) (Table 6-24).

Significant annual revenue from fish were recorded in all but a few villages (Table 6-25) with 53% of all households claiming earnings ranging from PGK 360 to PGK 21,600 (US$115.20 to US$6,912). The overall average for all vendors was PGK 1,722, (US$551.04) with 9 of the 27 villages recording above–average earnings. The highest average revenue was recorded at Wabo, followed by among coastal Iare and Ahia villages (noting the Ahia village of Evara is close to the logging camp). The lowest average revenue was recorded at Maipenairu (Iare). The high average at Wabo is inflated by a few highly successful vendors.

**Table 6-23 Two weekly income from sale of fish**

| Village | Language group | Ecological zone | n | % of households that sold fish | Range of income (PGK) | Average income (PGK) |
|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | 14 | 64 | 20-500 | 142.22 |
| Aivai | Iare | DSP | 9 | 33 | 7-70 | 26.80 |
| Kaevaria | Iare | DSP | 10 | 30 | 45-356 | 150.33 |
| Mapaio FC | Iare | DSP | 3 | 0 | - | - |
| Kapai 2 | Iare | M | 16 | 6 | 8 | 8 |
| Maipenairu | Iare | M | 18 | 0 | - | - |
| Aiere | Kaimare | M | 6 | 67 | 20-100 | 36.67 |
| Mariki | Kaimare | M | 17 | 41 | 10-200 | 91.43 |
| Upaia | Kaimare | M | 13 | 46 | 50-100 | 75 |
| Akoma | Koriki | DSP | 11 | 27 | 2-20 | 10.33 |
| Kairimai | Koriki | M | 19 | 32 | 9-50 | 25.83 |
| Kairu'u | Koriki | M | 10 | 40 | 5-120 | 35.25 |
| Apiope | Maipua | M | 16 | 13 | 20-90 | 55 |
| Harevavo | Orokolo | SECc | 30 | 30 | 2-20 | 9.67 |
| Herakela | Orokolo | SECc | 21 | 19 | 15-600 | 233.75 |
| Iuku | Orokolo | SECc | 24 | 50 | 10-30 | 13.12 |
| Ere | Orokolo | SECi | 13 | 54 | 10-75 | 36.43 |
| Kilavi | Orokolo | SECi | 15 | 7 | 91 | 91 |
| Paevera | Orokolo | SECi | 15 | 0 | - | - |
| Poroi 1 | Pawaia | DSP | 5 | 40 | 20-65 | 42.50 |
| Poroi 2 | Pawaia | MPH | 14 | 43 | 10-70 | 30.71 |
| Poroi 3 | Pawaia | MPH | 5 | 20 | 200 | 200 |
| Subu | Pawaia | MPH | 2 | 0 | - | - |
| Subu 2 | Pawaia | MPH | 7 | 0 | - | - |
| Ura | Pawaia | MPH | 12 | 25 | 15-36 | 27.75 |
| Wabo | Pawaia | MPH | 22 | 14 | 10-300 | 18.65 |
| Wabo Station | Pawaia | MPH | 7 | 0 | - | - |
| **All villages** | | | **354** | **27** | **2-600** | **63.29** |

n = no. of households
- = no sales of fish in the two-week period
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills. Source: ERIAS Group 2016b.

## Table 6-24 Two weekly sales of prawns and 'other river/sea products' (excluding shellfish and crabs)

| Village | Language group | Ecological zone | n | Prawns | | | Other river/sea produce | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | % of HH that sold | Range of income (PGK) | Average income (PGK) | % of HH that sold | Range of income (PGK) | Average income (PGK) |
| Evara | Ahia | DSP | 14 | 29 | 16-160 | 88 | - | - | - |
| Aivai | Iare | DSP | 9 | 33 | 2-50 | 23 | - | - | - |
| Kaevaria | Iare | DSP | 10 | 0 | - | - | - | - | - |
| Mapaio FC | Iare | DSP | 3 | 0 | - | - | - | - | - |
| Kapai 2 | Iare | M | 16 | 0 | - | - | - | - | - |
| Maipenairu | Iare | M | 18 | 0 | - | - | - | - | - |
| Aiere | Kaimare | M | 6 | 17 | 30 | 30 | - | - | - |
| Mariki | Kaimare | M | 17 | 0 | - | - | 12 | 20-40 | 30 |
| Upaia | Kaimare | M | 13 | 31 | 20-70 | 38.33 | 8 | 40 | 40 |
| Akoma | Koriki | DSP | 11 | 0 | - | - | 9 | 10 | 10 |
| Kairimai | Koriki | M | 19 | 16 | 5-50 | 27.50 | 5 | 5 | 5 |
| Kairu'u | Koriki | M | 10 | 10 | 3 | 3 | - | - | - |
| Apiope | Maipua | M | 16 | 6 | - | - | - | - | - |
| Harevavo | Orokolo | SECc | 30 | 7 | 5 | 5 | 3 | 8 | 8 |
| Herakela | Orokolo | SECc | 21 | 5 | - | - | 5 | 7 | 7 |
| Iuku | Orokolo | SECc | 24 | 25 | 4-15 | 7.20 | 4 | 30 | 30 |
| Ere | Orokolo | SECi | 13 | 31 | 15-70 | 31.25 | - | - | - |
| Kilavi | Orokolo | SECi | 15 | 0 | - | - | - | - | - |
| Paevera | Orokolo | SECi | 15 | 7 | - | - | - | - | - |
| Poroi 1 | Pawaia | DSP | 5 | 0 | - | - | - | - | - |
| Poroi 2 | Pawaia | MPH | 14 | 0 | - | - | - | - | - |
| Poroi 3 | Pawaia | MPH | 5 | 40 | 500 | 500 | - | - | - |
| Subu | Pawaia | MPH | 2 | 0 | - | - | - | - | - |
| Subu 2 | Pawaia | MPH | 7 | 0 | - | - | - | - | - |
| Ura | Pawaia | MPH | 12 | 8 | 25 | 25 | - | - | - |
| Wabo | Pawaia | MPH | 22 | 14 | 7-10 | 8.50 | 4.5 | 25 | 25 |
| Wabo Station | Pawaia | MPH | 7 | 0 | - | - | - | - | - |
| **All villages** | | | **354** | **10.2** | **354** | **35.51** | **2.5** | **5-40** | **20.56** |

n = no. of households
- = no sales of fish in the two-week period
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills. Source: ERIAS Group 2016b.

## Table 6-25 Annual income from sale of fish

| Village name | Language group | Ecological zone | No of vendors | % of households who sold | Minimum (PGK) | Maximum (PGK) | Average (PGK) |
|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | 13 | 93 | 96 | 10,400 | 2,390 |
| Aivai | Iare | DSP | 7 | 78 | 255 | 10,400 | 3,416 |
| Kaevaria | Iare | DSP | 5 | 50 | 180 | 12,000 | 3,528 |
| Mapaio FC | Iare | DSP | 3 | 100 | 1,750 | 15,300 | 6,284 |
| Kapai 2 | Iare | M | 12 | 75 | 120 | 1,200 | 658 |
| Maipenairu | Iare | M | 12 | 67 | 30 | 2,600 | 1,098 |
| Aiere | Kaimare | M | 6 | 100 | 600 | 4,420 | 1,998 |
| Mariki | Kaimare | M | 16 | 94 | 300 | 6,000 | 2,298 |
| Upaia | Kaimare | M | 12 | 92 | 200 | 5,200 | 2,121 |
| Kairimai | Koriki | DSP | 11 | 58 | 240 | 2,600 | 1,020 |
| Akoma | Koriki | M | 7 | 64 | 60 | 2,600 | 747 |

| Village name | Language group | Ecological zone | No of vendors | % of households who sold | Minimum (PGK) | Maximum (PGK) | Average (PGK) |
|---|---|---|---|---|---|---|---|
| Kairu'u | Koriki | M | 7 | 70 | 260 | 600 | 463 |
| Apiope | Maipua | M | 14 | 88 | 180 | 3,600 | 1,349 |
| Harevavo | Orokolo | SECc | 14 | 47 | 130 | 2,880 | 888 |
| Herekela | Orokolo | SECc | 11 | 52 | 50 | 4,800 | 1,567 |
| Iuku | Orokolo | SECc | 9 | 38 | 240 | 3,600 | 968 |
| Ere | Orokolo | SECi | 1 | 8 | 700 | 700 | 700 |
| Kilavi | Orokolo | SECi | 0 | 0 | - | - | - |
| Paevera | Orokolo | SECi | 0 | 0 | - | - | - |
| Poroi 1 | Pawaia | DSP | 3 | 60 | 480 | 2,400 | 1,760 |
| Poroi 2 | Pawaia | MPH | 8 | 57 | 240 | 2,400 | 809 |
| Poroi 3 | Pawaia | MPH | 1 | 20 | 360 | 360 | 360 |
| Subu | Pawaia | MPH | 0 | 0 | - | - | - |
| Subu2 | Pawaia | MPH | 4 | 57 | 50 | 1,200 | 673 |
| Ura | Pawaia | MPH | 2 | 17 | 50 | 840 | 445 |
| Wabo | Pawaia | MPH | 9 | 41 | 100 | 21,600 | 3,154 |
| Wabo Station | Pawaia | MPH | 0 | 0 | - | - | - |
| **All Villages** | | | **188** | **53** | **0-1,750** | **360-21,600** | **1,722** |

- = no sales of fish in the two-week period
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

### 6.4.3 Government programs/commercial fisheries

Currently there are no government fisheries programs active in the PAOI. A commercial prawn fishing operation has been active in the waters off Orokolo Bay and the mouths of the Purari delta since the early 1970s (Gwyther, 1983). By-catch of fish and sharks is occasionally purchased by residents of Orokolo villages (and possibly others) who take outriggers or dinghies to the fishing vessels and obtain fish either by purchase or exchange for other local products (Plate 6-20).

## 6.5 HUNTING AND COLLECTION

A range of plant and animal resources are harvested/collected/hunted from the landscape of the PAOI. These resources represent the foundation of traditional daily life in the PAOI. They provide essential raw materials for construction of houses, watercraft and many tools, and together with produce from agriculture and fishing, provide the majority of foods consumed within the villages. They also provide many products of medicinal and cultural significance.

The resources available to each village vary according to their location:

- The Pawaia people have access to vast areas of hill forests, the upper reaches of the Purari River and its tributaries, and the PRL-15 oxbow wetlands, each habitat providing a wide range of native plant and animal resources.
- Iare, Ahia, Koriki and Orokolo villages living in the freshwater habitats of the Purari delta and Iare, Koriki, Kaimare and Maipua villages living in the

estuarine zone of the delta, each have access to more restricted suites of habitats and associated resources.

- The coastal Orokolo villages have access to diverse habitats and resources that uniquely includes the foreshore of Orokolo Bay.

Seasonality is strongly expressed for some resources. For example, each September to December two large species of turtle (pig-nosed and soft-shelled) migrate upriver from the marine and estuarine zone to lay their eggs in sand banks in the freshwater reaches of the Purari River and its tributaries, and crocodiles are said to lay their eggs at the same time of year. Seasonal breeding also occurs among many bat species, resulting in marked variations in the numbers to be found in particular cave systems in the PAOI. For some other animal resources, including wild pigs, cassowaries and crocodiles, access varies in accordance with water levels in the Purari system—high water levels restrict access to some areas and resources but improve access to others. Some terrestrial animals including wild pigs and bandicoots are said to become concentrated on elevated ground during and after floods, making them easier to locate.

For this report, the resources obtained from the land are separated from the resources obtained from the river, swamps and oceans. For animal resources, this spatial distinction works better than one based on any contrast between hunting and collecting which are not distinguished either by technology used, by location or timing, or by who undertakes the activity. This lack of distinction is also evident from usage of a single term in Melanesian pidgin—*painim abus* (to find animal foods that can be eaten with a staple such as sago or taro)—to cover these activities. *Painim abus* also accurately portrays the essentially opportunistic nature of most Melanesian hunting and gathering activity. While hunters may enter the bush with particular items in mind (a wild pig or cassowary), any bushmeat secured is usually greatly appreciated by the community.

**Plate 6-20 Dinghy full of by-catch obtained from commercial prawn trawlers**



### 6.5.1 Land resources

The pattern of land use across the PAOI is primarily dictated by customary land boundaries, vegetation types, drainage and flooding affecting access, and population pressure. These factors are discussed in relation to the following land uses.

#### *6.5.1.1 Subsistence agriculture*

There are no formal subsistence agriculture or identifiable land use boundaries other than those determined by the landscape and associated vegetation. Although recent gardens are visible in high-resolution aerial (LiDAR) imagery these do not constitute a specific land use unit but rather a general location where gardens are made. Moreover, gardens on poor soils may be used for as little as four months before being abandoned, resulting in a mosaic of gardens in different stages of development and regenerating forest. As discussed in Section 6.3.1, only in the inland Orokolo area has been extensively disturbed for subsistence agriculture. This area is mapped in Figure 6-9.

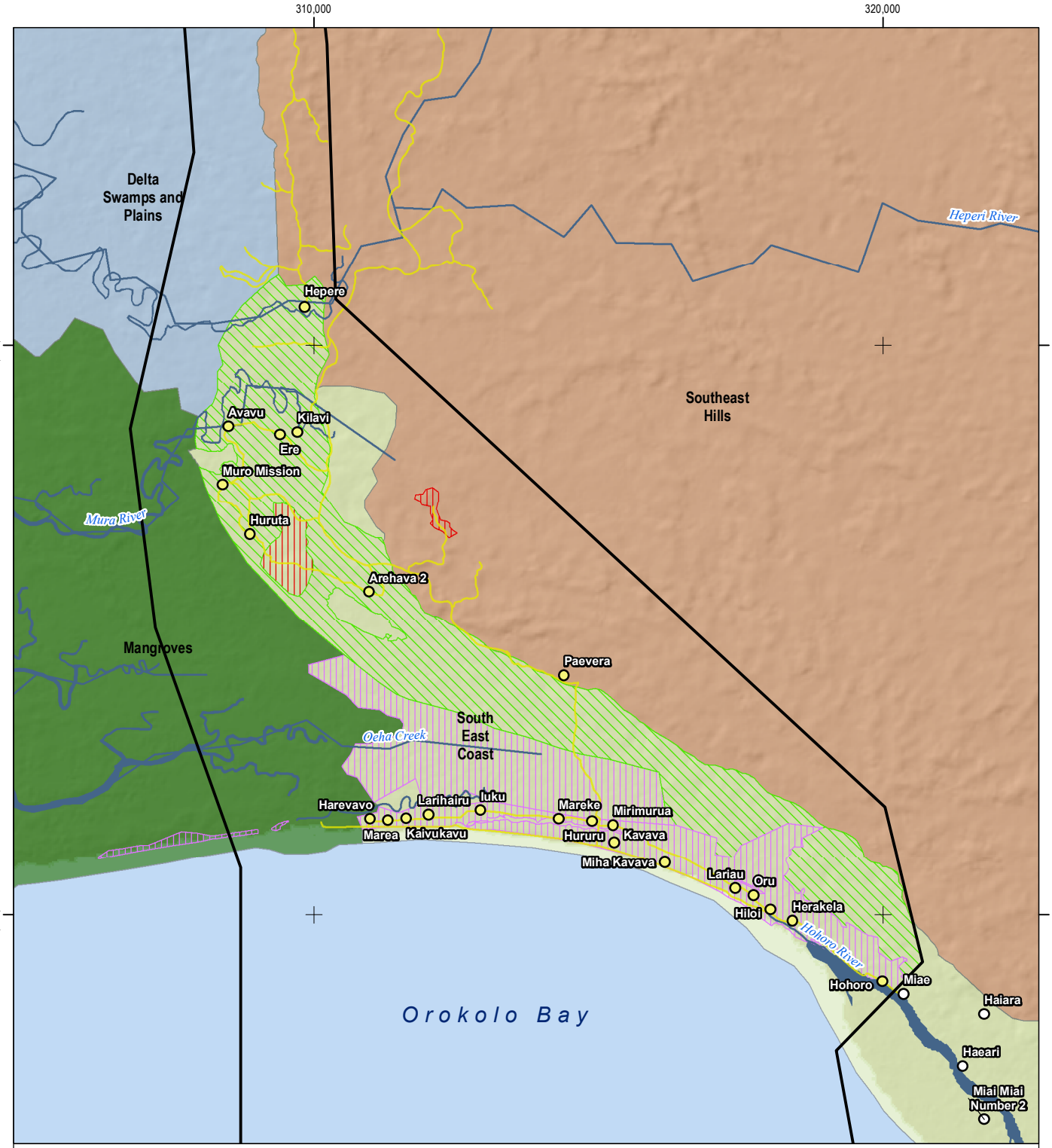
#### *6.5.1.2 Sago production*

Sago production is either from planted sago or from wild stands. Planted sago is grown along river banks, drainage lines and almost any small poorly drained depression in the landscape that is accessible to nearby villages. However, the most extensive areas of planted sago occur across the swales of the beach plains to the north of the coastal Orokolo villages. Further information is provided in Section 6.3.1.3.

#### *6.5.1.3 Collecting resources*

The largest and most diverse use of the land resources is for a variety of provisioning services that are provided from the different vegetation types within the PAOI. These are essential ecosystem services that fall into the following categories:

- Hunting and fishing (including plants used to make hunting and fishing tools, plants that produce seed and fruit that attract animals and are used as hunting sites, plants that produce fish poison).
- Medicinal.
- Construction (plants used in house construction and fencing).
- Food (plants other than garden plants).
- Canoe, paddles and rafts.
- Domestic (brooms, floor mats, containers, washing tools, plant extracts used as shampoo etc.).
- Firewood and torches/matches (only the favored firewood species and plants that smolder that are used to relight fires).
- Cultural (plants used in celebrations, plants used in sorcery, plant dyes, plants used to make bilums and mats and traditional fiber etc.).




**SCALE:** 1:100,000 @ A4

0 1,000 2,000 3,000 4,000 5,000 Metres

**COORDINATE SYSTEM:** PNG94 PNGMG94 Zone 55

**Towns and Villages**
**Language Group**
- E - Orokolo
- Not verified

Tracks
Waterways
Waterbodies
Export pipeline corridor

**SBS Gardens**
- Gardens alluvial forest
- Gardens and sago cultivation
- Gardens hill forest

**Ecological Zones - Upstream**
- Delta swamps and plains
- Mangroves
- South east coast
- Southeast hills

N

*Note, not all Host LLG Communities have been verified in the field.*

# TITLE: Subsistence Agriculture in the Orokolo Coast Hinterland

## FIGURE: 6.9

**PROJECT:** Papua LNG Project

**DOCUMENT NUMBER:** R_097-79662 **REVISION:** B

**DATE:** 11/04/2017

**DATA SOURCES:**
Town and villages, rivers, tracks, export pipeline corridor, hillshade supplied by ERIAS Group and TOTAL (2015-2016).
SBS gardens from Howard Rogers.
Ecological Zones supplied by Iain Woxvold (2016)

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T:\Projects\ERI002 Elk Antelope LNG Project EIS-ESHIA\Work Requests\R_097 - LNR Mapping\ERI002-R_097-79662-Figure 6.9-B.mxd

- High value non-timber forest products (NTFPs) (e.g., Eaglewood).
- Famine resources e.g. sago and wild yams if harvested in drought or if food crops fail due to flooding or disease.

The ecosystems services interviews identified between 48 and 94 plants of use from at least 200 plant species (Appendix E). The dominant plant uses across the PAOI were for house construction, followed by domestic, food and medicinal purposes (Table 6-26). Across the various 'useful plants', trees were the most useful with 580 recorded uses, followed by palms which had 157 uses. Other useful plants had a relatively small number of recorded uses in comparison.

The pattern of resource use by useful plants did not differ substantially amongst the villages based on the plant use percentage for each village (Table 6-27). The main differences were a high percentage use of climbing palms (rattans) by some of the Pawaia villages (Ura and Poroi 2) reflecting the abundance of those plants in the hill forests where they live. Aivai (Iare) and Evara (Ahia) also reported a higher use of climbing palms reflecting the abundance of this resource in the swamp forests of their customary land. In contrast, use of climbing palms was at its lowest in the coastal Orokolo villages reflecting the lower availability or the resource particularly in the intensively used and modified beach ridge and plains landform behind the coastal villages.

The Pawaia villages mostly had a lower percentage use of palms, which probably reflects the wider resource choices they have compared to other locations rather than a lower overall use of palms. Coastal sites in particular have limited availability of forest resources other than mangroves and often substitute the use of trees for house posts for coconut palm posts, which are abundant. This was also common at Aivai (Iare) and Evara (Ahia), particularly if timber from kwila trees, which is preferred for house posts for villages along the lower Purari River (i.e. downstream of Pawaia villages), are in short supply.

**Table 6-26 Records of plant use - all villages**

| | Use | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Canoe | Cultural | Domestic | Food | Firewood | House | Hunting / fishing | Medicinal | Other | |
| Bamboo | - | 1 | 10 | 2 | - | 7 | 3 | - | - | **23** |
| Climber /Vine | 1 | 6 | 12 | 3 | - | 1 | 3 | 8 | - | **34** |
| Climbing palm | - | 2 | 12 | - | - | 14 | 2 | 4 | 1 | **35** |
| Fern | - | 1 | 3 | 12 | - | - | - | 1 | - | **17** |
| Grass | - | | | | - | 1 | 4 | - | - | **5** |
| Herb | - | 4 | 11 | 7 | - | 11 | 2 | 6 | - | **41** |
| Liana | - | | 1 | | - | - | - | - | - | **1** |
| Palm | - | 5 | 31 | 37 | 2 | 59 | 18 | 3 | 2 | **157** |
| Pandanus | - | 1 | 5 | 1 | - | 6 | - | 1 | - | **14** |
| Shrub | - | 6 | 1 | 2 | 4 | 1 | - | 11 | 1 | **26** |
| Tree | 68 | 33 | 38 | 57 | 72 | 232 | 15 | 56 | 9 | **580** |
| Tree fern | - | - | - | 2 | - | - | - | 1 | - | **3** |
| **Total** | **69** | **59** | **124** | **123** | **78** | **332** | **47** | **91** | **13** | **936** |

Source: ERIAS Group 2016c

**Table 6-27 Plant use by village (%)**

| Village | Language Group | Ecological zone | Bamboo | Climber /Vine | Climbing palm | Fern | Grass | Herb | Palm | Pandanus | Shrub | Tree | Tree fern |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aivai | Iare | DSP | 3 | 2 | 5 | 3 | 0 | 5 | 29 | 3 | 3 | 48 | 0 |
| Avavu | Orokolo | SECi | 2 | 4 | 2 | 2 | 0 | 3 | 14 | 2 | 0 | 70 | 0 |
| Evara | Ahia | DSP | 1 | 5 | 5 | 1 | 2 | 3 | 22 | 1 | 0 | 60 | 0 |
| Herekela | Orokolo | SECc | 0 | 0 | 2 | 1 | 0 | 6 | 20 | 0 | 3 | 68 | 0 |
| Iuku | Orokolo | SECc | 0 | 1 | 1 | 4 | 0 | 5 | 19 | 4 | 10 | 55 | 0 |
| Larihairu | Orokolo | SECc | 5 | 1 | 1 | 3 | 0 | 5 | 16 | 0 | 8 | 61 | 0 |
| Paevera | Orokolo | SECi | 7 | 3 | 1 | 0 | 0 | 4 | 24 | 0 | 6 | 53 | 0 |
| Poroi | Pawaia | DSP | 1 | 6 | 8 | 1 | 1 | 6 | 12 | 0 | 0 | 63 | 1 |
| Subu 2 | Pawaia | MPH | 4 | 3 | 10 | 1 | 1 | 9 | 13 | 2 | 0 | 55 | 1 |
| Ura | Pawaia | MPH | 0 | 10 | 0 | 0 | 0 | 0 | 10 | 4 | 2 | 71 | 2 |
| Wabo | Pawaia | MPH | 2 | 5 | 5 | 2 | 1 | 1 | 11 | 2 | 0 | 70 | 0 |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016c

### *6.5.1.4 Community resource importance and characterization*

Surveys and interviews with village respondents emphasized that all forest resources are of high value, and rarely was a particular resource considered more important than another. This reflects the predominantly subsistence livelihoods of most villages and the high value of predominantly forest based resources for their livelihoods. However, despite the lack of a clear hierarchy of resource importance based on community interview responses, the following generalizations can be made.

**House building materials**

House posts are the most important part of the house since the quality (durability) of the posts will determine how long the house lasts before a complete rebuild is required. It typically takes two to four months to build a house depending on labor available to assist, therefore having a durable house is of high importance to minimize the frequency of house rebuilding. For villages downstream of the Pawaia people's territory, kwila is the preferred house post because of its strength and resistance to decay. A high proportion of the kwila is harvested from swamp forests near the Purari River.

The Pawaia mostly have access to hill forest which supports a greater diversity of tree species compared to the alluvial forests and provides several species that can be used for house posts including rosewood and malas. The only other village to use several different species for house posts was Evara (Ahia), which has access to extensive alluvial and hill forest resources. Downstream from Evara, kwila, rosewood and mangrove cedar were commonly used. When these species are in short supply coconut palms and the trunk of the Okari nut are used. From Aivai (Iare) downstream, kwila and coconut palm stems were the preferred timbers for house posts, however coconuts were only being used because kwila was increasingly in short supply or had to be purchased from villages such as Aumu (Iare) which had a small trade in kwila post sales.

Mangroves were also occasionally used, particularly mangrove cedar, although it was not the preferred species.

Most other house building materials (bearers, rafters, studs and wall materials) were relatively abundant including thatch for the roof. Roofing thatch was made from the leaves of sago palms or nipa palms only, depending on what resource was available locally. Nipa palms are only available in tidal areas and are mostly used in the coastal villages and inland Orokolo villages (e.g., Avavu) that have access to mangrove villages via waterways. The inland Orokolo village of Paevera has no waterways so uses sago palm thatch only.

### Canoe trees

Dugout canoes are the main form of transport for most villages in the PAOIs except for inland villages such as Paevera where there is no navigable waterway. Moreover, the coastal Orokolo villages travel by motorized dinghy along the coast but still use dugout canoes for coastal and waterway fishing, collecting mud crabs and shellfish from the mangroves. Canoe ownership data from the household surveys (Table 6-28) indicates the importance of canoes across the PAOI with individual households owning between one and five canoes suggesting widespread demand for canoe trees. Outboard motors used on the larger canoes and dinghies were also widely owned across the PAOI. For the riverways villages, the outboard motors are mostly used on large canoes but for the coastal villages outboards are mostly used on dinghies for ocean travel. The prevalence of outboard motors throughout the inland villages indicates the importance and ongoing demand for the very large canoe trees.

Villages that require canoes have a preference for the species of canoe tree, which was similar amongst the villages (Appendix D). The most widespread canoe species is a light timber that is easy to hollow out but has low durability due to attack by insect borers. There are at least 27 species of canoe tree all of which are important species. A canoe tree is of higher value when located close to a waterway due to the reduced labor required to drag the finished canoe to a waterway. However, at Wabo, canoe trees were being harvested over 1 km from a major waterway in hill forest. Once constructed, the canoe was dragged down a steep slope to a small creek where it was dragged/floated to a navigable waterway. Notably, residents of the inland Orokolo village of Paevera also value canoe trees, which canoe tree owners sell to members of other villages that no longer have this resource locally available.

## Table 6-28 Canoe ownership for the PAOI responses (%)

| Village | Language group | Eco zone | n | No. of canoes (%) | | | | | | | | | No. of outboard motors (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 |
| Evara | Ahia | DSP | 14 | 14 | 36 | 36 | 7 | | 7 | | | | 57 | 43 | | | | |
| Aivai | Iare | DSP | 9 | 22 | 44 | 22 | | | 11 | | | | 67 | 33 | | | | |
| Kaevaria | Iare | DSP | 10 | 20 | 50 | 10 | 20 | | | | | | 90 | | | | 10 | |
| Mapaio FC | Iare | DSP | 3 | | 67 | | | 33 | | | | | 33 | 67 | | | | |
| Kapai 2 | Iare | M | 16 | 19 | 44 | 6 | 6 | 19 | 6 | | | | 75 | 19 | 6 | | | |
| Maipenairu | Iare | M | 18 | 17 | 22 | 22 | 17 | 17 | 6 | | | | 72 | 17 | 6 | 6 | | |
| Aiere | Kaimare | M | 6 | | 50 | 17 | 17 | 17 | | | | | 83 | 17 | | | | |
| Mariki | Kaimare | M | 17 | 18 | 35 | 41 | 6 | | | | | | 76 | 18 | 6 | | | |
| Upaia | Kaimare | M | 13 | 8 | | 46 | 15 | 23 | 8 | | | | 77 | 23 | | | | |
| Kairimai | Koriki | DSP | 19 | 21 | 37 | 37 | | 5 | | | | | 74 | 26 | | | | |
| Akoma | Koriki | M | 11 | 18 | 18 | 36 | 18 | | 9 | | | | 100 | | | | | |
| Kairu'u | Koriki | M | 10 | | 30 | 30 | 20 | 10 | 10 | | | | 90 | | 10 | | | |
| Apiope | Maipua | M | 16 | 13 | 44 | 6 | 6 | 25 | 6 | | | | 75 | 19 | 6 | | | |
| Harevavo | Orokolo | SECc | 30 | 47 | 30 | 13 | 3 | 7 | | | | | 97 | 3 | | | | |
| Herekela | Orokolo | SECc | 21 | 67 | 24 | 10 | | | | | | | 81 | 14 | 5 | | | |
| Iuku | Orokolo | SECc | 24 | 83 | 8 | 4 | 4 | | | | | | 92 | 8 | | | | |
| Ere | Orokolo | SECi | 13 | 23 | 38 | 38 | | | | | | | 77 | 23 | | | | |
| Kilavi | Orokolo | SECi | 15 | 47 | 47 | 7 | | | | | | | 93 | 7 | | | | |
| Paevera | Orokolo | SECi | 15 | 100 | | | | | | | | | 100 | | | | | |
| Poroi 1 | Pawaia | DSP | 5 | 20 | 60 | 20 | | | | | | | 80 | | 20 | | | |
| Poroi 2 | Pawaia | MPH | 14 | 36 | 14 | 21 | 21 | 7 | | | | | 57 | 36 | | | | 7 |
| Poroi 3 | Pawaia | MPH | 5 | 20 | 40 | 40 | | | | | | | 80 | 20 | | | | |
| Subu | Pawaia | MPH | 2 | | 50 | | 50 | | | | | | 50 | 50 | | | | |
| Subu2 | Pawaia | MPH | 7 | 14 | 29 | 14 | 14 | 29 | | | | | 29 | 71 | | | | |
| Ura | Pawaia | MPH | 12 | 33 | 25 | 25 | 8 | 8 | | | | | 67 | 33 | | | | |
| Wabo | Pawaia | MPH | 22 | 14 | 14 | 41 | 23 | 5 | | | | 5 | 73 | 23 | 5 | | | |
| Wabo Station | Pawaia | MPH | 7 | 71 | 29 | | | | | | | | 71 | 29 | | | | |

n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills Source: ERIAS Group 2016b.

## Medicinal plants

Medicinal plants are widely used across the PAOI and are reportedly used for cuts and wounds, skin diseases and sores, respiratory infections, general body pain, toothache and malaria. From field inspections, 58 species of medicinal plant were recorded. Higher numbers of medicinal uses were recorded for the Pawaia villages (Wabo, Ura, Subu 2 and Poroi 2) than other villages, which could reflect a greater reliance or better current knowledge of medicinal plants.

Use of medicinal plants frequently involves the use of inner tree bark, which is scraped, masticated and applied, or sap extracted, heated and applied. Many of the tree barks have milky latex exudates with a range of uses. Alternatively, medicinal leaves are crushed heated and the steam vapour inhaled. Most medicinal plants were relatively common and could be collected within nearby

forested areas, including disturbed forest and regrowth. A list of medicinal plants is provided in the plant resource tables in Appendix E.

## Firewood

Firewood is an essential resource for cooking food throughout the PAOI and Papua New Guinea where 85% of the population of the country, including some urban areas rely on firewood for domestic and commercial cooking, utilising approximately 1.8 $m^3$ per person per year (Page *et al.*, 2016). Almost any species of tree can be used for firewood in the PAOI provided it is dry, however there are several species, which are preferred. A total of 36 species of tree and one shrub were identified as important firewood species including a range of mangroves and strangling figs and common trees that occur in hill forest, alluvial forest and swamp forest. Occasionally, coconut shells and the shells of the Okari nut are also used for firewood when available. A list of firewood trees is provided in the plant resource tables in Appendix E**.**

Firewood is collected from as close to the village or hunting/garden hut as possible to minimize carrying the wood to the point of use. Frequently firewood is collected from trees cleared to make new gardens and from secondary forests close to the village. However, residents of Ura (Pawaia) also collect firewood from the river banks and the coastal Orokolo villages collect driftwood from the beach (Plate 6-21). Community members from Kaivukavu (coastal Orokolo) collected nearly all their firewood from the beach. However, firewood collection along the beach is subject to clan ownership restrictions and frequent disputes arise over ownership of beach firewood in the coastal Orokolo villages.

Firewood collection is a labor-intensive task. For the Pawaia, typically 1 – 2 days each week are spent collecting firewood. Large firewood logs are floated along the river by canoe to the village for use. Firewood is also harvested by women on the way back from garden maintenance. Up to one hour a day would be spent collecting firewood on return from a nearby garden. Time estimates for firewood collection from a selection of villages is as follows:

- Aivai (Iare): 3 – 4 hours a few days each week.
- Avavu (inland Orokolo): 1 day/week.
- Herekela (coastal Orokolo): 2 hours/week.
- Iuku (coastal Orokolo): 2 hours/day.
- Larihairu (coastal Orokolo): 1 day/week but occasionally long firewood collections trips are undertaken of up to one week.

**Plate 6-21 Firewood collected from the beach**



## Food plants

The primarily forested landscape of the PAOI provides at least 46 species of plant that are used as a supplementary food to sago and garden food crops. Trees and palms have the most uses, reflecting edible nuts, fruit and leaves. Grass and tree ferns had the lowest number of food uses across all the villages.

There are a number of relatively common trees that are important for fruit or nut production. These trees are widespread across hill forest, alluvial forest and to a lesser extent swamp forest. They are mostly absent from mangroves, however the mangroves of the delta are dominated by a nipa palm that produces abundant edible starchy nuts each year. These are seasonally available for the communities in the Mangrove ecological zone. The number of recorded uses is provided in Table 6-29 and a list of food plants is provided in the plant resource tables in Appendix E.

## Domestic uses

A total of 49 plants were recorded as used for domestic purposes. The main uses included:

- Use of palm inflorescences and palm leaf rachis for brooms.
- Use of large leaved herbs and Pandanus leaves to wrap food (particularly sago, meat and fish) prior to cooking.
- Canes and bark for use as rope (where use in house construction had not been specified) for tying bundles of firewood, hauling canoes from construction point to river, for tethering pigs etc.

- Axe handles and sago pounder handles made from the stem of a palm.
- Sections of bamboo for use as a traditional cooking pot.

The most widely used plants (recorded from most of the villages assessed) were bamboo, palm, rattan, and a particular tree (*Trichospermum)*. These were recorded in seven or more of the 11 villages assessed. A cane called *Calamus* is used as a cane rope, often in house building, the bark fibres of *Trichospermum* are used to make rope, the bark is also peeled off and placed under heavy logs to reduce friction when pulling kwila logs to a river to be floated to a village, and the trunk is used as a raft to prevent heavy logs sinking when being rafted to a village.

Resources for domestic uses were mostly obtained from forested environments but also planted resources such as bamboo, which is widely planted by the coastal Orokolo villages. There was no clear distinction in domestic uses amongst the villages other than coastal villages had access to mangrove-specific resources such as the stilt roots of the mangrove tree, which is used as a sago pounder. A list of domestic plants is provided in the plant resource tables in Appendix E.

**Table 6-29 Number of recorded uses of different plants by village**

| Life form | Aivai | Avavu | Evara | Herekela | Iuku | Larihairu | Paevera | Poroi | Subu | Ura | Wabo | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bamboo | 2 | 2 | 1 | - | - | 4 | 7 | 1 | 4 | - | 2 | **23** |
| Climber/Vine | 1 | 4 | 4 | - | 1 | 1 | 3 | 6 | 3 | 5 | 4 | **32** |
| Climbing palm | 3 | 2 | 4 | 2 | 1 | 1 | 1 | 8 | 9 | - | 4 | **35** |
| Fern | 2 | 2 | 1 | 1 | 3 | 2 | - | 1 | 1 | - | 2 | **15** |
| Grass | - | - | 2 | - | - | - | - | 1 | 1 | - | 1 | **5** |
| Herb | 3 | 3 | 3 | 5 | 4 | 4 | 4 | 6 | 8 | - | 1 | **41** |
| Palm | 19 | 13 | 19 | 17 | 15 | 13 | 23 | 11 | 12 | 5 | 10 | **157** |
| Pandanus | 2 | 2 | 1 | - | 3 | - | - | - | 2 | 2 | 2 | **14** |
| Shrub | 2 | - | - | 3 | 8 | 6 | 6 | - | - | 1 | - | **26** |
| Tree | 32 | 65 | 52 | 59 | 43 | 48 | 47 | 60 | 50 | 34 | 62 | **552** |
| Tree fern | - | - | - | - | - | - | - | 1 | 1 | 1 | - | **3** |
| **Total** | **66** | **93** | **87** | **87** | **78** | **79** | **91** | **95** | **91** | **48** | **88** | **903** |

Source: ERIAS Group 2016c.

## Cultural uses

The PAOI provides a wide range of flora resources that have cultural uses[16], many of which are common throughout Papua New Guinea and some of which are possibly specific to a language group or village. The forests (hill and alluvial) provide the greatest range of cultural plants simply because they are species rich ecosystems compared to relatively low diversity swamps and grasslands.

[16] For this study cultural uses refers to plants that were believed to have magical properties, used in ceremonies and to dye ceremonial plants, plants used to make traditional items such as bilums and mats.

The dominant plant uses were for use in celebrations, as narcotics or involved in the use of narcotics, and sorcery (Table 6-30). 'Celebrations' refers to plants used to decorate villages or bodies, to welcome guests or for traditional singsings. Narcotics refers to the use of betel nut substitutes and associated items, home grown tobacco and plants used as stimulants for hunting dogs to improve their performance. Sorcery refers to plants that were reported to have magical properties that improve garden crop yield, attract a partner by casting a spell over them, plants that drive away evil spirits, and plants such as the leaf of the Sui'i tree that women from the Pawaia village Ura, use to get rid of the second wife by placing the leaf under the husband's pillow.

Respondents often noted that there was less knowledge and use of cultural plants that had magical properties, particularly amongst the younger generations, and that much of the knowledge is likely to be lost. However, the Pawaia people appeared to have much stronger knowledge of both the traditional names and uses of plants across all generations than other language groups, however often the knowledge remained with the village elders only.

The full list of plants and associated uses are provided in Appendix E.

**Table 6-30 Cultural uses of plant resources**

| Cultural use | % of plant resources |
|---|---|
| Bilum – A string bag made by hand in PNG | 6 |
| Celebration | 20 |
| Carving | 2 |
| Dye | 14 |
| Instrument | 2 |
| Mat | 4 |
| Narcotic | 22 |
| Sorcery | 24 |
| Tapa cloth – A decorated cloth made from beaten bark of the paper mulberry tree | 6 |

Source: ERIAS Group 2016c.

#### *6.5.1.5 Hunting and collecting of land animal resources*

An extremely broad range of provisioning ecosystem services are obtained from land animals which are acquired through hunting and collecting activities. This includes many kinds of vertebrates and invertebrates, and for some of these, eggs and larvae also. The distribution of these resources across the diverse habitats of the PAOI is summarized in Appendix F.

As already noted in Section 6.5, most animal products are viewed in two ways:

- something that can be eaten to satisfy family needs.
- something that might generate revenue from sales.

Most villages across the PAOI cited 'income (I)' (i.e. commercial opportunity) as the primary motivation for hunting and collecting of land animals, with 'consumption (C)' as a secondary motivation (Table 6-31). Exceptions included the inland Orokolo villages, the near-coastal Kaimare and Koriki villages, and several of the Pawaia villages where consumption was cited as the primary or even the sole motivation.

## Table 6-31 Motivation for hunting and collecting of land animal resources

| Village | Language group | Ecological zone | Wild pig | Wallaby | Cassowary | Cuscus | Bandicoot | Monitors* / Python(p) | Bush fowl | Birds incl. Gouria (g) | Flying fox |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | C>I | I | C>I | - | I | - | I | - | - |
| Aivai | Iare | DSP | I>C | I>C | - | I>C | I>C | - | - | - | - |
| Kaevaria | Iare | DSP | I>C | - | I>C | C | - | - | - | C | - |
| Mapaio | Iare | DSP | I>C | - | I>C | I>C | I>C | I>C | - | - | - |
| Aumu | Iare | M | I>C | - | I>C | - | I>C | I>C | I>C | - | - |
| Maipenairu | Iare | M | I>C | - | - | I>C | I>C | I>C | I>C | - | - |
| Mariki | Kaimare | M | - | - | - | - | - | - | - | - | - |
| Upaia | Kaimare | M | C | - | - | C | C | C | C | | - |
| Ara'ava | Koriki | DSP | I>C | - | I>C | - | I | - | - | I | I |
| Kairimai | Koriki | DSP | I>C | - | I>C | - | | - | - | I>C | - |
| Akoma | Koriki | M | C | - | C | C | C | C | - | - | - |
| Ikinu | Koriki | M | C | - | - | C | C | C | C | - | - |
| Kairu'u | Koriki | M | C | - | C | C | C | C | - | - | - |
| Apiope | Maipua | M | I>C | - | - | I>C | C | C | C | - | - |
| Harevavo | Orokolo | SECc | I>C | | - | I>C | I>C | I>C | I>C | - | - |
| Iuku | Orokolo | SECc | I>C | I>C | I>C | I>C | I>C | - | - | - | - |
| Kaivukavu | Orokolo | SECc | I>C | | I>C | I>C | I>C | I>C | - | - | - |
| Kavava | Orokolo | SECc | I>C | I>C | I>C | I>C | I>C | - | - | - | - |
| Larihairu | Orokolo | SECc | I>C | - | I>C | I>C | I>C | - | - | I>C | - |
| Marea | Orokolo | SECc | C>I | - | C>I | - | C>I | C>I | - | C>I | - |
| Mareke | Orokolo | SECc | I>C | I>C | I>C | - | I>C | - | - | I>C | - |
| Oru, Lariau, Herakela | Orokolo | SECc | I>C | I>C | I>C | I>C | - | - | I>C | - | - |
| Avavu | Orokolo | SECi | I>C | - | I>C | I>C | I>C | I>C | - | - | - |
| Ere | Orokolo | SECi | I>C | I>C | I>C | I>C | - | I>Cp | - | - | - |
| Hepere | Orokolo | SECi | C | C | C | C | C | - | - | - | - |
| Huruta | Orokolo | SECi | C | C | C | - | C | - | - | C | - |
| Kilavi | Orokolo | SECi | I>C | I>C | I>C | I>C | - | I>Cp | - | - | - |
| Paevera | Orokolo | SECi | C | C | C | C | - | - | - | C | - |
| Poroi 2 | Pawaia | MPH | C>I | I | C>I | I | - | I | - | - | - |
| Subu | Pawaia | MPH | - | - | - | - | - | - | - | - | - |
| Subu 2 | Pawaia | MPH | I>C | - | I>C | I>C | - | - | I>C | I>C | - |
| Ura | Pawaia | MPH | C | C | C | C | C | - | - | - | - |
| Wabo | Pawaia | MPH | C | - | C | C | C | - | - | C | - |

C = Consumption; I = Income
* = Monitor lizards
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group, 2016b

Most of the methods used today are similar to those described in regional historical sources, albeit with the occasional addition of some modern items of equipment including guns. Accordingly, it is considered that the money-earning aspect of these activities is 'artisanal' in nature rather than commercial, as it

depends more on the skill of the individual than it does on the application of technology. Indeed, currently, there appears to be no true commercial hunting or collecting activities operating within the PAOI. One reason given for this was the difficulty in gaining legal access to a gun; the household survey recorded gun ownership (1 or 2 guns; legality not questioned) by only 15 out of 354 or 4% of households across the entire PAOI, with most of these held in Iare, Orokolo and Pawaia villages. Guns were said to be most useful for hunting wild pigs, cassowaries and crocodiles, although damage caused by use of a shotgun to the skin of a crocodile limits their usefulness for this purpose.

The methods used for hunting and collecting are essentially the same across the entire PAOI and a collective description can be given here. Five categories of methods can be usefully distinguished as they tend to produce different suites of returns.

**Active pursuit** comes closest to a western notion of 'hunting'. It typically involves travel across the landscape by one or a few people, usually on foot, in the hope that a substantial game animal such as a wild pig, wallaby or cassowary will be encountered and can be run down or shot (with bow and arrow or gun). Because larger game animals are usually only found at distance from areas of regular human traffic, this kind of activity generally involves travel away from a village and it is often combined with travel away from a village for other reasons such as fishing or the manufacture of sago.

Active pursuit of terrestrial game is most productive when the party is assisted by one or more trained dogs. Hunting dogs are the domestic dog, *canis familiaris*, but there are many different mixes of breeds due to interbreeding of the traditional New Guinea village breed with other kinds introduced by Europeans. A well-trained dog can locate game animals by scent and sound and may also assist by running the animal to ground. Dogs will also locate and flush smaller game including bandicoots, ground birds and pythons, and can identify trees that are occupied by cuscuses and other arboreal animals. Hunting with dogs is usually carried out during the day but sometimes also at night, generally only if a torch is available. Less commonly a person will stalk game animals without the assistance of dogs, hoping to get close enough to shoot or club them. Dog ownership ranged from 36 – 92% of households in the surveyed villages, with no strong pattern by language group or ecological context; many households reported owning multiple dogs. Hunting dogs are owned and used through the PAOI, and represent a valued commodity.

Some active pursuit is done from a canoe, usually after dark and with torches. The major targets are aquatic animals (crocodiles and turtles). Some tree-dwelling mammals such as spotted cuscus and flying foxes can be located asleep in tree tops by day or at night with use of a torch. Spotted cuscus is especially abundant in the mangrove habitat.

Active pursuit of small birds is often carried out by groups of children and youths armed with bow and arrow or more recently, with a sling shot. This clearly represents a training behavior but the returns can represent a significant contribution to a family's dietary intake.

**Ambush** involves waiting patiently at a location that game animals are known to frequent. Local examples include waiting at the base of a fruiting fig tree that is visited by bandicoots or ground birds, and sitting on a platform in a fruiting or flowing tree visited by cuscuses and flying foxes. Ambush is also used along trails traveled regularly by larger game such as pigs, wallabies and cassowaries.

**Snaring** involves the setting of noose snares or deadfall traps. These are of traditional design but today often include wire or nylon rope in their manufacture. Snares and traps can be scaled up or down to target animals from the size of rats and bandicoots to wild pigs, wallabies and cassowaries. Small snares and traps are often set close to villages and are checked regularly. Larger snares and traps are more commonly set at sago plantations or near remote gardens; these are activated during residence at these localities. Setting of snares and traps is an individual or family group activity.

**Harvesting** involves the collecting of animal resources at localities where they are known to occur in regular numbers or to congregate naturally. Most examples involve the collection by hand of aquatic or marine organisms including crabs, shellfish including gastropods, bivalves and oysters, and mangrove worms (Teredinidae). Turtle eggs are collected in September to December at the interface of the land and waterways. Land resources include sago grubs harvested from felled trunks, other beetle larvae extracted from standing or fallen trees, and eggs of scrub fowl and brush turkeys. Bats (both small and large) are also harvested: from caves and rock overhangs where they occur either year-round or during breeding seasons, and from seasonal 'camps' in the case of flying foxes that congregate for social and breeding purposes. Harvesting of the larger bats sometimes involves use of special techniques, including the construction of barricades across a cave mouth, or the felling of trees at a flying fox camp. All harvesting activities can be carried out as an individual but some including the harvesting of cave-roosting fruit bats is more often a group activity.

**Chance encounters** occur during a wide range of other activities including travel, clearing and maintenance of gardens, and collecting of other forest products. Animals that are more typically collected under these circumstances include rats, lizards, snakes, frogs and tadpoles, small birds and their eggs, and slugs, grubs, grasshoppers, spiders, moths and caterpillars, and beetle larvae. Although some people in the PAOI regard the consumption of these 'lesser' kinds of *abus* as a thing of the past, in most villages they remain valued and important components of total dietary protein intake.

Results from the household survey provide some insight into the effort devoted to hunting and collecting of land animal resources in the different villages (Table 6-32). Harvesting of eggs at the time of the survey probably referred mainly to scrub turkey and brush fowl eggs as the survey was done outside of the freshwater turtle egg season. The results suggest that, on any given day, only a small proportion of households in the PAOI (5–6% overall for any particular method) undertake some kind of hunting or collecting activity aimed at land resources. However, there is considerable variation between villages, most notably among villages living in the freshwater part of the delta (e.g. >10% Ahia, inland Iare and Orokolo) who devote more effort to these activities than either

the near-coastal or the Pawaia villages further inland. However, even in these villages no single method is used so often that it would rate as a daily or even a weekly activity for all members of any village.

Hunting with dogs and/or bow and setting of traps were used in approximately equal frequency across all villages. Harvesting of eggs was less commonly done except among villages living in the freshwater part of the delta (e.g. Ahia, inland Iare and inland Koriki).

**Table 6-32 Effort devoted to various hunting and collecting methods on the day before and for the two weeks before the household survey (% of households)**

| Language group | Ecological zone | n | Day before household survey | | | Two weeks before household survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Hunting with dogs or bow (%) | Setting traps (%) | Harvesting eggs (%) | Hunting with dogs or bow (%) | Setting traps (%) | Harvesting eggs (%) |
| Ahia | DSP | 28 | 11 | 4 | 11 | 32 | 29 | 14 |
| Iare | DSP | 44 | 16 | 14 | 16 | 27 | 27 | 21 |
| Iare | M | 68 | 6 | 2 | 1 | 13 | 7 | 6 |
| Kaimare | M | 72 | 0 | 1 | 9 | 10 | 10 | 9 |
| Koriki | DSP | 38 | 18 | 13 | 13 | 21 | 18 | 11 |
| Koriki | M | 42 | 5 | 0 | 0 | 7 | 7 | 5 |
| Maipua | M | 32 | 0 | 3 | 6 | 6 | 6 | 6 |
| Orokolo | SECc | 150 | 2 | 3 | 1 | 10 | 11 | 1 |
| Orokolo | SECi | 86 | 10 | 13 | 5 | 18 | 27 | 7 |
| Pawaia | DSP | 10 | 0 | 0 | 0 | 10 | 0 | 0 |
| Pawaia | MPH | 138 | 5 | 8 | 3 | 31 | 19 | 8 |
| **All Villages** | | **708** | **6** | **6** | **5** | **17** | **16** | **7** |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

Data on hunted and collected land animals consumed in each of the households recorded by the household survey shows strong contrasts between villages in different parts of the PAOI. This data pertains to three time periods—the two weeks prior to the household survey (Table 6-33A) and the preceding year (Table 6-33B), and the day immediately before the survey (Table 6-34; this dataset is available for each gender). Consumption of the larger game animals (wild pigs, cassowaries, wallabies, pythons) occurred more frequently in the inland villages than the near coastal villages. However, monitor lizards (monitors), bandicoots and cuscuses were consumed more evenly across all villages, as were sago grubs and scrub turkey and brush fowl (meat and eggs). Sago grubs were consumed in a greater proportion of households than any other land animal resource in the past two weeks and was second only to wild pig in the Pawaia villages in the past year.

## Table 6-33 Consumption of selected hunted and collected land animal resources A: during the two weeks prior to the household survey and B: during the previous year (% of households)

A: Two weeks prior to the household survey

| Language group | Ecological zone | Wild pig | Cassowary | Wallaby | Cuscus/ bandicoot | Flying Fox | Python | Monitor | Bush fowl meat/ eggs | Sago grubs | Honey[17] | No. of surveys |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahia | DSP | 57 | 50 | 50 | 50 | 64 | 29 | 43 | 50 | 79 | 21 | 14 |
| Iare | DSP | 68 | 46 | 27 | 18 | 27 | 5 | - | 59 | 73 | 5 | 22 |
| Iare | M | 18 | - | - | 32 | 15 | 9 | 6 | 21 | 62 | - | 34 |
| Kaimare | M | 25 | - | - | 28 | - | - | 14 | 28 | 64 | 5 | 36 |
| Koriki | DSP | 47 | 53 | - | 42 | 5 | - | 16 | 58 | 95 | 11 | 19 |
| Koriki | M | 24 | 5 | - | 14 | 5 | - | 19 | 52 | 81 | - | 21 |
| Maipua | M | 6 | - | - | 13 | - | - | 6 | 31 | 38 | - | 16 |
| Orokolo | SECc | 13 | 3 | 1 | 24 | 12 | 9 | 21 | 19 | 76 | 4 | 75 |
| Orokolo | SECi | 72 | 30 | 23 | 53 | 23 | 28 | 35 | 47 | 98 | 11 | 43 |
| Pawaia | DSP | 100 | - | - | - | - | - | - | 20 | 20 | - | 5 |
| Pawaia | MPH | 70 | 55 | 38 | 48 | 51 | 51 | 39 | 22 | 70 | 14 | 69 |
| **All villages** | | **42** | **23** | **14** | **34** | **21** | **18** | **22** | **32** | **73** | **7** | **354** |

B: Year prior to the household survey

| Language group | Ecological zone | Wild pig | Cassowary | Wallaby | Cuscus/ bandicoot | Flying fox | Python | Monitor | Bush fowl meat/eggs | Sago grubs | Honey | No. of surveys |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahia | DSP | 93 | 71 | 86 | 79 | 86 | 36 | 71 | 93 | 93 | 21 | 14 |
| Iare | DSP | 91 | 73 | 32 | 41 | 37 | 5 | 23 | 86 | 82 | 5 | 22 |
| Iare | M | 53 | 3 | 3 | 62 | 23 | 12 | 15 | 71 | 80 | 3 | 34 |
| Kaimare | M | 70 | 11 | 8 | 50 | 5 | 6 | 41 | 59 | 72 | 20 | 36 |
| Koriki | DSP | 95 | 74 | 11 | 63 | 26 | 21 | 42 | 89 | 100 | 16 | 19 |
| Koriki | M | 81 | 14 | - | 53 | 19 | 5 | 28 | 81 | 91 | - | 21 |
| Maipua | M | 25 | 19 | 6 | 31 | - | - | 25 | 63 | 75 | - | 16 |
| Orokolo | SECc | 49 | 23 | 23 | 48 | 33 | 15 | 37 | 37 | 89 | 15 | 75 |
| Orokolo | SECi | 100 | 63 | 46 | 84 | 47 | 65 | 74 | 84 | 98 | 30 | 43 |
| Pawaia | DSP | 80 | 20 | 60 | 20 | - | - | - | 100 | 40 | 20 | 5 |
| Pawaia | MPH | 91 | 81 | 68 | 80 | 81 | 77 | 75 | 65 | 90 | 48 | 69 |
| **All villages** | | **74** | **43** | **32** | **61** | **40** | **31** | **47** | **66** | **87** | **21** | **354** |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills Source: ERIAS Group 2016b.

[17] Honey is included as a land animal resource as it is made by bees and therefore an animal product

The fact that most consumption rates for land animal resources fall around or below 50% over a two-week period, yet consumption rates increase notably in a 12-month period, suggests these food items are consumed commonly but not frequently. This is further borne out by data on the consumption of food items on the day immediately preceding the household survey (Table 6-34), which shows that 125 land animal food items were consumed by a total of 347 respondents. Furthermore, these were heavily weighted towards the inland villages, with very few of the residents of any coastal villages reporting the consumption of land animal products.

**Table 6-34 Consumption of land animal foods on the day before the household survey (% of households)**

| Language group | Ecological zone | Men | | | Women | | |
|---|---|---|---|---|---|---|---|
| | | Number of households surveyed | Items of land animal food consumed | Consumption rate of land animal food | Number of households surveyed | Items of land animal food consumed | Consumption rate of land animal food |
| Ahia | DSP | 10 | 1 | 10% | 3 | 2 | 67% |
| Iare | DSP | 9 | 8 | 89% | 4 | 1 | 25% |
| Iare | M | 22 | 5 | 23% | 10 | 0 | 0 |
| Kaimare | M | 22 | 2 | 9% | 12 | 0 | 0 |
| Koriki | DSP | 17 | 19 | 112% | 2 | 0 | 0 |
| Koriki | M | 16 | 0 | 0 | 5 | 0 | 0 |
| Maipua | M | 8 | 0 | 0 | 8 | 2 | 25% |
| Orokolo | SECc | 46 | 10 | 22% | 28 | 5 | 18% |
| Orokolo | SECi | 28 | 6 | 21% | 14 | 6 | 43% |
| Pawaia | DSP | 2 | 0 | 0 | 3 | 0 | 0 |
| Pawaia | MPH | 58 | 56 | 97% | 11 | 3 | 27% |
| **All villages** | | **245** | **110** | **45%** | **102** | **15** | **15%** |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Note: The number of responses can exceed the number of households.
Source: ERIAS 2016b

Perceptions regarding the adequacy of particular land animal resources to meet local needs vary among the villages and across the PAOI (Table 6–35). Most villages considered the resources to be sufficient or to exceed their needs. However, the Ahia village at Evara rated all items as below their needs and cited the disturbance caused by logging activities as the cause; however, from informal discussions with Ahia field assistants it also seems likely that proximity to the Evara logging camp has increased the market demand for items such as wild pig and cassowary meat, which in turn has led to overexploitation of large game in the area around the village. Residents of most of the coastal Orokolo villages also rated all items as below their needs; this is probably a result of long-term overexploitation of large game resources in this densely settled area, possibly combined with an increased market demand.

## Table 6-35 Perceptions of the adequacy of supply of hunted and collected land animal resources

| Village | Language group | Ecological zone | Wild pig | Wallaby | Cassowary | Cuscus | Bandicoot | Monitors*/ Python(p) | Bush fowl | Birds incl. Gouria (g) | Flying fox |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | < | < | < | - | < | - | < | - | - |
| Aivai | Iare | DSP | > | > | > | > | > | - | - | - | - |
| Kaevaria | Iare | DSP | = | - | = | = | - | = | - | - | - |
| Mapaio | Iare | DSP | = | - | = | = | = | - | - | - | - |
| Aumu | Iare | M | > | - | < | - | > | > | > | - | - |
| Maipenairu | Iare | M | = | - | - | = | = | = | = | - | - |
| Mariki | Kaimare | M | - | - | - | - | - | - | - | - | - |
| Upaia | Kaimare | M | = | - | - | = | = | = | = | - | - |
| Ara'ava | Koriki | DSP | > | - | > | - | = | - | - | = | = |
| Kairimai | Koriki | DSP | = | - | = | - | - | - | - | > | - |
| Akoma | Koriki | M | < | - | < | - | < | - | - | - | - |
| Ikinu | Koriki | M | = | - | - | = | - | - | - | - | - |
| Kairu'u | Koriki | M | < | - | < | - | < | - | - | - | - |
| Apiope | Maipua | M | = | - | - | - | = | = | = | - | - |
| Harevavo | Orokolo | SECc | = | - | - | = | = | = | = | - | - |
| Iuku | Orokolo | SECc | = | = | = | = | = | - | - | - | - |
| Kaivukavu | Orokolo | SECc | < | < | - | < | - | < | - | - | - |
| Kavava | Orokolo | SECc | > | - | < | < | < | < | - | - | - |
| Larihairu | Orokolo | SECc | < | - | < | < | < | - | - | < | - |
| Marea | Orokolo | SECc | > | - | > | - | > | - | - | > | - |
| Mareke | Orokolo | SECc | < | < | < | - | < | - | - | < | - |
| Oru, Lariau, Herakela | Orokolo | SECc | = | = | = | = | - | - | = | - | - |
| Avavu | Orokolo | SECi | = | - | = | > | = | = | - | - | - |
| Ere | Orokolo | SECi | > | > | > | > | - | >p | - | - | - |
| Hepere | Orokolo | SECi | = | = | = | = | = | - | - | <g | - |
| Huruta | Orokolo | SECi | < | < | < | - | < | - | - | - | - |
| Kilavi | Orokolo | SECi | > | > | > | > | - | >p | - | - | - |
| Paevera | Orokolo | SECi | = | = | = | = | - | - | - | = | - |
| Poroi 2 | Pawaia | MPH | > | = | > | = | = | = | - | - | - |
| Subu | Pawaia | MPH | - | - | - | - | - | - | - | - | - |
| Subu2 | Pawaia | MPH | > | - | > | > | > | - | - | > | - |
| Ura | Pawaia | MPH | = | = | = | = | = | - | - | - | - |
| Wabo | Pawaia | MPH | = | - | = | = | = | - | - | = | - |

p = python; g = gouria
* = Monitor lizards
< - less than needed; = - adequate for needs; > - more than needed.
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016a.

### 6.5.2 Hunting and collecting of river and coastal animal provisioning ecosystem services

A broad range of animal resources are acquired through hunting and collecting activities in and along the larger rivers and channels of the Purari system. Among the most important of these are the two species of crocodiles (freshwater and saltwater), various kinds of turtles, a river dolphin (the Australian Snubfin Dolphin) found mainly in the estuarine zone, a variety of mollusks that occur in many environments, and various crabs including the large and locally abundant mud crab (Plate 6-22). Additional resources are concentrated in the lower reaches of the system or in the beach-front habitat, including mangrove worms and crabs, and various small clams, oysters and mussels that are often collected after storm activity. The distribution of these resources across the diverse habitats of the PAOI is summarized in Appendix F.

**Plate 6-22 Mud crab and sago in Mariki village**



Some of the river and coastal animal resources are available only seasonally. The most significant seasonal resources are the eggs of two large estuarine turtles (soft-shelled and pig-nosed) that migrate upriver in September through to December to lay their eggs in sandbanks in the freshwater reaches of the Purari catchment. These migrations are much-anticipated and careful watch is kept on suitable places along the main river channel and its tributaries to identify egg-laying sites. The adults as well as the eggs are collected by inland residents at this time of year but the adults are available year-round in the estuarine and coastal habitats, with captures made in gill nets, by hook and line, or by spearing them from canoes.

Residents of inland villages also reported that crocodiles (likely freshwater) lay their eggs primarily during September to December; these are laid in leaf nests

constructed along river banks and around the margins of swamps and lagoons. Although the nests are attended by male crocodiles, these can be driven off or killed to gain access to the eggs. Few residents in the near-coastal villages in the PAOI mentioned seasonality of resource, although harvesting the eggs is probably too dangerous at any time of year.

Access to some riverine resources is influenced by flooding of the freshwater sections of the Purari River (and tributaries) or by heavy seas in the case of the coastal region. The latter is predictable and associated with the southeast trade winds but upriver flooding can occur at any time, as it is driven by rainfall in the Purari headwaters.

Marine turtles are encountered only infrequently in the Purari River system and there were no reports of egg-laying activity in this area. All mentions of 'turtles' refer specifically to the estuarine soft-shelled and pig-nosed turtles.

As already noted in relation to other resources, most animal products are viewed as commodities that can either be eaten to satisfy family needs or sold to generate revenue. The motivations cited for hunting and collecting of river and marine animals are quite mixed among the villages. However, 'income' rated above 'consumption' as a motivation in most cases for all resources and was always stated to be so for shellfish and crabs (Table 6-36). Exceptions included the inland Iare village of Kaevaria and the Pawaia village of Ura; in both villages consumption was cited as the sole motivation for pursuing any of these resources. As noted above in relation to the motivation for fishing, this widespread response is at odds with data on the low volume of sales (Section 6.4.1) and the moderately high frequency of consumption of many hunted and collected foods (see below), which together indicate that most of the total catch of riverine and coastal foods obtained by hunting and collecting is consumed by the households rather than sold. At one Iare and one Koriki village, turtles and/or crocodiles were said to be pursued for cultural reasons as well as income generation.

**Table 6-36 Motivation for hunting and collecting of aquatic animal resources**

| Village | Language group | Ecological zone | River turtle | Marine turtle | Turtle eggs | Crocodile | Crocodile eggs | River mudfish | Crabs | Shellfish | Mussels | Oysters | Mangrove worms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | I>C | | C>I | I>C | | | I>C | I>C | I>C | | |
| Aivai | Iare | DSP | I>C | | I>C | I>C | | | I>C | I>C | | | |
| Kaevaria | Iare | DSP | C | - | C | C | C | | | | | | |
| Mapaio | Iare | DSP | I>C | | I>C | I>C | | | I>C | I>C | | | |
| Aumu | Iare | M | I>Cu | I>Cu | C | I>Cu | | | | | I>C | | |
| Maipenai ru | Iare | M | C | I>C* | | I>C | | I>C | I>C | I>C | | I>C | |
| Mariki | Kaimare | M | C | | | I>C | | | I>C | I>C | | I>C | I>C |

| Village | Language group | Ecological zone | River turtle | Marine turtle | Turtle eggs | Crocodile | Crocodile eggs | River mudfish | Crabs | Shellfish | Mussels | Oysters | Mangrove worms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upaia | Kaimare | M | | C | C | I>C | | | I>C | I>C | | I>C | |
| Ara'ava | Koriki | DSP | C | | | I>C | | I>C | I>C | I>C | I>C | | |
| Kairimai | Koriki | DSP | I>C | | I>C | I>Cu | I>C | | I>C | I>C | | | |
| Akoma | Koriki | M | C | - | | I>C | | | I>C | I>C | | | |
| Ikinu | Koriki | M | | I>C | C | I>C | | C>I | I>C | I>C | | | |
| Kairu'u | Koriki | M | C | C | | I>C | | | I>C | I>C | | | |
| Apiope | Maipua | M | | I>C | I>C | I>C | | | I>C | I | I>C | | |
| Harevavo | Orokolo | SECc | C | | | C | | | | I>C | I>C | | I>C |
| Iuku | Orokolo | SECc | C | | | | | | | I>C | I>C | | |
| Kaivukavu | Orokolo | SECc | C | | | I>C | | | I>C | I>C | | I>C | |
| Kavava | Orokolo | SECc | | | | | | | | I>C | | | |
| Larihairu | Orokolo | SECc | | | | | | | | I>C | | | |
| Marea | Orokolo | SECc | I>C | | I>C | | | | I>C | | | | |
| Mareke | Orokolo | SECc | I | I | - | - | - | - | I>C | I>C | I>C | - | - |
| Oru, Lariau, Herakela | Orokolo | SECc | I>C | - | I>C | - | - | - | I>C | I>C | - | - | - |
| Avavu | Orokolo | SECi | I>C | - | - | I>C | - | - | I>C | I>C | I>C | - | - |
| Ere | Orokolo | SECi | I>C | - | - | I>C | - | - | - | I>C | I>C | - | - |
| Hepere | Orokolo | SECi | C | - | - | I>C | - | - | - | - | - | - | - |
| Huruta | Orokolo | SECi | I>C | - | - | I>C | - | I>C | - | I>C | - | I>C | - |
| Kilavi | Orokolo | SECi | I>C | - | - | I>C | - | - | - | I>C | I>C | - | - |
| Paevera | Orokolo | SECi | C | - | I>C | I>C | C | - | - | - | - | - | - |
| Poroi 2 | Pawaia | MPH | - | - | C>I | C>I | C>I | - | - | - | - | - | - |
| Subu2 | Pawaia | MPH | C | - | I>C | I>C | I>C | - | - | - | - | - | - |
| Ura | Pawaia | MPH | C | - | C | C | C | - | - | - | - | - | - |
| Wabo | Pawaia | MPH | I>C | - | I>C | I>C | C | - | - | - | - | - | - |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
I – Income; C – Consumption; Cu – Cultural; * - involves travel to coastal locations

The methods used for hunting and collecting of aquatic resources are essentially the same across the entire PAOI and a collective description can be given here. Most of the riverine and coastal resources are harvested by individuals or family groups that visit a place where the resource occurs. Overharvesting is a risk and people often mentioned avoiding localities that were becoming depleted to allow populations to rebuild.

Crocodiles are one of the few riverine and coastal resources that are hunted, although a significant number of captures of smaller crocodiles also occurs during use of gill nets. Currently, few households engage in regular crocodile hunting. One reason given for this was the difficulty in gaining legal access to a gun, as described previously. At any rate, it appears that many more crocodiles are consumed locally than enter the market as skins.

Soft-shelled and pig-nosed turtles are actively pursued by inland villages during the months in which they migrate upstream to lay eggs. Active pursuit at night assists with the location of eggs as well as the capture of the adult turtles. However, the eggs can sometimes be located by the distinctive tracks the turtles leave behind on sandbanks.

Results from the household survey provide some insight into the effort devoted to collecting aquatic animal resources in the different villages (Table 6-37). Collecting of crabs and shellfish is clearly a very regular activity among members of all villages in the Purari delta, including both the marine and lower reaches of the freshwater zones (36 to 76% of households over two weeks), though it is of minimal importance among residents of the more inland Ahia, Iare and Pawaia villages (0 to 5%).

Data on the rate of consumption of collected aquatic animal resources shows a strong contrast between villages in different parts of the PAOI (Table 6-38). Crabs and shellfish were consumed by the majority of men and women in the coastal villages (usually >75% of households over the two-week period) but much less regularly (usually <25%) by residents of the inland Ahia, Iare and Pawaia villages. The rate of consumption of these resources is high in these inland villages compared with the reported rates of harvesting; the likely explanation is that a large proportion of the crab and shellfish consumed by residents of the inland villages is sourced by exchange or purchase with residents of the coastal villages.

Given that the household survey was conducted outside of the turtle and freshwater crocodile eggs season, the reported values for turtle and crocodile commodities can be assumed to be consumption of meat rather than eggs. The values are surprisingly high—13% and 17%, respectively, across all villages and for the two-week period—and essentially similar in all villages. This is of particular interest in the case of crocodiles as the killing and consumption of 60 crocodiles during a two-week period by a total of 354 households spread across the PAOI implies a very high culling rate across the wider region. Many of these are probably small individuals caught in gill nets or collected by hand, so the figures do not necessarily equate with potential lost revenue from unexploited skins.

**Table 6-37 Effort devoted to collecting aquatic resources the day before and for the two weeks before the household survey (% of households)**

| Language group | Ecological zone | n | Day before survey | | Two weeks before survey | |
|---|---|---|---|---|---|---|
| | | | Collecting crabs/ shellfish | Other animal foods | Collecting crabs/ shellfish | Other animal foods |
| Ahia | DSP | 28 | 0 | 7 | 0 | 21 |
| Iare | DSP | 44 | 0 | 11 | 5 | 27 |
| Iare | M | 68 | 33 | 0 | 57 | 10 |
| Kaimare | M | 72 | 29 | 0 | 75 | 26 |
| Koriki | DSP | 38 | 8 | 11 | 32 | 26 |
| Koriki | M | 42 | 12 | 0 | 76 | 19 |
| Maipua | M | 32 | 22 | 0 | 53 | 16 |
| Orokolo | SECc | 150 | 11 | 4 | 44 | 23 |
| Orokolo | SECi | 86 | 8 | 10 | 36 | 38 |
| Pawaia | DSP | 10 | 0 | 0 | 0 | 0 |
| Pawaia | MPH | 138 | 1 | 12 | 4 | 35 |
| All villages | | 708 | 12 | 6 | 36 | 26 |

DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

The fact that consumption rates for mud crabs and shellfish fall just under 70% over a two-week period suggest these food items are consumed regularly but perhaps not frequently. This is further borne out by data on the consumption of food items on the day immediately preceding the household survey (Table 6-38), which shows that 152 aquatic animal food items were consumed by a total of 347 respondents. As noted above, this consumption was weighted towards the near-coastal villages where 50 – 100% of men and 20 – 100% of women reported the consumption of crabs and/or shellfish animal products.

Perceptions regarding the adequacy of particular land animal resources to meet local needs vary among the villages and across the PAOI (Table 6-39). Most villages considered the crab and shellfish resources to be sufficient or to exceed their needs. However, turtle and crocodile resources were rated more variably and with no obvious pattern related to language groups or ecological context. Notably, given this variability elsewhere, Pawaia villages were unanimous that both turtle (i.e. the seasonal breeding population) and resident crocodile resources were adequate for their needs.

## Table 6-38 Consumption of selected hunted and collected aquatic resources during the two weeks prior to the household survey and the previous year (% of households)

| Language group | Ecological zone | n | Two weeks before survey | | | | Year before survey | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Turtle meat/ eggs | Crocodile meat/ eggs | Mud crabs | Shellfish | Turtle meat/ eggs | Crocodile meat/ eggs | Mud crabs | Shellfish |
| Ahia | DSP | 14 | 29 | 7 | 21 | 21 | 79 | 86 | 64 | 71 |
| Iare | DSP | 22 | 14 | 18 | 41 | 46 | 68 | 59 | 55 | 59 |
| Iare | M | 34 | 18 | 12 | 88 | 79 | 56 | 50 | 88 | 88 |
| Kaimare | M | 36 | 14 | 22 | 97 | 97 | 72 | 75 | 97 | 100 |
| Koriki | DSP | 19 | 16 | 16 | 74 | 100 | 63 | 84 | 89 | 100 |
| Koriki | M | 21 | 5 | 10 | 100 | 100 | 62 | 62 | 100 | 100 |
| Maipua | M | 16 | 13 | 6 | 81 | 75 | 56 | 56 | 81 | 81 |
| Orokolo | SECc | 75 | 9 | 9 | 92 | 89 | 32 | 32 | 96 | 97 |
| Orokolo | SECi | 43 | 7 | 18 | 88 | 84 | 51 | 79 | 95 | 95 |
| Pawaia | DSP | 5 | 0 | 0 | 0 | 20 | 80 | 0 | 40 | 20 |
| Pawaia | MPH | 69 | 14 | 30 | 16 | 11 | 74 | 84 | 49 | 42 |
| **All villages** | | **354** | **13** | **17** | **69** | **68** | **58** | **63** | **81** | **81** |

n = no. of households
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016b.

## Table 6-39 Perceptions of the adequacy of supply of hunted and collected aquatic animal resources

| Village | Language group | Ecological zone | Turtles | Turtle eggs | Crocodiles | Crocodile eggs | River Mudfish | River crabs | Shellfish | Mussels | Oysters | Crabs | Mangrove worms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | < | > | < | > | - | - | > | > | - | > | - |
| Aivai | Iare | DSP | > | > | > | | > | - | > | - | - | > | - |
| Kaevaria | Iare | DSP | > | = | > | > | - | - | | - | - | - | - |
| Mapaio | Iare | DSP | > | < | > | - | - | - | = | | - | = | - |
| Aumu | Iare | M | = | > | > | - | - | - | > | > | - | - | - |
| Maipenairu | Iare | M | < | - | < | - | > | - | > | - | > | > | - |
| Mariki | Kaimare | M | < | - | = | - | - | - | - | - | - | - | - |
| Upaia | Kaimare | M | < | < | > | - | - | - | - | - | > | > | - |
| Ara'ava | Koriki | DSP | < | > | < | - | > | - | > | > | - | > | - |
| Kairimai | Koriki | DSP | = | > | < | > | - | - | > | > | - | > | - |
| Akoma | Koriki | M | < | - | < | - | < | - | > | - | - | > | - |

| Village | Language group | Ecological zone | Turtles | Turtle eggs | Crocodiles | Crocodile eggs | River Mudfish | River crabs | Shellfish | Mussels | Oysters | Crabs | Mangrove worms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ikinu | Koriki | M | < | < | - | - | = | - | = | - | - | = | - |
| Kairu'u | Koriki | M | < | - | > | - | < | - | > | - | - | > | - |
| Apiope | Maipua | M | = | > | = | - | - | - | > | < | - | > | - |
| Harevavo | Orokolo | SECc | - | - | - | - | - | - | > | - | - | > | > |
| Iuku | Orokolo | SECc | - | = | - | - | - | - | < | - | - | | - |
| Kaivukavu | Orokolo | SECc | - | - | - | - | - | - | > | - | - | > | - |
| Kavava | Orokolo | SECc | - | - | - | - | - | - | > | - | > | > | > |
| Larihairu | Orokolo | SECc | > | - | - | - | - | > | > | - | - | > | - |
| Marea | Orokolo | SECc | > | > | - | - | > | - | - | - | - | > | - |
| Mareke | Orokolo | SECc | - | - | - | - | - | - | - | - | > | > | > |
| Oru, Lariau, Herakela | Orokolo | SECc | < | > | - | - | - | - | > | - | - | - | - |
| Avavu | Orokolo | SECi | > | - | > | - | - | - | > | > | - | > | - |
| Ere | Orokolo | SECi | = | > | = | - | > | - | > | > | - | > | - |
| Hepere | Orokolo | SECi | = | > | = | = | - | - | > | - | - | > | - |
| Huruta | Orokolo | SECi | > | - | > | - | - | - | > | - | - | > | - |
| Kilavi | Orokolo | SECi | = | > | = | - | > | - | > | > | - | > | - |
| Paevera | Orokolo | SECi | = | > | = | = | > | - | - | - | - | - | - |
| Poroi 2 | Pawaia | MPH | - | > | - | = | - | - | - | - | - | - | - |
| Subu | Pawaia | MPH | - | - | - | - | - | - | - | - | - | - | - |
| Subu2 | Pawaia | MPH | = | > | = | > | - | - | - | - | - | - | - |
| Ura | Pawaia | MPH | = | > | = | - | - | - | - | - | - | - | - |
| Wabo | Pawaia | MPH | > | > | - | - | - | - | - | - | - | - | - |

I – Income; C – Consumption; Cu – Cultural.
< - less than needed; = - adequate for needs; > - more than needed.
DSP = Delta Swamp Plains, M = Mangroves, SH = Southeast Hills, SECc = Southeast Coast (coastal), SECi = Southeast Coast (inland), DSP = Delta Swamps and Plains, MPH = Middle Purari Hills
Source: ERIAS Group 2016a.

#### *6.5.2.1 Importance of hunted and collected river and coastal animal resources*

The contribution of hunted and collected aquatic animals to overall diet and nutrition has not been widely quantified among Papua New Guinea societies. Among the few examples, the most relevant are Rhoads' (1980, Appendix 5) data on food consumption patterns at Waira village near Kikori Station on the middle Kikori River and Kari's (1977) study of shellfish utilization among coastal villages around Kerema.

The Kikori study, conducted over a period of more than 12 months, documented average household consumption of turtles and other aquatic animal foods (apart from fish) on fewer than 2.5 days per 100. The ecology around Rhoads' study site is probably most similar to that of the Pawaia villages in the Purari system and his data are broadly consistent with the present results. The Kerema study

did not present any quantitative data but nonetheless makes it clear that harvested shellfish were of primary importance in the coastal subsistence systems. Even more remotely in time, the studies of Hipsley (1950) and Hamilton (1955) in the Koriki village at Koravage present the same overall picture of people heavily reliant on shellfish and crab resources for the bulk of their regular protein intake.

Set against this broader comparative context, albeit limited in detail, the strong reliance on aquatic animal resources among coastal villages in the PAOI is clearly part of a wider regional pattern that pertains across the Gulf of Papua. Similarly, the limited usage (and partly seasonal nature) of aquatic resources (other than fish) by inland PAOI villages also has parallels elsewhere across the region.

#### *6.5.2.2 Division of labor and benefits*

Collecting river and coastal animal resources is performed by members of both sexes. In most villages men and women perform these tasks at more or less even frequency. However, where there are exceptions, as observed for the Kaimare, coastal Koriki and inland Orokolo, where men more often perform the tasks.

The pattern of consumption of land animal resources by men and women was recorded for the day preceding the household survey. In all villages where crabs and shellfish were eaten, men and women consumed them at similar rates, with no obvious pattern to the variation.

### 6.5.3 Commercial uses

For land resources, large scale forestry is the main commercial use in the PAOI.

There are two logging concessions, known as FMAs that overlap the PAOI, Vailala Block 3 and Baimuru Block 3 (Table 6-40), of which only Vailala Block 3 is active. However, Turama Forest Industries is likely to start logging in Baimuru Block 3 in approximately five years (Pers. Com. General Manger, Frontier Holdings, 21/09/2016). The Vailala Block 3 concession is held by Frontier Holdings, which is a subsidiary of the Malaysian logging company Rimbunan Hijau (RH). Much of the concession has been logged with current harvesting occurring in hill forest approximately 15 km to the southwest of Herd Base. Logs are transported to Evara Logging Camp just south of Evara for shipment by logging barge. Approximately one to two logging barges depart Evara Logging Camp each month.

Villages that have signed the logging agreement receive Project Development Benefits (sometimes referred to as annual benefits, and previously referred to as premiums), which are split 40% cash and 60% projects. The cash component is distributed to the Incorporated Landowner Groups (ILG) that have signed the logging agreement. The project component, along with the agriculture, community development and business development levies that typically form part of the logging agreement, are paid into a trust fund (established for each logging permit). The trust fund is administered by a committee that decides how the benefits are allocated. The committee is chaired by the Provincial Administrator

and includes five landowner representatives, a women's representative and a representative from the logging company.

The approximate value of the benefits is:

- Royalty paid to the ILGs varying between PGK 10 and PGK 35 /$m^3$.
- Agriculture, community development, business development and reforestation levies, each PGK 1/$m^3$.
- Project Development Benefits, which equate to approximately 7% of the value of log exports.

Villages from the inland Orokolo and Ahia (Evara) have been the main beneficiaries of these benefits. Yearly royalties are also paid to Aivai Village (Iare) as rent for a log loading wharf opposite the village (Koki).

**Table 6-40 Logging concessions in or overlapping the PAOI**

| Concession name | Concession type | Gross area* (ha) | Status and expiry date |
|---|---|---|---|
| Vailala Block 3 | FMA | 196,353 | Current and active. Expires on 28/05/2045 |
| Baimuru Block 3 | FMA | 321,876 | Current but no logging yet. Expires on 28/05/2045 |
| **Total** | | **518,229** | |

* Gross area includes operable and inoperable areas. Inoperable areas include steep slopes, swamps, gardens and settlements and can account for up to 50 of the area in some instances. FMA = Forest Management Area

## 6.6 NATURAL RESOURCE USE LIMITATIONS

### 6.6.1 Environmental conditions and natural phenomena

Natural phenomena in the PAOI primarily relate to extreme climatic events, particularly flooding and drought associated with El Niño climatic events which when severe have resulted in notable reductions in rainfall in some of the wettest environments, and major fires resulting in the loss of large areas of forest (Haberle *et al.*, 2001, McVicar and Bierwith, 2001). These and other weather-related potential natural disaster events are discussed below.

#### *6.6.1.1 Cyclones*

Tropical cyclones have minimal influence on this part of Papua New Guinea, with tropical storms and cyclonic tracks in the Gulf of Papua discouraged by prevailing northwesterly winds during the November to April cyclone season, and by flanking landmasses of the Fly Platform, Southeast Peninsula and Cape York Peninsula (Evans and Allan, 1992, Evesson, 1983, McAlpine *et al.*, 1983).

#### *6.6.1.2 Flooding*

A normal wet season results in extensive flooding in coastal areas, particularly across the swales of the beach plains adjacent to the Orokolo coast. This area is important for sago production and garden crops. When seasonal flooding is severe sago cannot be accessed and garden crops die if inundated for too long.

In addition to seasonal flooding infrequent catastrophic flooding also occurs. Severe flooding/unseasonably wet years in Papua New Guinea have been associated with La Niña climate events in 1996, 1971, 1964 and 1910 causing

crop failure in some locations (Cobon *et al.,* 2016). These events typically precede an El Niño event. This scenario appears to have also occurred in 2014 when high rainfall resulted in severe flooding along the Purari River which was most severe upstream, particularly in the Pawaia villages where strong river flows and high water rising by 10 m swept away 53 houses, destroyed river-side food gardens, and uprooted planted sago palms. The worst affected villages were the upstream villages Subu, Wabo and Uru, and Mapaio in the lower Purari (PNG Post courier, 2014). This loss of gardens resulted in an increase in the use of hill forest for food gardens to ensure that some food staples will still be available during future flood events. Downstream, extreme flooding is less severe in the riverways villages, since the river is slower flowing and is less destructive, however inundation occurs destroying crops and flooding villages to sufficient height that canoes are required to travel from house to house such as at Aumu.

#### *6.6.1.3 Drought*

Papua New Guinea is subjected to infrequent but episodic drought associated with the El Niño climatic events that makes forests susceptible to human-induced fire and can cause crop failure (Evesson, 1983). Since the 1900s there has been 11 major and widespread food shortages in Papua New Guinea caused by crop failure, with the most severe impact occurring in the highlands. Eight of the 11 widespread food shortages were associated with El Niño, which caused frost, and crop mortality (Cobon *et al.,* 2016). Severe drought most recently occurred in 2015/16 with severe impacts (food shortages, water shortages, frost in the highlands and bush fire) reported from the highlands and some lowland areas of Western Province (Jorgensen, 2016) and Morobe Province (Bourke, 2015). A more widespread and severe drought associated with frost (in the highlands) occurred in 1997 (Allen, 1997). The 1997 drought was particularly severe and resulted in 80,000 people, mostly in the highlands, being in a life threatening situation due to no food other than famine foods (Allen and Bourke, 1997).

In the PAOI, the 1997 drought resulted in extremely low river flows, consequently there was insufficient water to process sago in some locations and drinking water was in short supply in some villages, particularly in the Baimuru LLG. Approximately 2.3% of the population of Gulf Province was severely affected by the 1997 drought and required food aid (Allen and Bourke, 1997).

#### *6.6.1.4 Trade winds and travel*

The south coast of Papua New Guinea including Orokolo Bay is subject to seasonally rough seas associated with the trade winds which impact much of the south coast of Papua New Guinea. Data from Port Moresby which has a similar trade season timing has the largest mean wave height during June to September, of around 1.4 m, consisting of trade wind generated waves from the southeast, and a small component of swell propagated from storm events in the Tasman Sea and in the south. During the wetter months of December to March, mean waves reach a minimum with a seasonal mean height of around 0.8 m and are directed from the south with some locally generated monsoonal westerly waves. Waves larger than 2.3 m occur during the dry months, and at Port Moresby the height of a 1-in-50 year wave was calculated to be 4.1 m (ABM 2011).

Consequently, boat travel along the coast and in the lower reaches of the major channels can be severely restricted during the seasonal trade winds.

Of these natural phenomena, the major impact is the potential loss of access to food resources, the physical loss of food from intense flooding and the loss of the ability to grow food because of prolonged inundation or drought, and the loss of the ability to process sago. In these circumstances villages typically resort to famine foods to survive, which often comprises coconuts in the coastal areas which is supplemented by store food. The village responses to the occurrence of flooding and drought in year prior to the survey are summarized in Table 6-41.

**Table 6-41 Flood and drought impacted villages in the previous year – village responses**

| Village | Language group | Flood impacted | Drought impacted |
|---|---|---|---|
| Evara | Ahia | - | - |
| Aivai | Iare | - | - |
| Aumu | Iare | Yes | - |
| Avavu | Iare | Yes | - |
| Kaevaria | Iare | Yes | - |
| Maipenairu | Iare | Yes | - |
| Mapaio | Iare | Yes | - |
| Mariki | Kaimare | - | - |
| Upaia | Kaimare | - | Yes |
| Akoma | Koriki | - | Yes |
| Ara'ava | Koriki | Yes | - |
| Ikinu & Kakari | Koriki | Yes | - |
| Kairimai | Koriki | Yes | - |
| Kairu'u | Koriki | - | Yes |
| Apiope | Maipua | Yes | - |
| Ere | Orokolo | - | Yes |
| Harevavo | Orokolo | - | - |
| Hepere | Orokolo | Yes | - |
| Huruta | Orokolo | - | - |
| Iuku | Orokolo | - | - |
| Kaivukavu | Orokolo | - | Yes |
| Kavava | Orokolo | Yes | - |
| Kilavi | Orokolo | - | Yes |
| Larihairu | Orokolo | - | - |
| Marea | Orokolo | - | Yes |
| Mareke | Orokolo | Yes | - |
| Oru, Lariau, Herakela | Orokolo | Yes | - |
| Paevera | Orokolo | - | Yes |
| Poroi 2 | Pawaia | - | - |
| Subu | Pawaia | - | - |
| Subu2 | Pawaia | Yes | - |
| Ura | Pawaia | - | - |
| Wabo | Pawaia | - | - |

- = Not impacted
Source: ERIAS Group 2016b.

## 6.6.2 Flora and fauna

### *6.6.2.1 Weeds*

Three weed species were of significant nuisance value to the villages of the PAOI, which comprise the 'mile-a-minute' vine, the aquatic herb water hyacinth and the mostly aquatic weed kangkong. Further information on these weeds is provided in the Weeds Baseline Report (Booyong Forest Science, 2017).

Residents at Evara (Ahia) stated 'mine-a-minute' vine had been introduced to their land by the logging company. This species has rapid growth and in poorly drained areas it climbs over banana plants, inhibiting growth. Frequent additional weeding is required to keep it under control. The aquatic weed water hyacinth can clog slow moving waterbodies making canoe travel difficult or small waterways unusable. For example, kangkong has been reported to cause access problems in the PRL-15 oxbow wetlands, particularly since sections of Nea'a Creek became obstructed by fallen trees, thereby inhibiting prior action to keep the waterways clear.

In total, 96 species of weeds are likely to be present in the PAOI (Booyong Forest Science, 2017). Most of these have nuisance value but two species, African Tulip tree and the shrub Bamboo daka are 'Priority 1' weed species that have the potential to degrade forests and reduce forest species diversity, particularly in forests impacted by logging or other anthropogenic disturbance. These species therefore have the potential to reduce the ecosystem services values of forest by competing out useful plants and reducing habitat quality for fauna.

One weed, kangkong (Plate 6-23) is edible but was not mentioned as a food resource by villagers during the surveys.

### *6.6.2.2 Animal pests*

Several species of invasive alien rodents are long-established in near-coastal parts of the PAOI but these are currently expanding their distributions into villages and disturbed habitats in the inland regions. These species can damage garden and tree crops, as well as household possessions, can predate on eggs and chicks, and can spread diseases to pigs as well as to people. Their impacts are poorly documented in Papua New Guinea but they can be expected to follow patterns that are well-known from other parts of the world (Singleton et al. 2010).

In the vicinity of Evara (Ahia), the invasive alien rodents are said to have arrived with the start of logging activities. However, villages to the north, including Subu 2 and Wabo, were infested only within the past two years. The widest distribution of a pest in the PAOI is from the Black Rat, which is the world's most widespread and destructive rodent pest (Aplin et al., 2011).

**Plate 6-23 Kangkong**



### *6.6.2.3 Fish diseases*

Estuarine fish populations worldwide are prone to disease outbreaks caused by variety of viral, bacterial and fungal agents. Estuarine systems are more prone to such events than purely freshwater or marine systems because of the complex interplay of tidal versus freshwater inputs and the resultant local variability in water salinity and nutrient levels.

A widespread epizootic event occurred in southern New Guinea in late-1975 to mid-1976, with reports of mass fish mortality from an ulcer disease from Merauke in the Indonesian Province of Papua to Port Moresby (Haines, 1983). All species of bony fish were affected and the rate of infection was locally high, with peak incidences of 50% early in the outbreak in the Purari and Kikori rivers. Local people claimed at the time to have never seen the disease before. Although it was not formally diagnosed, the disease was suspected to be 'Bundaberg disease', a recurrent ulcerating disease of estuarine bony fish populations in Queensland that is caused by a bacterium. Outbreaks are believed to be triggered by heavy inflow of freshwater into estuarine systems, with the drop in salinity causing a lowering of resistance to a persistent environmental bacterium. Haines (1983) reported no outbreaks subsequent to 1976; however PAOI residents interviewed in 2016 were aware of an 'ulcer disease' that they claimed to witness on occasion among local fish stock.

### *6.6.2.4 Introduced fish species*

Numerous species of fish have been introduced to Papua New Guinea over the past 50 years or so, the majority with a view to 'enhancing' the subsistence or artisanal fisheries of inland waterways or to provide species suitable for

aquaculture (West and Glucksman 1976; Povlson 1993). While there are no records of species being introduced directly into the lower reaches of the Purari system, numerous species have been released into the Purari headwaters (Povlson 1993).

At the time of the Purari River (Wabo) Hydropower project studies in the late-1970s there were no records of introduced fish in the Purari system below Hathor Gorge, although Haines (1983) later noted the lack of natural impediment to dispersal from the upland catchment where they were already present. This invasion has occurred progressively over the past 40 years, with Tilapia said to have arrived in the PAOI in the mid-1990s and others including one or more species of mahseer (locally known as 'besta' or 'mackerel'), carp and 'trout' (probably Snow Trout) only in the last few years. A large flood event in 2014 was mentioned in several villages as heralding the arrival of many new kinds of introduced fishes.

Some of the newly invasive fish species appear to have become locally abundant. For example, at the Mapaio Fish Camp at the mouth of Nea'a Creek, fishermen claimed that the most common catch since 2014 is the Copper Mahseer, which was said to be 'sweet but full of bones'. Tilapia, despite having been present for several decades, does not appear to dominate the local catches anywhere in the Purari River catchment. The reason for the varied invasive success of the introduced fishes is probably to be found in the wider ecology of the Purari River catchment. As described by Haines (1983), the catchment is characterized by naturally low productivity of algae and other aquatic plants, and its native fish fauna is dominated by carnivorous species (mostly insect and crustacean eaters) with smaller numbers of fruit eaters and mud eaters. Mahseer are omnivores and thus suited to the Purari River catchment, while Tilapia are herbivores and thus subject to resource limitations in most parts of the catchment. The recent introduction of invasive alien water plants into the PRL-15 oxbow wetlands and nearby waterways may result in a shift in this balance in coming years.

### 6.6.3 Cultural uses

Although Christianity is prevalent throughout the PAOI, this has augmented rather than replaced traditional belief systems which continue to influence the day-to-day lives of most people. Under these systems, particular plants and animals, as well as physical places, can all have special cultural significance, either for some or all members of a community.

Cultural uses of natural resources across the landscape of the PAOI is closely related to ancestral movement of the various clans, particularly in objects, names and landscapes which form the migration histories of the different villages. The stories of the migration histories and the associated material markers provide the basis for claims to a given portion of the landscape (Bell, 2006a), and therefore partly determine what resources have cultural significance. During the community interviews nine cultural sites were mentioned in the context of land and natural resource use, which probably reflects a small proportion of the total number of sites across the PAOI. More information about the cultural heritage of the PAOI is provided in Skelly (2017).

### 6.6.4 Commercial

Apart from forestry there are no large scale commercial operations or associated limitations in the PAOI. Once the logging concessions have completed harvesting and the FMA has expired logging is not permitted until a new FMA is negotiated. This is also dependent on adequate forest regeneration and growth, since logging will not be viable until sufficient timber volumes are present to support another logging operation. The Vailala Block 3 and Baimuru Block 3 FMAs expire in 2045.

### 6.6.5 Access and market restrictions

The PAOI has little land (roads, access tracks) transport infrastructure and many villages are remote with travel via the Purari River (and tributaries) and ocean the only means of accessing markets, medical and education facilities and other regions. Travel within the PAOI and to regional centers is dominated by river and ocean travel, particularly using dugout canoes or motorized dinghies. Many villages are isolated with no walking tracks connecting other villages apart from the coastal and inland Orokolo villages. No public or government owned roads exist in the PAOI.

In addition to seasonal restrictions for ocean travel due to rough weather, riverway travel can be restricted by tidal movements in the lower Purari system with canoe travel limited to travelling upstream with the incoming tide, and downstream with the outgoing tide for longer trips. Moreover, when in flood floating debris prevents safe travel on the Purari River.

Ocean travel to Kerema is partly restricted by cost, with fares of K75 for one-way travel with additional fares for cargo. A summary of the main transport options is provided below.

#### *6.6.5.1 Roads*

There are no operable roads in the PAOI linking the PAOI with other regions or the provincial capital, Kerema. The only roads are logging roads which link harvesting operations to logging camps and export wharfs. Once logging stops the roads become inoperable due to erosion and vegetation regrowth. Within PRL-15, a road with variable connectivity that was built by the previous operator links Herd Base with wellpads in the Antelope 3 area. Tracks in the PAOI (including old logging roads and the Project road in PRL-15) are shown in Figure 3-1.

#### *6.6.5.2 Riverways travel*

The main way to travel around the PAOI is on the Purari River and its navigable tributaries using dugout canoe, motorized dugout canoes (Plate 6-24) or motorized dinghy. Travel by dugout canoe is the main mode of transport on the riverways to access food gardens and sago places, to access medical facilities at Kapuna, to access education facilities and to reach more distant markets, among other reasons. Occasionally longer trips are made by the waterways to Kikori to sell betel nut where motorized canoe is preferred.

**Plate 6-24 Motorized dugout canoe for long distance travel and for carrying cargo**



### *6.6.5.3 Ocean travel*

Ocean travel mostly occurs outside of the trade wind season when the seas are relatively calm. The main destinations are Kerema to access Port Moresby by bus, Kikori, Daru and Kamusi logging camp in Western Province to sell betel nut.

### *6.6.5.4 Airstrips*

Airstrips are located in the middle Purari near Herd Base and at Wabo. The Purari strip currently services the previous and existing petroleum operators. The Wabo strip services Wabo Station with flights to the highlands.

### *6.6.5.5 Walking tracks*

Most villages have local walking tracks and tracks for hunting or accessing gardens and sago places where river travel is not required. There is one main coastal walking track that connects the coastal Orokolo villages to Kerema, however a canoe fare must be paid to ferry travelers across the Vailala River. This route was used by vehicles in the past to transport copra. Paevera is regarded as an important location as a mid-way point for inland villages travelling to the coast and vice versa. A well-established and used track connects the inland Orokolo villages of Avavu, Ere and Kilavi with Huruta, Arehava 2 and Paevera in the center, and down to the coastal Orokolo villages (Harevavo, Kaivukavu, Marea, Larihairu and Iuku) (Figure 6-8). The track is used to access health services, markets at Muro and Kaivukavu and to trade food and other items amongst communities from inland Orokolo to the coast.

### 6.6.6 Food storage

There is very little capacity in the villages to store animal foods for any length of time. Very few people own refrigerators or freezers (2% across the PAOI) and the preservation of fish, pig and other meats by smoking is done over a fire. This results in a low level of preservation that, under tropical conditions, allows for short term storage only. Because of these limitations, most animal foods need to be consumed very soon after they are obtained. Shellfish and crabs can be kept alive for several days and thus are better suited than other animal foods for transport.

The inability to effectively store food limits the capacity of household members to schedule food production or gathering activities around other potential opportunities such as paid labor.

### 6.6.7 Gender issues

While men, women and children all contribute to the harvesting and production of animal foods, there are imbalances in the gender roles and contributions. In particular, men play an essential security role in the exploitation of any resources that are localized at distance from a village (e.g. fishing camps, sago plantations) and thus require extended travel or overnight stays. Similarly, activities such as pig or cassowary hunting that require extensive individual or small group movement within a broad territory are usually done by men, and only rarely by unaccompanied women, either due to concerns about personal security or because women have other responsibilities (e.g. young children) that limit their mobility. In most villages, men perform much of the work associated with garden establishment and women undertake most of the maintenance (see Section 6.3.1.6), and the collection of building materials.

Women perform much of the work involved in the production of sago, raising of pigs and chickens, collecting firewood, and are largely responsible for food preparation. Fishing is done by men and women, with some contrasts in the principal methods used.

The essential security role played by men in many of the extractive activities, even those such as sago processing where women do most of the actual work, is a weak point in what is otherwise a highly flexible subsistence strategy.

# 7 CONCLUSIONS, SENSITIVITIES AND VALUES

## 7.1 CONCLUSIONS

Adequate information has been collected, analyzed and presented in this report to meet the specific objectives outlined in Section 1.2. The following key conclusions have been drawn from the study.

### Land tenure and disputes

- The vast majority of land in the PAOI is customary owned. Land ownership is vested in clans, which identify themselves and their land through oral histories, including genealogies, stories, beliefs, customs and practices. Land is held generally on a patrilineal basis, passing from father to the first-born son, however, it is not the ownership of the land that is inherited (as this remains with the clan), but the right to use the land.
- Leaders from 83% of villages surveyed indicated that the village contained one or more ILGs. In the PAOI, ILGs have been established as a vehicle to receive royalties from logging operations. Amendments to the Land Groups Incorporation Act 1974 in March 2012 included tighter regulation on all ILGs by March 2017. It is unknown whether the ILGs in the PAOI, in their current form, will meet the requirements of the amended Land Groups Incorporation Act.
- Papua New Guinea has a formal process for attempting to resolve land disputes starting with mediation, then Local Land Courts, and finally, Provincial Land Courts. In special cases, particularly relating to large-scale extractive industries, the National Government may instruct a dispute to be settled by other means, such as a hearing of the Land Titles Commission.
- Within the PAOI, village leaders indicated that land disputes had occurred in 27 villages (79% of villages surveyed) within the past decade. A total of 57% of villages had land disputes between two parties from within the village, and these were generally minor disputes over gardening land or sago, and easily resolved. Sixty percent of villages indicated that land disputes had also occurred with clans from other villages. These disputes often focused on land boundaries and generally involved some kind of benefits, or potential future benefits, such as logging royalties, land rental for a communication tower, land rental for an airstrip, or potential benefits from sand mining.

### Subsistence agriculture

- Sago is the primary staple food across the PAOI and cultivated sago is mostly more important than wild sago.
- A range of important staple foods and vegetables are grown in food gardens made in clearings in forest regrowth, previously undisturbed, forest, shoreline sand dunes and nipa palm vegetation areas.

- Food gardens are located throughout the PAOI along the banks of the Purari River, upstream and downstream of riverway settlements, and within a few kilometers of inland villages.
- The beach ridges and plains of the inland Orokolo area are an essential landform for sago cultivation and food gardens for the coastal, as well as the inland, Orokolo villages.
- The river banks of the Purari River and its tributaries are essential landform for the cultivation of sago for the Pawaia villages.
- A variety of fruit and nut trees are grown in villages and food gardens that are important for nutrition.
- Domestic pig and chickens, reared using methods accessible to all households, are important as traditional (pigs) or emergent (chickens) items of customary payment and exchange; they represent a means by which all community members can participate in social interactions, irrespective of their financial situation.

**Hunting and collecting**

- Forests, rivers and the ocean of the PAOI support a diverse range of terrestrial, freshwater and marine habitats that provide villages with a diversity of important plant and animal resources:
    - The vegetation of alluvial forest, hill forest, swamp woodland, mangroves and forest regrowth provide essential resources including materials for house construction canoes, medicinal plants and food plants.
    - Areas of forest that are distant from villages support high diversity of animal foods and are important for hunting and gathering.
    - Cave systems in areas of limestone karst support colonies of bats that are harvested on a periodic basis.
    - Mangrove communities are highly valued as a source of fish, crustaceans and shellfish for coastal villages.
    - Tributaries of the Purari River are highly valued for fishing more so than the main Purari River channel.
    - The annual upriver migration of several estuarine turtles produces a seasonal pulse in turtle meat and eggs for villages living alongside the freshwater reaches of the Purari River and its major tributaries.
    - The coastal foreshore and near-shore habitats support high diversity and abundance of finfish fishes, sharks and octopuses and squid, while the beach swash zone and tidal

inlets provide a regular supply of smaller marine animals, including crabs and shellfish.

- Low human population density across most of the PAOI currently places little strain on most natural resources. One exception is the Orokolo Bay area where population density is high and many resources are limited or becoming limited.
- Most fishing, hunting and collecting activities use traditional knowledge and methods that are available to all community members, augmented in some cases with 'new' technologies such as gill nets and hooks and line for fishing.
- The traditional approaches to animal food acquisition, often using 'low-tech' equipment such as bow and arrow, allow for flexible and opportunistic foraging behavior, and communities generally invest little in transport and maintenance of equipment for hunting.

**Transport**

- The Purari River and its navigable tributaries provide essential transport routes for villages of the PAOI.
- The ocean is an important transport route (using motorized dinghies) to access Kerema for onward transport to Port Moresby outside of the trade wind season.
- There are no operable roads in the PAOI linking the PAOI with other regions or the provincial capital, Kerema.

**Commercial opportunities and exchange networks**

- Large scale forestry occurs throughout the PAOI to the south of the Purari River where logging is mostly confined to hill forest and drier alluvial forest.
- A small number of natural products are sold to buyers in Kerema or Port Moresby. The most lucrative of these is betel nut which is an important source of revenue for the Orokolo villages. Sales of crocodile skins, dried shark fins and processed sago also occur, though only a few households make any significant income from these sources.
- A range of resources are sold locally across the PAOI. These include surplus garden food, sago, canoe trees, kwila posts for house construction, Pandanus mats and Pandanus bilums, domestic livestock (pigs and chickens), bush-meat, fish, shellfish and crustaceans.
- The majority of households generate relatively small revenues from the sale of local resources, probably no more than a few thousands of kina per year. This cash is used primarily for payment of educational expenses, travel costs including fuel, and purchase of capital items, such as pots, pans and general household equipment. Sale of animal products and garden surplus are commonly made to outsiders, including workers at logging camps and Project facilities. Local distribution of surplus is more

commonly done through barter or exchange networks, both within and between villages, with cash generally not changing hands in these contexts.

- Exchange of food stuffs and construction materials is an important feature of the regional socio-economic system, as it provides access to nutritionally important commodities (e.g., sago and garden produce to villages with the mangrove zone; shellfish and crabs to inland communities) as well as maintaining social interactions. Although the majority of PAOI villages thus derive the bulk of their food stuffs and other lifestyle necessities from the natural environment few, if any, are entirely self-sufficient.

**Cultural**

- Pigs (and to a lesser extent, chickens) have a societal value that exceeds their commercial value, as they represent the currency of social negotiation (bride price, compensation, ceremonies).
- Although Christianity is prevalent throughout the PAOI, this has augmented rather than replaced traditional belief systems which continue to influence the day-to-day lives of most people. Under these systems, physical places as well as particular plants and animals can all have special cultural significance, either for some or all members of a community. Documentation of these traditional belief systems is beyond the scope of this report but detailed in Skelly (2017).

### 7.2 SENSITIVITIES AND VALUES

The important sensitivities and associated values for the PAOI are as follows:

- The communities are dependent on the land (e.g., forest), freshwater and marine provisioning ecosystem services within the PAOI for their livelihoods (essential resources to meet the necessities of life) and wellbeing (primary nutrition and health).
- Sago, both planted and wild is an essential staple food resource for most communities within the PAOI.
- The Purari River and its tributaries are an essential source of drinking water, particularly in severe drought.
- The Purari River and its tributaries provide an essential transport route for the riverway communities of the PAOI.
- Patterns of exchange of food and other commodities between communities (whether by barter or by sale) are vitally important, as few if any communities have direct access to all essential natural resources.
- Traditional divisions of labor between men and women underpin current patterns of utilization of many key natural resources.
- Pigs retain a social and cultural exchange value that exceeds their value in terms of protein, but this is being challenged by an increasing emphasis on cash as a status item.

# 8 STUDY TEAM

## Dr Howard Rogers

Dr Howard Rogers is a tropical forest specialist, with a focus on the sustainability of forest use and the impacts of resource industry development on forests, rural land use, ecosystem health monitoring, flora surveys, soil surveys, weed surveys, ecosystem services and vegetation mapping. He has worked on assignments in Australia, Tanzania, East Timor, Indonesia and extensively across Papua New Guinea. His early career involved working as a lecturer and consultant in tropical forest management and forest ecology at the University of Technology in Papua New Guinea. Howard has worked on a variety of consulting and research projects for a range of organizations including international companies, government departments and NGOs, including 20 years' experience from Papua New Guinea.

## Dr Ken Aplin

Dr Ken Aplin is a biologist with special expertise in Melanesian mammals and more than 35 years of research engagement in Papua New Guinea. He also has an academic background in anthropology and archaeology and has a special interest in the traditional subsistence lifestyles of people living in Melanesia. He has been involved in extensive field survey campaigns in Papua New Guinea, much of it based in rural villages or remote field camps. After an earlier career phase working for museums and CSIRO in Australia, he has worked on a variety of consulting and research projects for a range of organizations including international companies and NGOs. Ken has authored or contributed to several ecosystems services reports for resource sector projects, and has also worked extensively across the wider region, with past assignments in almost all countries from India and Bangladesh to Indonesia and the Philippines, and in East Africa.

## Mike Finlayson

Mike has over 20 years' experience in Australia, Asia and the Pacific, working in the aid industry since the 1980s and in large-scale resource industries (oil and gas, mining, petroleum, hydropower and agriculture) since 1998. Mike has spent considerable time in villages in different parts of Papua New Guinea and is also very familiar with government systems and donors. Mike's economic background and broad development experience provides a unique set of skills in undertaking social impact assessments or providing advice in relation to benefit sharing arrangements or community development programs. Mike has pioneered work on benefit stream analysis in PNG's resource industries.

## Amos Ona

Amos has extensive experience of managing conservation programs and associated fieldwork in Papua New Guinea, particularly in Gulf Province where he has worked in various roles based out of Kopi in the lower Kikori Basin. His role in Papua New Guinea as a manager involved extensive liaison with international funding agencies, local villages, NGOs and consultants. More recently he has experience of gas development (LNG) projects where he has worked as a social specialist identifying social sensitivities along 315 km of the PNG LNG Project right-of-way. This was followed by employment as a senior community liaison

officer for the main pipeline design, engineering and construction contractors on PNG LNG as well as with lead environmental and social consultants.

**Benjamin Kelimbua**

Benjamin is a field botanist and eco-forester based in Madang. He is a graduate in forestry from the PNG University of Technology (1999). Benjamin is a specialist dendrologist with the ability to identify trees from bark characteristics which is important for infertile specimens. He has worked on several research and consulting projects throughout Papua New Guinea. His work includes vegetation surveys and permanent sample plot establishment, ecosystem services surveys and flora and weed assessments. His consulting experience includes surveys for Lihir Gold, PNG Gas Project and the PNG LNG Project, Ok Tedi Mining Ltd. He has also worked as an ecoforester for WWF in Kikori (Gulf Province) and an environmental officer/advisor with on numerous other petroleum development projects. Benjamin has extensive experience of terrestrial flora surveys on the PNG LNG Foundation Project and the PNG LNG Expansion Project (P'nyang).

**Junior Novero**

Junior is an experienced PNG national biologist with expertise in mammals and birds, and in traditional practices of wildlife exploitation. He was a foundation member of the PNG Institute of Biological Research, an NGO based in Goroka, and has conducted remote fieldwork in many parts of Papua New Guinea. He has co-authored biodiversity and ecosystems services reports for resource sector projects and is currently studying toward a PhD on wildlife resource use in his home environment in the Autonomous Region of Bougainville.

# 9 GLOSSARY AND ABBREVIATIONS

## 9.1 GLOSSARY

Alienated land – Lands no longer held under customary ownership. Only 3% of the landmass of Papua New Guinea is alienated land.

Community Based Commercial Activity – Commercial activity where items are produced locally and sold/exchanged between communities.

Customary land – Land owned under traditional or customary title by nationals. Over 97% of the total land area in Papua New Guinea is 'customary land'.

Flock – A number of birds of one kind feeding, resting, or travelling together.

Introduced species (also commonly referred to alien, exotic or pest species) – Plants, animals, pathogens and other organisms that are living outside their native distributional range and have arrived there predominantly due to anthropogenic activity either deliberately or accidentally.

Kwila Posts – A durable and termite resistant hardwood from the kwila tree (*intsia bijuga*) commonly used for house posts in the PAOI.

Livestock – Animals and birds that are kept on a farm, such as cows, sheep, or chickens.

Rapid Rural Appraisal – A term used to describe a systematic but flexible way of obtaining information from local people in a limited period of time.

PRL-15 Oxbow Wetland – Five oxbow lakes within a single wetland system of lakes and vegetated swamps covering an area of approximately 25 $km^2$ in the southwest of PRL-15.

Tok Ples – Local Language

Weed – A valueless plant growing in an unwanted place and has a perceived negative effect on ecosystems. Weeds can be native, alien and/or invasive species.

## 9.2 ABBREVIATIONS

| | |
|---|---|
| AAC | Annual Allowable Cut |
| AGRU | Acid Gas Removal Unit |
| asl | Above Mean Sea Level |
| CEPA | Conservation and Environment Protection Authority |
| CSIRO | Commonwealth Scientific and Industrial Research Organization |
| COI | Commission of Inquiry |
| CPF | Central Processing Facility |
| DBH | Diameter at breast height |
| DEC | Department of Environment and Conservation |
| DEM | Digital elevation model |
| EIS | Environmental Impact Statement |
| ESHIA | Environmental, Social and Health Impact Assessment |
| DLPP | Department of Lands and Physical Planning |
| FGD | Focus Group Discussion |
| FIMS | Forest Inventory Mapping System |
| FMA | Forest Management Area |
| ha | hectare |
| ILG | Incorporated Land Group |
| PGK | Papua New Guinean Kina |
| KII | Key Informant Interview |
| km | kilometer |
| LNG | Liquefied Natural Gas |
| NFP | National Forest Plan |
| NFS | National Forest Service |
| NGO | Non-Government Organization |
| NTFP | Non-Timber Forest Product |
| PAOI | Project Area of Influence |
| PNGFA | Papua New Guinea Forest Authority |
| PNGRIS | Papua New Guinea Resource Information System |
| PRL | Petroleum Retention License |
| SABL | Special Agricultural and Business Leases |
| SBS | Social Baseline Study |
| SFM | Sustainable Forest Management |
| TA | Timber Authority |
| TFI | Turama Forest Industries |
| TRP | Timber Rights Purchase Area |

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# APPENDIX A

# SOCIAL INSTRUMENTS AND ECOSYSTEM SERVICES QUESTIONNAIRES

# COMMUNITY SURVEY – LAND AND NATURAL RESOURCE USE (LNR)
# KEY INFORMANT INTERVIEW (KII)

# Key Informant Interview - Land & Natural Resource Use

| | |
|---|---|
| **Facilitator** | |
| **Date of KII (day/month/year)** | / /2016 |
| **Village Name** | |
| **Photo reference** | |

# A Land – Gardening (Crops, sago, other productive assets)

| No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **What garden resource?** (Type/Species) *Try to list at least top 3.* | | | | | |
| **A1) Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **A2) Who grows resource?** Code: **1**=men, **2**=women, **3**=children, **4**=all | | | | | |
| **A3) When is the resource grown?** *Code: Months **1** [January] - **12** [December],* ***13** = Year round, **14** = No particular time* | | | | | |
| **A4) Who collects the resource?** Code: **1**=men, **2**=women, **3**=children, **4**=All | | | | | |
| **A5) How abundant, generally, is the resource?** How much do you generally grow? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **A6) Are there ever shortages of resource? Why?** *Code: **1**=Under-planting, **2**=Overharvesting, **3**=Drought, **4**=Flood, **5**=Disease/pest/weeds, **6** =Other (specify)* | | | | | |
| **A7) How do you cope with shortages?** *Code: **1**=Supplement with other garden product, **2**=Supplement with bush plants, **3**=Supplement with hunting/catch, **4**=Supplement with store food, **5**=do nothing, **6**=Other (specify)* | | | | | |
| **A8) Why do you grow this resource?** **1**=Income, **2**=Consumption, **3**=Medicinal, **4**=Cultural (bilas). | | | | | |
| **A9) Do you actively manage this resource? Describe.** *Code: **1**=Fallow land, **2**=Fertilise land, **3**=Improve conditions, **4**=Burn land, **5** =Other (specify)* | | | | | |

## B Land – Collecting (Forest food, building materials, firewood, medicine, cultural, etc.)

| No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **What resource?** (Type/Species) *Try to list at least top 3.* | | | | | |
| **B1) Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **B2) Who collects resource?** *Code: **1**=men, **2**=women, **3**=children, **4**=All* | | | | | |
| **B3) When is the resource collected?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **B4) How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |
| **B5) Are there ever shortages of resource? Why?** *Code: **1**=Overharvesting,* | | | | | |

| No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| ***2**=Drought, **3**=Flood, **4**=Disease/pest/weeds, **5** =Other (specify)* | | | | | |
| **B6) How do you cope with shortages?** *Code: **1**=Supplement with garden produce, **2**=Supplement with other bush resource, **3**=Supplement with hunting/catch, **4**=Supplement with store-brought item, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **B7) Why do you collect this resource?** *Code: 1=Income, 2=Consumption, 3=Medicinal, 4=Cultural (bilas).* | | | | | |
| **B8) Do you actively manage this resource? Describe.** *Code: **1**=Allow to replenish, **2**=Improve land, **3**=improve conditions, **4**=Burn land, **5** =Other (specify)* | | | | | |

## C Land – Hunting (Wild animals, e.g., pig, flying foxes, possums etc.)

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **C1)** | **What resource?** (Type/Species) | | | | | |
| **C2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **C3)** | **Who hunts resource?** *Code: **1**=men, **2**=women, **3**=children, **4**=All* | | | | | |
| **C4)** | **When is the resource hunted?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **C5)** | **How abundant, generally, is the resource?** How much do you generally hunt? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **C6)** | **Are there ever shortages of resource? Why?**<br>*Code: **1**=Overhunting, **2**=Drought, **3**=Flood, **4**=Disease/pest/ weeds, **5** =Other (specify)* | | | | | |
| **C7)** | **How do you cope with shortages?**<br>*Code: **1**=Supplement with garden produce, **2**=Supplement with bush plants, **3**=Supplement with other hunting/catch, **4**=Supplement with store food, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **C8)** | **Why do you hunt this resource?**<br>*Code**: 1**=Income, **2**=Consumption, **3**=Medicinal, **4**=Cultural (bilas).* | | | | | |
| **C9)** | **Do you actively manage this resource? Describe.**<br>*Code: **1**=Avoid impacted area, **2**=Avoid impacted species, **3**=Avoid type of impacted species (ie, young) **4** =Other (specify)* | | | | | |

## D Rivers – Fishing

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **D1)** | **What resource?** (Type/Species) | | | | | |
| **D2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **D3)** | **Who fishes for the resource?** *Code: **1**=men, **2**=women, **3**=children, **4**=All* | | | | | |
| **D4)** | **When is the resource fished?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **D5)** | **How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **D6)** | **Are there ever shortages of resource? Why?** *Code: **1**=Overharvesting, **3**=Drought, **4**=Flood, **5**=Disease/pest/ weeds, **5** =Other (specify)* | | | | | |
| **D7)** | **How do you cope with shortages?** *Code: **1**=Supplement with other garden item, **2**=Supplement with bush plants, **3**=Supplement with hunting/catch, **4**=Supplement with store food, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **D8)** | **Why do you fish for this resource?** *Code**: 1**=Income, **2**=Consumption, **3**=Medicinal, **4**=Cultural (bilas).* | | | | | |
| **D9)** | **Do you actively manage this resource? Describe.** *Code: **1**=Avoid impacted area, **2**=Avoid impacted species, **3**=Avoid type of impacted species (ie, young) **4** =Other (specify)* | | | | | |

## E Rivers – Collecting (River plants, eggs, etc.)

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **E1)** | **What resource?** (Type/Species) | | | | | |
| **E2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **E3)** | **Who collects resource?** *Code: **1**=men, **2**=women, **3**=children, **4**=All* | | | | | |
| **E4)** | **When is the resource collected?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **E5)** | **How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **E6)** | **Are there ever shortages of resource? Why?** ***1****=Overharvesting,* ***3****=Drought,* ***4****=Flood,* ***5****=Disease/pest/ word,* ***5*** *=Other (specify)* | | | | | |
| **E7)** | **How do you cope with shortages?** *Code:* ***1****=Supplement with garden produce,* ***2****=Supplement with bush plants,* ***3****=Supplement with hunting/catch,* ***4****=Supplement with other collecting,* ***5****=Supplement with store food,* ***6****=Do nothing,* ***7****=Other (specify)* | | | | | |
| **E8)** | **Why do you collect this resource?** *Code:* ***1****=Income,* ***2****=Consumption,* ***3****=Medicinal,* ***4****=Cultural (bilas).* | | | | | |
| **E9)** | **Do you actively manage this resource? Describe.** *Code:* ***1****=Avoid impacted area,* ***2****=Avoid impacted item/species,* ***3****=Avoid type of impacted item/species (ie, young)* ***4*** *=Other (specify)* | | | | | |

## F Rivers – Hunting (Crocodiles, turtles, etc.)

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **F1)** | **What resource?** (Type/Species) | | | | | |
| **F2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **F3)** | **Who hunts the resource?** **M**=men, **W**=women, **C**=children, **A**=All | | | | | |
| **F4)** | **When is the resource hunted?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **F5)** | **How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **F6)** | **Are there ever shortages of resource? Why?** *Code: **1**=Overhunting, **3**=Drought, **4**=Flood, **5**=Disease/pest/ weeds, **5** =Other (specify)* | | | | | |
| **F7)** | **How do you cope with shortages?** *Code: **1**=Supplement with garden produce, **2**=Supplement with bush plants, **3**=Supplement with other hunting/catch, **4**=Supplement with store food, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **F8)** | **Why do you hunt this resource?** I=Income, C=Consumption, M=Medicinal, C=Cultural (bilas). | | | | | |
| **F9)** | **Do you actively manage this resource? Describe.** *Code: **1**=Avoid impacted area, **2**=Avoid impacted species, **3**=Avoid type of impacted species (ie, young) **4** =Other (specify)* | | | | | |

## G Ocean (including estuarine habitats (e.g. mangroves) – Fishing

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **G1)** | **What resource?** (Type/Species) | | | | | |
| **G2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **G3)** | **Who fishes for the resource?** *Code: **1**=men, **2**=women, **3**=children, **4**=All* | | | | | |
| **G4)** | **When is the resource fished?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **G5)** | **How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **G6)** | **Are there ever shortages of resource? Why?** *Code: **1**=Overharvesting, **3**=Drought, **4**=Flood, **5**=Disease/pest /weeds, **5** =Other (specify)* | | | | | |
| **G7)** | **How do you cope with shortages?** *Code: **1**=Supplement with garden produce, **2**=Supplement with bush plants, **3**=Supplement with hunting/other catch, **4**=Supplement with store food, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **G8)** | **Why do you fish for this resource?** *Code**: 1**=Income, **2**=Consumption, **3**=Medicinal, **4**=Cultural (bilas).* | | | | | |
| **G9)** | **Do you actively manage this resource? Describe.** *Code: **1**=Avoid impacted area, **2**=Avoid impacted species, **3**=Avoid type of impacted species (ie, young) **4** =Other (specify)* | | | | | |

## H Ocean – Collecting (Shells, crabs, seaweed, etc.)

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **H1)** | **What resource?** (Type/Species) | | | | | |
| **H2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **H3)** | **Who collects resource?** *Code: **1**=men, **2**=women, **3**=children, **4**=All* | | | | | |
| **H4)** | **When is the resource collected?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **H5)** | **How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **H6)** | **Are there ever shortages of resource? Why?** *Code: **1**=Overharvesting, **3**=Drought, **4**=Flood, **5**=Disease/pest / weeds, **5** =Other (specify)* | | | | | |
| **H7)** | **How do you cope with shortages?** *Code: **1**=Supplement with garden produce, **2**=Supplement with bush plants, **3**=Supplement with hunting/catch, **4**=Supplement with store food, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **H8)** | **Why do you collect this resource?** *Code: **1**=Income, **2**=Consumption, **3**=Medicinal, **4**=Cultural (bilas).* | | | | | |
| **H9)** | **Do you actively manage this resource? Describe.** *Code: **1**=Avoid impacted area, **2**=Avoid impacted item/species, **3**=Avoid type of impacted item/species (ie, young) **4** =Other (specify)* | | | | | |

# I Ocean – Hunting (Turtles, crocodiles, dugongs, sharks, etc.)

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **I1)** | **What resource?** (Type/Species) | | | | | |
| **I2)** | **Where?** Can location be identified on map? Note distance travelled from primary residence in pursuit of activity? | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** | *Map* ***Distance*** |
| **I3)** | **Who hunts the resource?** **M**=men, **W**=women, **C**=children, **A**=All | | | | | |
| **I4)** | **When is the resource hunted?** *Code: Months **1** [January] - **12** [December], **13** = Year round, **14** = No particular time* | | | | | |
| **I5)** | **How abundant, generally, is the resource?** How much do you generally collect? *Code: **1**=Not enough for family, **2**=Enough for family, **3**=More than family needs (excess is sold/given away), **4** =Other (specify)* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **I6)** | **Are there ever shortages of resource? Why?**<br>*Code: **1**=Overhunting, **3**=Drought, **4**=Flood, **5**=Disease/pest /weed, **5** =Other (specify)* | | | | | |
| **I7)** | **How do you cope with shortages?**<br>*Code: **1**=Supplement with garden produce, **2**=Supplement with bush plants, **3**=Supplement with other hunting/catch, **4**=Supplement with store food, **5**=Do nothing, **6**=Other (specify)* | | | | | |
| **I8)** | **Why do you hunt this resource?**<br>I=Income, C=Consumption, M=Medicinal, C=Cultural (bilas). | | | | | |
| **I9)** | **Do you actively manage this resource? Describe.**<br>*Code: **1**=Avoid impacted area, **2**=Avoid impacted species, **3**=Avoid type of impacted species (ie, young) **4** =Other (specify)* | | | | | |

## J Cultural Uses

| | |
|---|---|
| **J1) Any there any restricted resources or forbidden areas?**<br>Describe.<br>Plot on map, if possible. | |
| **J2) Knowledge of nationally / internationally protected species?**<br>Describe. | |

## K Food: Fauna and Flora Consumption

Frequency of wild flora and fauna consumption (indicate only for yes)

| | | YES |
|---|---|---|
| **K1)** | Freshwater fish | |
| **K2)** | Prawns | |
| **K3)** | Crocodile | |
| **K4)** | Crocodile eggs | |
| **K5)** | Turtle | |
| **K6)** | Turtle eggs | |
| **K7)** | Dugong | |
| **K8)** | Frogs/small reptiles | |
| **K9)** | Marine fish | |
| **K10)** | Crabs (mangroves) | |

| | | |
|---|---|---|
| **K11)** | Crabs (saltwater) | |
| **K12)** | Lobster | |
| **K13)** | Sea urchins | |
| **K14)** | Shellfish | |
| **K15)** | Beche-de-mer (sea cucumbers) | |
| **K16)** | Trochus | |
| **K17)** | Green snails | |
| **K18)** | Squid/octopus | |
| **K19)** | Seaweed | |
| **K20)** | Wild pig | |
| **K21)** | Sago grubs | |
| **K22)** | Other binatang | |
| **K23)** | Flying foxes | |
| **K24)** | Bandicoots | |
| **K25)** | Kapul (possums) | |
| **K26)** | Rats | |
| **K27)** | Wallabies | |
| **K28)** | Muruk (Cassowaries) | |
| **K29)** | Pisin (small birds) | |
| **K30)** | Brush-turkey eggs | |
| **K31)** | Honey | |
| **K32)** | Beetle larvae | |
| **K33)** | Land crabs | |
| **K34)** | Sago | |
| **K35)** | Fungi | |
| **K36)** | Marita | |
| **K37)** | Wild nuts (karuka) | |

# L Migration and Mobility

## Land

| |
|---|
| **L1) Primary land transport route/s.**<br>Describe.<br>Mark on map if possible. |
| **L2) Is land travel seasonally affected? Describe.** |
| If YES, How do you cope with seasonal effects? |

## Rivers

| |
|---|
| **L3) Primary river transport route.**<br>Describe.<br>Mark on map if possible. |
| **L4) Is river travel seasonally affected? Describe.** |
| If YES, How do you cope with seasonal effects? |

## Ocean

| |
|---|
| **L5) Primary ocean transport route/s.**<br>Describe<br>Mark on map if possible. |
| **L6) Is ocean travel seasonally affected? Describe.** |
| If YES, How do you cope with seasonal effects? |

## Spokespeople

| Name | Gender | | Contact details |
|---|---|---|---|
| 1) | M | F | |
| 2) | M | F | |
| 3) | M | F | |
| 4) | M | F | |
| 5) | M | F | |
| 6) | M | F | |
| 7) | M | F | |
| 8) | M | F | |

**COMPLETION CHECKLIST:**

| | |
|---|---|
| All questions complete / filled in: | |
| Photo record taken: | |
| Spokesperson/s recorded: | |

**QA COMPLETED:**

---
SIGNATURE of Technical Lead or authorised delegate

---
PRINT NAME

---
DATE

# FLORA ECOSYSTEM SERVICES QUESTIONNAIRE

# FLORA ECOSYSTEM SERVICES QUESTIONNAIRE

## Total Antelope Elk Ecosystem Services – Flora and ecosystems

**Objective:** To identify those ecosystem services for which project impacts could lead to a loss in the general well-being of beneficiaries, which are generally those individuals and villages who depend on ecosystem services to maintain their subsistence lifestyle, health and culture.

*Provisioning services:* the goods and products people obtain from terrestrial and aquatic ecosystems, such as food, freshwater, timber, construction materials, medicinal plants, etc.

*Regulating services:* the benefits people obtain from the regulation of ecosystem processes,such as surface water purification, e.g. drinking water from streams, protection from natural hazards, e.g. forested slopes protecting from landslides, mangroves protecting from storm surges.

*Cultural services:* the non-material benefits people obtain from ecosystems, such as spiritual well-being, recreation and aesthetic enjoyment.

*Supporting services:* natural processes that maintain the other services. For example, fallow vegetation improving soil fertility, nutrient cycling assisted by climate of closed canopy forest

<u>Categories of useful plants:</u>

- Hunting and fishing (includes plants that attract animals for fruit/seed) and the vine used to poison fish. Focus on items used as tools/fishing rope vines rather than a long list of plants that attract animals.
- Medicinal
- Construction (House, fence)
- Food (Plants other than garden plants)
- Canoe, paddles and rafts
- Domestic (Brooms, floor mats, containers, washing)
- Firewood and torches/matches (Only the favored species)
- Cultural (plants for bilas for celebrations and plants for magic and spirits etc.)
- High Value NTFP (e.g., Eaglewood)
- Critical Resources e.g. sago if a staple food. Wild yams if harvested in drought or if food crops fail.
- Other (anything else)

**Checklist of other issues to be covered off on from field work or discussed**

- **Planted sago**: Note if sago is planted as a staple food crop.
- **Planted betel nut**: Note presence and if planted as an economic crop
- **Timber**: Note if there is any portable sawmill activity and if so determine what species are being harvested. If harvested for timber sales determine prices.
- **Weed regulation**: Influence intact vegetation has on excluding weeds: e.g. does having intact primary forest (i.e. free of disturbance such as logging and gardens etc.) reduce the weeds in the local environment.
- **Ecosystem types/ ecosystem structures**: Identify specific ecosystem types where important resources are located. Abandoned settlements along the Purari are important locations for established fruit trees.
- Disturbed/secondary forest may be important for harvesting poles for house construction, medicinal plants (e.g. weed species).
- Consider impact on different beneficiaries: In addition to landowners small businesses could be impacted such as starch trade and buai trade, etc.
- **Aesthetic value**: Cultural value placed on landscapes and landmarks. Note if anything mentioned but do not need to question specifically on this.
- **Interaction between villages and the natural environment**: Consider nature of the interaction between landowners and the natural environment (forest), e.g. spiritual connection in addition to resource dependence.
- LIST SPECIES ON SEPARATE USEFUL PLANT SHEET IF NEEDED. The species list sheet is designed for use in the forest when accompanied by landowners who are explaining uses.

**<u>Interviewer to fill in where known:</u>**

**Date:**

**Location:**

**Interviewee (s):**

**District:**

**Village**

**Age class of interview participants: Young adults, middle aged or senior?**

| Young | | Middle aged | | Senior | |
|---|---|---|---|---|---|
| **Male** | **Female** | **Male** | **Female** | **Male** | **Female** |
| | | | | | |

**List names of key spokesperson (s) from the community**

**Note: Include responses from women where possible.**

**For all the main categories of resources/priority resources where possible note:**

- who collects them.
- where they collect them from in the landscape.
- what time of year the resources are collected and how often (e.g. few times a year or many etc.)?
- how common the resources are in the landscape?

**Questions:**

1. Where do you collect useful plants from (forest types and rough locations and consider by plant use category for important plants if relevant).For locations a simple approach is to classify locations as disturbed areas (e.g. secondary forest near villages and primary forest) (Focus on categories that are obviously important, e.g. canoe trees if the village uses canoes etc.):

2. What are the main species used for house construction?

   Posts:

   Bearers:

   Rafters:

   Walls:

   Thatch:

   Rope:

3. What are the preferred firewood species?

4. Are some places more important than others for collecting plants and why? E.g. forest, swamp, grassland, riparian, Pandanus forest etc. For very important resources try to get an idea of the distance from the village based on: klostu, longwe liklik, longwe.

5. Are some important plants difficult to find and if so what plants are they?

6. How much time do you spend collecting construction material to build a new house? How much time do you spend collecting firewood each week? (Half of a day, a few days a week or less)

   House construction:

   Firewood:

   Other important resources (list):

7. If there is a drought (e.g. the 1997/98 drought or the 2015/16 drought) where do you grow your garden food (in the same gardens or in another area)? If drought does not affect the area state "Not drought affected "

8. If your garden food crops fail (e.g., due to disease or too much rain) what food do you find to feed your family (e.g. wild yams). Note if a community's main staple food is sago this question may not be so relevant but note dependence on sago.

9. Economic plants: Is there Eaglewood on your land and do you harvest it. Where is it located if present? Ask about value and current priced per kg.

   Do you harvest Massoia and if so what prices do you get? Massoia is aromatic oil derived from the bark of the tree from *Cryptocarya* species, including *Cryptocarya massoy*.

   Do you sell sago starch? If so what prices do you get?

10. Are there any threats to your plant resources (forests or other types of vegetation)? Possible threats could include actual and perceived. E.g. flooding, landslides on hilly ground, erosion, concern about logging or population increase causing overharvesting.

# FAUNA ECOSYSTEM SERVICES QUESTIONNAIRE

**BIODIVERSITY: LONG-BEAKED ECHIDNA, TREE KANGAROOS, PIG-NOSED TURTLE, SOFT-SHELLED TURTLE**

**People with no knowledge of any species (list by number):**

**SIGHTING RECORDS (LBE / LTK / GTK / DTK / PNT / SST)**

| KI # | TAXON | SIGHTING NO | WHEN? | WHERE? | OTHER INFO (WHO CAPTURED, HOW CAPTURED, WHO CONSUMED, ETC) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## ECOSYSTEM SERVICES: FOCAL RESOURCES

**T = Turtle eggs; C = crocodile eggs; F = flying fox colony; O = other**

| KI # | Taxon | When<br>Months/years? | Where | Other info (Who can access? How accessed? How capture is distributed?) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## ECOSYSTEM SERVICES: COMMERCIAL RESOURCES

**A = bush meat; B = Bird of Paradise/Parrot feathers; C = cassowary; F = fish; O = other**

| KI # | Taxon | When<br>Months/years? | Where | Other info (Value? Customers? Sale venue? Beneficiaries?) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# FAUNA ECOSYSTEM SERVICES QUESTIONNAIRE

| | |
|---|---|
| **Interviewer** | |
| **Date (day/month/year)** | / /2016 |
| **Village Name** | |
| **Photo reference** | |

## List of informants (continued over)

| No. | Name | Sex | Age | Resident of: | Duration of residency | Prior residency |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
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# APPENDIX B

# VEGETATION TERMINOLOGY

| Major vegetation group/FIMS code | FIMS Group/Description | Biodiversity Study term |
|---|---|---|
| **Natural vegetation types** | | |
| **Hill forest** | | |
| ***H*** | ***Low altitude forest on uplands (below 1,000 m)*** | ***Hill forest*** |
| Hm | Medium crowned forest | Hill forest |
| Hm.Ar | Medium crowned forest - Presence of *Araucaria* noted | Hill forest, *Araucaria* noted |
| Hm/Hs | Complex: Medium/Small crowned forest | Hill forest/small crowned hill forest |
| Hm/Sc | Complex: Medium crowned forest/Scrub | Hill forest/Scrub |
| Hs | Small crowned forest | Small crowned hill forest |
| **Alluvial forest** | | |
| ***P*** | ***Low altitude forest on plains and fans (below 1,000 m)*** | ***Alluvial forest*** |
| Pl | Large to medium crowned forest | Alluvial alluvial forest |
| Po | Open forest | Open alluvial forest |
| Po/Fsw | Complex: Open forest/Mixed swamp forest | Open alluvial forest/Swamp forest |
| Po/Fsw/M | Complex: Open forest/Mixed swamp forest/Mangrove | Open alluvial forest/Swamp forest/Mangrove |
| Po/Wsw | Complex: Open forest/Swamp woodland | Open alluvial forest/Swamp woodland |
| Ps | Small crowned forest | Small crowned alluvial forest |
| ***Fri*** | ***Seral forest*** | |
| Fri | Riverine mixed successions | Riverine seral forest |
| **Freshwater swamp habitats** | | |
| ***Fsw*** | ***Swamp forest*** | |
| Fsw | Mixed swamp forest | Swamp forest |
| FswC | Swamp forest with *Campnosperma* | Swamp forest with *Campnosperma* |
| Fsw/Gsw | Complex: Mixed swamp forest/Swamp grassland | Swamp forest/Swamp grassland |
| Fsw/M | Complex: Mixed swamp forest/Mangrove | Swamp forest/Mangrove |
| Fsw/Wsw | Complex: Mixed swamp forest/Swamp woodland | Swamp forest/Swamp woodland |
| ***W*** | ***Woodland*** | |
| Wsw | Swamp woodland | Swamp woodland |
| Wsw/Gsw | Complex: Swamp woodland/Swamp grassland | Swamp woodland/Swamp grassland |
| Wsw/Hsw | Complex: Swamp woodland/Herbaceous swamp | Swamp woodland/Herbaceous swamp |

| Major vegetation group/FIMS code | FIMS Group/Description | Biodiversity Study term |
|---|---|---|
| ***G/Hsw*** | ***Grassland and herbland*** | |
| Gri | Riverine successions dominated by grass | Riverine successional grassland |
| Gsw/Fsw | Complex: Swamp grassland/Mixed swamp forest | Swamp grassland/Swamp forest |
| Gsw/Wsw | Complex: Swamp grassland/Swamp woodland | Swamp grassland/Swamp woodland |
| Hsw | Herbaceous swamp | Herbaceous swamp |
| Hsw/Wsw | Complex: Herbaceous swamp/Swamp woodland | Herbaceous swamp/Swamp woodland |
| **Marine tidal** | | |
| ***M*** | ***Estuarine Villages*** | |
| M | Mangrove | Mangrove |
| **Littoral forest** | | |
| **B** | ***Littoral forest*** | |
| B | Mixed forest | Littoral forest |
| **Non-vegetation/areas dominated by land use** | | |
| E | Lakes and large rivers | Rivers and lakes |
| O | Non-forest areas dominated by land use | Land use |
| U | Larger urban areas | Urban areas |

# APPENDIX C

# PIG AND CHICKEN OWNERSHIP WITHIN SURVEYED VILLAGES

## Table 1. Pig ownership by community

| Village | Language group | Ecological zone | No. of surveys | Pigs minimum | Pigs maximum | No of pig owners | % pig ownership | Average pig herd |
|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | 14 | 0 | 0 | 0 | 0% | 0 |
| Kapai 2* | Iare | M | 16 | 0 | 0 | 0 | 0% | 0 |
| Maipenairu* | Iare | M | 18 | 0 | 5 | 8 | 44% | 1.88 |
| Aivai | Iare | DSP | 9 | 0 | 0 | 0 | 0% | 0 |
| Kaevaria | Iare | DSP | 10 | 0 | 1 | 1 | 10% | 1 |
| Mapaio FC | Iare | DSP | 3 | 0 | 0 | 0 | 0% | 0 |
| Aiere | Kaimare | M | 6 | 0 | 1 | 1 | 17% | 1 |
| Mariki | Kaimare | M | 17 | 0 | 25 | 14 | 82% | 7.71 |
| Upaia | Kaimare | M | 13 | 0 | 5 | 8 | 62% | 2.13 |
| Kairimai | Koriki | DSP | 19 | 0 | 1 | 2 | 11% | 1 |
| Akoma | Koriki | M | 11 | 0 | 15 | 7 | 64% | 5.43 |
| Kairu'u | Koriki | M | 10 | 0 | 17 | 6 | 60% | 7.17 |
| Apiope* | Maipua | M | 16 | 0 | 25 | 10 | 63% | 9.30 |
| Harevavo | Orokolo | SECc | 30 | 0 | 18 | 22 | 73% | 5.86 |
| Herakela | Orokolo | SECc | 21 | 0 | 0 | 0 | 0% | 0 |
| Iuku | Orokolo | SECc | 24 | 0 | 11 | 11 | 46% | 5.82 |
| Ere | Orokolo | SECi | 13 | 0 | 6 | 6 | 46% | 2.17 |
| Kilavi | Orokolo | SECi | 15 | 0 | 1 | 1 | 7% | 1 |
| Paevera | Orokolo | SECi | 15 | 0 | 2 | 2 | 13% | 2 |
| Poroi 1 | Pawaia | DSP | 5 | 0 | 0 | 0 | 0% | 0 |
| Poroi 2 | Pawaia | MPH | 14 | 0 | 1 | 2 | 14% | 1 |
| Poroi 3 | Pawaia | MPH | 5 | 0 | 2 | 4 | 80% | 1.25 |
| Subu* | Pawaia | MPH | 2 | 0 | 0 | 0 | 0% | 0 |
| Subu 2 | Pawaia | MPH | 7 | 0 | 1 | 4 | 57% | 1 |
| Ura | Pawaia | MPH | 12 | 0 | 3 | 5 | 42% | 1.6 |
| Wabo | Pawaia | MPH | 22 | 0 | 4 | 13 | 59% | 1.85 |
| Wabo Station | Pawaia | MPH | 7 | 0 | 6 | 2 | 29% | 3.5 |

* have SDA church or members in the village
Source: ERIAS Group, 2016b

## Table 2. Chicken ownership by community

| Village | Language | Ecological zone | No. of surveys | Chickens minimum | Chickens maximum | No of chicken owners | % chicken ownership | Average chicken flock |
|---|---|---|---|---|---|---|---|---|
| Evara | Ahia | DSP | 14 | 0 | 50 | 12 | 86% | 10.25 |
| Kaevaria | Iare | DSP | 10 | 0 | 38 | 7 | 70% | 17.5 |
| Mapaio FC | Iare | DSP | 3 | 5 | 30 | 3 | 100% | 12.143 |
| Aivai | Iare | DSP | 9 | 0 | 30 | 6 | 67% | 18.333 |
| Kapai 2 | Iare | M | 16 | 0 | 30 | 13 | 81% | 13.462 |
| Maipenairu | Iare | M | 18 | 0 | 52 | 12 | 67% | 21.583 |
| Aiere | Kaimare | M | 6 | 0 | 30 | 5 | 83% | 22 |
| Mariki | Kaimare | M | 17 | 0 | 10 | 13 | 76% | 5.462 |
| Upaia | Kaimare | M | 13 | 0 | 20 | 12 | 92% | 8.333 |
| Kairimai | Koriki | DSP | 19 | 0 | 23 | 11 | 58% | 9.091 |
| Akoma | Koriki | M | 11 | 0 | 20 | 5 | 45% | 11 |
| Kairu'u | Koriki | M | 10 | 0 | 30 | 5 | 50% | 14.6 |
| Apiope | Maipua | M | 16 | 0 | 35 | 12 | 75% | 15.75 |
| Harevavo | Orokolo | SECc | 30 | 0 | 25 | 16 | 53% | 7.375 |
| Herakela | Orokolo | SECc | 21 | 0 | 30 | 16 | 76% | 8.563 |
| Iuku | Orokolo | SECc | 24 | 0 | 23 | 13 | 54% | 12.313 |
| Ere | Orokolo | SECi | 13 | 0 | 15 | 8 | 62% | 10.462 |
| Kilavi | Orokolo | SECi | 15 | 0 | 30 | 12 | 80% | 9.833 |
| Paevera | Orokolo | SECi | 15 | 0 | 64 | 11 | 73% | 17.273 |
| Poroi 1 | Pawaia | DSP | 5 | 0 | 30 | 4 | 80% | 15.75 |
| Poroi 2 | Pawaia | MPH | 14 | 0 | 115 | 7 | 50% | 20.143 |
| Poroi 3 | Pawaia | MPH | 5 | 0 | 12 | 4 | 80% | 5.25 |
| Subu | Pawaia | MPH | 2 | 0 | 0 | 0 | 0% | 0 |
| Subu 2 | Pawaia | MPH | 7 | 0 | 2 | 3 | 43% | 1.667 |
| Ura | Pawaia | MPH | 12 | 0 | 30 | 6 | 50% | 6.833 |
| Wabo | Pawaia | MPH | 22 | 0 | 5 | 6 | 27% | 2.333 |
| Wabo Station | Pawaia | MPH | 7 | 0 | 12 | 3 | 43% | 8.333 |

Source: ERIAS Group, 2016b

# APPENDIX D

# CANOE TREES

## Types of canoe trees identified by villagers

| Species/Village | Aivai | Avavu | Evara | Herekela | Iuku | Larihairu | Paevera | Poroi | Subu | Ura | Wabo | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Alstonia scholaris* | | | | | 1 | | | | | | 1 | **2** |
| *Anacardiaceae* | | | 1 | | | | | | | | | **1** |
| *Anthocephalus chinensis* | 1 | 1 | | | | | | | | | | **2** |
| *Antiaris toxicaria* | | 1 | 1 | 1 | 1 | | | 1 | 1 | | 1 | **7** |
| *Artocarpus sp.* | | | 1 | | | | | | | | | **1** |
| *Buchanania sp.* | | | | 1 | | | | | | | | **1** |
| *Burkella sp.* | | | 1 | | | | | | | | | **1** |
| *Cryptocarya sp.* | | 1 | | | | | | | | | | **1** |
| *Elmerrillia papuana* | | | | | | | | 1 | 1 | 1 | 1 | **4** |
| *Endospermum sp.* | | | | | | | | | | | 1 | **1** |
| *Garcinia sp.* | | | | | | | | 1 | 1 | | | **2** |
| *Hernandia sp.* | | | | 1 | | | | | | | | **1** |
| *Homalium foetidum* | | | | | | | | | | | 1 | **1** |
| *Intsia palembanica* | 1 | | | | | | | 1 | | | | **2** |
| *Litsea sp.* | | 1 | | | | 1 | | | | | | **2** |
| *Nauclea sp.* | 1 | | | | | | | | | | | **1** |
| *Octomeles sumatrana* | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | **9** |
| *Pometia pinnata* | | | 1 | | | | | | | | | **1** |
| *Pouteria sp.* | | | | | | | | | | | 1 | **1** |
| *Pterocarpus indicus* | 1 | 1 | | 1 | | | | | | | | **3** |
| *Sonneratia sp.* | | 1 | | | | | | | | | | **1** |
| *Sterculia sp.* | | | | | 1 | | | | | | | **1** |
| *Syzygium sp.* | | | | 1 | | | | | | | | **1** |
| *Terminalia kaernbachii* | | | 1 | | | | | | | | 1 | **2** |
| *Terminalia sp.* | 1 | 1 | 1 | | 1 | 1 | | 1 | | | 1 | **7** |
| *Toona sureni* | | 1 | | 1 | | | | 1 | | | | **3** |
| *Trema orientalis* | | | | 1 | | | | | | | | **1** |
| **Total** | **6** | **9** | **7** | **8** | **5** | **3** | **1** | **7** | **4** | **1** | **9** | |

Source: ERIAS Group 2016c.

# APPENDIX E

# PLANT SPECIES BASED ECOSYSTEM SERVICES

**Notes**

Plant Use: Can = Canoe; Cul = Cultural; D = Domestic; FD = Firewood; F = Food; H = House Construction; Hu = Hunting/Fishing; M = Medicinal

Category codes for Plant Part: IB = Inner Bark; OB = Outer Bark; S = Stem; L = Leaf; R = Roof; SP = sap; T = Timber; F = Fruit

Category codes for Types of Plant: G = Grass; B = Bamboo; T = Tree; TF = Tree fern; H = Herb; F = Fern; S = Shrub; M = Medicinal; O = Other

Species: Where a plant could not be identified to genus level but the family is known the family has been entered in capital letters

Use and preparation: No. 1 = Most preferred species for the particular use where stated. No. 2 = second most preferred use etc.

*= Weed species

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Bamboo | *Bambusa sp.* | Hoiare | D | S | Sections of stem used as a container for cooking on fire to steam food (vegetables, fish and meat) |
| Ahia | Evara | Climber/Vine | *Derris sp.* | I | Hu | S | Stem beaten and sap extracted to kill fish by placing on surface of water |
| Ahia | Evara | Climber/Vine | *Dioscorea sp.* | Kil'e | M | L | Rub on cut forehead to relieve any kind of sickness (cultural type of medicine mainly) |
| Ahia | Evara | Climber/Vine | *Merremia sp.* | Hahoike | D | S | Used as rope to tie bundles of firewood |
| Ahia | Evara | Climber/Vine | *Piper betel* | Yoro | Cul | F | Seed (daka) chewed with betel nut to enhance stimulant effect |
| Ahia | Evara | Climbing palm | *Calamus aruensis* | Hiruka | D | L | Leaves used for wrapping food (large size) |
| Ahia | Evara | Climbing palm | *Calamus aruensis* | Hiruka | H | S | Cane rope used for house construction (large size) |
| Ahia | Evara | Climbing palm | *Calamus sp.* | Oihakare | H | S | Cane rope used for house construction |
| Ahia | Evara | Climbing palm | *Korthalsia zippelii* | Hoyokare | H | S | Strong cane rope for house construction. Also used for tethering canoes |
| Ahia | Evara | Fern | *Diplazium esculentum* | Pipiko | F | Leaf | Edible new shoots (leaves). Usually cooked |
| Ahia | Evara | Grass | *Miscanthus floridulus* | Moi | Hu | S | Stem used for arrow shafts |
| Ahia | Evara | Grass | *Saccharum edule* | Moi (Tok Pisin - Pitpit) | Hu | S | Stem used for arrow shafts |
| Ahia | Evara | Herb | *Comminsia sp.* | Hiokoro | D | L | Leaves used for wrapping food prior to cooking |
| Ahia | Evara | Herb | *Comminsia sp.* | Hiokoro | H | L | Leaves used for roof thatch on hunting houses/temporary huts |
| Ahia | Evara | Herb | *Horstedtia scottiana* | Uhu'e | F | F | Edible fruit |
| Ahia | Evara | Herb | Not seen or identified during survey | Heokoro | H | L | Leaf used for thatched roof |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Herb | Not seen or identified during survey | Heokoro | H | L | Leaf used for wrapping food for cooking |
| Ahia | Evara | Palm | *Actinorhytis sp.* | Noporo | H | S | Stem split for flooring |
| Ahia | Evara | Palm | *Actinorhytis sp.* | Noporo | F | F/L | Edible new shoots. Fruit used as a replacement for betel nut |
| Ahia | Evara | Palm | *Areca catechu* | Ihere | H | S | Stem split for flooring (Betelnut palm) |
| Ahia | Evara | Palm | *Areca catechu* | Ehere | Cul | F | Nut is chewed together with lime and mustard as stimulant (Betelnut palm) |
| Ahia | Evara | Palm | *Arenga macrocarpa* | Korovea | D | L | Leaves rachis used for making broom |
| Ahia | Evara | Palm | *Arenga macrocarpa* | Korovea | F | S | Young shoots are edible |
| Ahia | Evara | Palm | *Black Palm* | Apo | D | I | Inflorescence used for a broom |
| Ahia | Evara | Palm | *Black Palm* | Apo | H | S | Stem split for flooring |
| Ahia | Evara | Palm | *Black Palm* | Buho - Horeova | Hu | S | Stem used to make arrow heads |
| Ahia | Evara | Palm | *Caryota rumphiana* | Buho - Hoporo | D | S | Stem used to make a strong axe handle |
| Ahia | Evara | Palm | *Cocos nucifera* | Ne | D | L | Leaves used to make a broom |
| Ahia | Evara | Palm | *Cocos nucifera* | Ne | H | S | House post |
| Ahia | Evara | Palm | *Cocos nucifera* | Ne | F | F | Edible nut (Coconut) |
| Ahia | Evara | Palm | *Hydriastele costata* | Hoiho | D | F | Inflorescence used as a broom |
| Ahia | Evara | Palm | *Hydriastele costata* | Hoiho | H | S | Stem split for flooring |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Palm | *Hydriastele costata* | Hoiho | H | S | Stem split for flooring |
| Ahia | Evara | Palm | *Hydriastele costata* | Hoiho | H | I | Inflorescence used for a broom |
| Ahia | Evara | Palm | *Meteroxylon sagu* | Poi | F | S | Stem processed to extract starch for food. Edible mushrooms also harvested from sago waste |
| Ahia | Evara | Palm | *Meteroxylon sagu* | Poi | H | L | Leaves used for thatched roofing |
| Ahia | Evara | Pandanus | *Pandanus conoideus* | Hokob'ea | F | F | Edible fruit. Juice from red seed extracted to make a soup |
| Ahia | Evara | Tree | *ANACARDIACEAE* | Murito | H | S | Bearer (carries the weight of the floor joists across the length of the house) |
| Ahia | Evara | Tree | *ANACARDIACEAE* | Morito | H | S | House bearers and studs |
| Ahia | Evara | Tree | *ANACARDIACEAE* | Morito | Can | S | Canoe tree |
| Ahia | Evara | Tree | *Antiaris toxicaria* | Moo | Can | S | Preferred canoe tree (the best species) |
| Ahia | Evara | Tree | *Artocarpus sp.* | Liuko | F | F | Edible fruit |
| Ahia | Evara | Tree | *Artocarpus sp.* | Liuko | Can | S | Canoe tree |
| Ahia | Evara | Tree | *Burkella sp.* | Poihohouke | H | S | Bearer and floor joists |
| Ahia | Evara | Tree | *Burkella sp.* | Poihohouke | Can | S | Canoe tree |
| Ahia | Evara | Tree | *Cananga odorata* | Keroro | D | OB | Outer bark used as a floor mat |
| Ahia | Evara | Tree | *Cananga odorata* | Keroro | H | OB | Bark used for house walls |
| Ahia | Evara | Tree | *Celtis sp.* | Mou | FD | S | Most preferred firewood |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Tree | *Celtis sp.* | Mou | FD | T | The best firewood species |
| Ahia | Evara | Tree | *Celtis sp.* | Mou | H | S | House bearers and studs |
| Ahia | Evara | Tree | *Cryptocarya sp.* | Horitohuweke | Hu | IB | Bark scrapings mixed with water and fed to dog to improve hunting ability |
| Ahia | Evara | Tree | *Cryptocarya sp.* | Horitohuweke | M | IB | Bark scrapings rolled with tobacco and smoked to relive sickness |
| Ahia | Evara | Tree | *Diospyros sp.* | Kako | H | S | Bearer |
| Ahia | Evara | Tree | *Dracontomelon dao* | Ouho | H | S | Bearer |
| Ahia | Evara | Tree | *Dracontomelon dao* | Ouho | FD | T | Firewood |
| Ahia | Evara | Tree | *Dysoxylum gaudichaudianum* | Koreaovo | H | S | General house construction |
| Ahia | Evara | Tree | *Dysoxylum gaudichaudianum* | Koreaovo | Hu | F | Hunting tree. Hornbills and Victoria crowned pigeons feed on fruits |
| Ahia | Evara | Tree | *Endospermum medullosum* | Horohoro | H | S | General house construction including rafters |
| Ahia | Evara | Tree | *Endospermum sp.* | Horohoro | H | S | House studs |
| Ahia | Evara | Tree | *Ficus nodosa* | Hovehe | Cul | B | Bark used to make tapa cloth |
| Ahia | Evara | Tree | *Ficus polyantha* | E'ra | Hu | F | Hunting tree. Flying fox feed on fruit |
| Ahia | Evara | Tree | *Ficus wasa* | Mouhe | D | L | Leaf used as sandpaper and to scrub pots |
| Ahia | Evara | Tree | *Garcinia sp.* | Maoe | H | S | House posts and bearers |
| Ahia | Evara | Tree | *Glochidion sp.* | Popu | H | F | Stem split for flooring and walling |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Tree | *Gnetum gnemon* | Uri | FD | T | Firewood |
| Ahia | Evara | Tree | *Gnetum gnemon* | Uri | Cul | IB | Inner bark used as rope for weaving string bag (bilum) |
| Ahia | Evara | Tree | *Gnetum gnemon* | Uri | F | F /L | Fruit and leaves are edible |
| Ahia | Evara | Tree | *Homalium foetidum* | Kevea | H | S | House post |
| Ahia | Evara | Tree | *Intsia palembanica* | Pido | H | S | Most preferred house post |
| Ahia | Evara | Tree | *Macaranga aleuritoides* | Pokue | H | S | Rafter |
| Ahia | Evara | Tree | *Macaranga sp.* | Kokio | H | L | Leave used as roofing for bush house/hunting hut (Large leaf Macaranga sp.) |
| Ahia | Evara | Tree | *MALVACEAE* | Hore Hore | D | L | House posts and stem split for house walls |
| Ahia | Evara | Tree | *MALVACEAE* | Hore Hore | D | L | Used to make floor mats |
| Ahia | Evara | Tree | *MALVACEAE* | Horehore | H | T | Bearer |
| Ahia | Evara | Tree | *Myristica sp.* | Hapo | M | F | Fruit eaten to cure cough |
| Ahia | Evara | Tree | *Myristica sp.* | Hapo | FD | S | Firewood |
| Ahia | Evara | Tree | *Planchonia papuana* | Purite | H | S | House posts and bearer |
| Ahia | Evara | Tree | *Pometia pinnata* | Uhabu | H | T | Bearer |
| Ahia | Evara | Tree | *Pometia pinnata* | Uhabu | F | F | Edible fruit |
| Ahia | Evara | Tree | *Pometia pinnata* | Uhabu | Can | S | Canoe tree |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Tree | *Pometia pinnata* | Uhabu | FD | T | Firewood |
| Ahia | Evara | Tree | *Premna orientalis* | Opitoro | H | S | Rafters |
| Ahia | Evara | Tree | *Premna orientalis* | Opitoro | M | L | Leaf boiled and steam inhaled for curing body and headaches. |
| Ahia | Evara | Tree | *Pterocarpus indicus* | Opo | H | S | House posts |
| Ahia | Evara | Tree | *Terminalia kaernbachii* | Hipo | H | S | Bearer |
| Ahia | Evara | Tree | *Terminalia kaernbachii* | Hipo | Can | S | Canoe tree |
| Ahia | Evara | Tree | *Terminalia kaernbachii* | Hipo | F | F | Edible nut |
| Ahia | Evara | Tree | *Terminalia sp.* | Hidaeo | Can | S | Preferred canoe tree |
| Ahia | Evara | Tree | *Vitex cofassus* | Moio | H | S | House post. Third best species |
| Ahia | Evara | Tree | Not seen or identified during survey | Horitohuveke | M | IB | Scrape bark and mix with water and drink for curing sickness and for giving energy for playing sports |
| Ahia | Evara | Tree | Not seen or identified during survey | Horitohuveke | Hu | IB | Scrape bark and mix with water give it to the dogs to enhance their hunting performance |
| Ahia | Evara | Tree | Not seen or identified during survey | Kite | M | L | Leaf used for curing body pain and headaches. |
| Ahia | Evara | Tree | Not seen or identified during survey | Hapo | F | T, F | Fruit is edible |
| Ahia | Evara | Tree | Not seen or identified during survey | Kurobaubau | H | T | House bearers |
| Ahia | Evara | Tree | Not seen or identified during survey | Iharo | H | T | House posts |
| Ahia | Evara | Tree | Not seen or identified during survey | Daredare | H | T | House bearers |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Ahia | Evara | Tree | Not seen or identified during survey | Kikiro | H | T | House rafters |
| Ahia | Evara | Tree | Not seen or identified during survey | Kumoi | H | T | House bearers |
| Ahia | Evara | Tree | Not seen or identified during survey | Uahu | H | T | House rafters |
| Ahia | Evara | Tree | Not seen or identified during survey | Leke | H | T | House rafters |
| Ahia | Evara | Tree | Not seen or identified during survey | Moroko | H | S | Stem split for house walls |
| Ahia | Evara | Tree | Not seen or identified during survey | Kubokeo | FD | T | Firewood |
| Ahia | Evara | Tree | Not seen or identified during survey | Pairae | FD | T | Firewood |
| Ahia | Evara | Not seen during survey | Not seen or identified during survey | Kokeou | H | L | Leaves used for thatched roof |
| Ahia | Evara | Not seen during survey | Not seen or identified during survey | Uruavu | H | L | Leaves used for thatched roof |
| Ahia | Evara | Not seen during survey | Not seen or identified during survey | Hokoro | H | L | Leaves used for thatched roof |
| Ahia | Evara | Not seen during survey | Not seen or identified during survey | Oparove | H | S | Traditional rope |
| Iare - D | Aivai | Bamboo | *Bambusa sp.* | Vanua | Hu | S | Stem used for constructing hunting bows |
| Iare - D | Aivai | Bamboo | *Bambusa sp.* | Inaku | D | S | Stem sections used as a cooking pot for sago and fish and as a container for carrying water. Soft bamboo species |
| Iare - D | Aivai | Climber/Vine | *Piper sp.* | Kora | Cul | S | Native Piper species chewed with betel nut and lime |
| Iare - D | Aivai | Climbing palm | *Calamus petilis* | Ini haro | M | S | Liquid from the stem used as an eye drop to cure sore eyes |
| Iare - D | Aivai | Climbing palm | *Calamus sp.* | Ini urupu (white stem) | H | S | Traditional rope |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Iare - D | Aivai | Climbing palm | *Calamus sp.* | Ini moroa | H | S | Traditional rope |
| Iare - D | Aivai | Fern | *Acrostichum aureum* | Veia | F | L | Greens |
| Iare - D | Aivai | Fern | *Stenochlaena pallustris* | Veia | F | L | Edible new leaves |
| Iare - D | Aivai | Fern | Not seen or identified during survey | Aua'rape | F | L | Edible new shoots |
| Iare - D | Aivai | Fern | Not seen or identified during survey | Auwarate | F | L | Edible new leaves |
| Iare - D | Aivai | Herb | *Ammomum sp.* | Varae moroa | F | F | Fruit is edible |
| Iare - D | Aivai | Herb | *Ammomum sp.* | Varae moroa | D | L | Leaves used as wrapper for cooking fish and nice aromatic spell |
| Iare - D | Aivai | Herb | *Cominsia gigantea* | Vi'pipr | D | L | Leaves used for wrapping sago for cooking |
| Iare - D | Aivai | Palm | *Actinorhytis calapparia* | Auri'ipir | H | S | Stem split for flooring |
| Iare - D | Aivai | Palm | *Actinorhytis sp.* | Makuru | Hu | S | Stem used to make hunting bows and spears |
| Iare - D | Aivai | Palm | *Areca sp.* | Kamea | Cul | F | Substitute for betel nut (Kabibi) |
| Iare - D | Aivai | Palm | *Arenga macrocarpa* | Kauwapa | F | S | Young shoots are edible, taken from the base of the stem |
| Iare - D | Aivai | Palm | *Arenga macrocarpa* | Kauwapa | H | S | Stem used as a house post for a temporary shelter or cook house |
| Iare - D | Aivai | Palm | *Arenga macrocarpa* | Kauwapa | Cul | L | Leaves used to make decoration for welcoming guests and singsings |
| Iare - D | Aivai | Palm | *Arenga macrocarpa* | Kauwapa | D | L | Leaf rachis used to make brooms |
| Iare - D | Aivai | Palm | *Calyptrocalyx albertisianus* | Varia ika | H | S | House post and stem split for flooring |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Iare - D | Aivai | Palm | *Caryota rumphiana* | Vaiapa | Hu | S | Arrow head for hunting pigs |
| Iare - D | Aivai | Palm | *Caryota rumphiana* | Vaiapa | F | S | Edible grubs harvested from rotting stem |
| Iare - D | Aivai | Palm | *Caryota rumphiana* | Vaiapa | D | S | Stem used to make strong axe handles |
| Iare - D | Aivai | Palm | *Caryota rumphiana* | Vaiapa | D | S | Sago pounder handle and axe handle |
| Iare - D | Aivai | Palm | *Cocos nucifera* | Beira | H | S | Preferred house post (No.2) |
| Iare - D | Aivai | Palm | *Cocos nucifera* | Beira | F | F | Edible nut |
| Iare - D | Aivai | Palm | *Cocos nucifera* | Beira | D | L | Leaf midrib used to make broom |
| Iare - D | Aivai | Palm | *Korthalsia zippelii* | Ini urupu (white stem) | H | S | Traditional cane rope |
| Iare - D | Aivai | Palm | *Licuala lauterbachii* | Koraka | Hu | S | Stem used to make hunting bows |
| Iare - D | Aivai | Palm | *Nypa fruticans* | Onopu | H | L | Leaves used for house thatch |
| Iare - D | Aivai | Palm | *Nypa fruticans* | Onopu | F | F | Edible nut (starchy) |
| Iare - D | Aivai | Palm | Not seen or identified during survey | Makuru | H | S | Stem used for house posts and split for flooring |
| Iare - D | Aivai | Palm | Not seen or identified during survey | Auri ipiri | Hu | S | Stem used for arrow heads |
| Iare - D | Aivai | Pandanus | *Pandanus sp.* | Auni | H | R | Tall prop roots split for use as framing to attach sago roofing |
| Iare - D | Aivai | Pandanus | *Pandanus sp.* | Oa'a (pronounced wa'a) | D | L | Leaves used to weave traditional mats. Leaves stripped and boiled and then dried before weaving. Pandanus grows by creeks |
| Iare - D | Aivai | Shrub | *Donax canniformis* | Nivaea | M | L | Sap from young leaf petiole is used as an eye drop to cure sore eyes |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Iare - D | Aivai | Shrub | *Homalomena sp* | Kaui minai minai | Cul | L | Leaf petiole cut and boiled, then given to dog to improve hunting ability |
| Iare - D | Aivai | Tree | *Anthocephalus chinensis* | Oviorupu (white) | Can | S | Canoe tree (No. 2) and paddle |
| Iare - D | Aivai | Tree | *Calophyllum sp.* | Varakia | H | T | House post (No. 1) |
| Iare - D | Aivai | Tree | *Canarium sp.* | None provided during survey | H | T | House post |
| Iare - D | Aivai | Tree | *Dracontomelon dao* | Oamu | H | T | House bearer |
| Iare - D | Aivai | Tree | *Dracontomelon dao* | Oamu | F | F | Fruit is edible |
| Iare - D | Aivai | Tree | *Ficus polyantha* | Pouku | M | SP | Sap mixed with water and drunk to cure diarrhea |
| Iare - D | Aivai | Tree | *Ficus polyantha* | Pouku | Cul | IB | Bark used for traditional tapa cloth |
| Iare - D | Aivai | Tree | *Ficus sp. (strangler fig)* | E'ere | Cul | L, IB, OB | Boil and steam and inhale to drive away evil spirits. |
| Iare - D | Aivai | Tree | *Gastonia spectabilis* | Ba'apa | FD | S | Firewood (No. 2) |
| Iare - D | Aivai | Tree | *Goniothalamus sp.* | Eape | M | L, R, B | Leaves and bark boiled and then mixed with lemon grass. Mixture mixed with cold water to wash body to relieve fever and body pain (No. 1) |
| Iare - D | Aivai | Tree | *Homalium foetidum* | Dorebaro | H | T | House posts (No. 2) and bearers |
| Iare - D | Aivai | Tree | *Homalium foetidum* | Dorebaro | FD | S | Firewood |
| Iare - D | Aivai | Tree | *Intsia palembanica* | Ora | H | T | Preferred house post (No.1) |
| Iare - D | Aivai | Tree | *Intsia palembanica* | Ora | Can | S | Canoe tree |
| Iare - D | Aivai | Tree | *Intsia palembanica* | Ora | FD | T | Firewood. Branches preferred (No. 1) |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Iare - D | Aivai | Tree | *Macaranga aleuritoides* | Arako | H | T | House bearer, floor joist, studs, rafters |
| Iare - D | Aivai | Tree | *Myristica sp.* | Ma'uni | F | F | Flesh of fruit edible |
| Iare - D | Aivai | Tree | *Nauclea sp.* | Oviaharo (yellow) | Can | S | Canoe tree and for making canoe paddles |
| Iare - D | Aivai | Tree | *Octomeles sumatrana* | Ipaa | Can | S | Canoe tree |
| Iare - D | Aivai | Tree | *Pometia pinnata* | O'amu | H | T | Bearers and flooring |
| Iare - D | Aivai | Tree | *Pometia pinnata* | O'amu | F | F | Edible fruit |
| Iare - D | Aivai | Tree | *Pterocarpus indicus* | Aravea | M | SP | Sap mixed with water and drink to cure diarrhea |
| Iare - D | Aivai | Tree | *Pterocarpus indicus* | Aravea | H | T | House post |
| Iare - D | Aivai | Tree | *Pterocarpus indicus* | Aravea | Can | T | Canoe tree |
| Iare - D | Aivai | Tree | *Syzygium sp.* | Kapaea ma'a | F | F | Edible fruit |
| Iare - D | Aivai | Tree | *Terminalia sp.* | Niene | Can | S | Canoe tree |
| Iare - D | Aivai | Tree | *Terminalia sp.* | Muria | H | T | House post (No. 2) |
| Iare - D | Aivai | Tree | *Terminalia sp.* | Heauma one ne | H | T | House post and bearers |
| Iare - D | Aivai | Tree | *Terminalia sp.* | Heauma one ne | Can | S | Canoe tree |
| Iare - D | Aivai | Tree | *Trichospermum sp.* | Uri | D | S | Stems tied together with kwila (Intsia sp.) logs to raft logs to village. Trichospermum is used as a float to prevent the kwila logs sinking |
| Iare - D | Aivai | Tree | *Trichospermum sp.* | Uri | D | OB | Bark laid on ground to provide a slippery surface to pull heavy kwila logs across to the river bank before rafting to the village |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Iare - D | Aivai | Tree | *Trichospermum sp.* | Uri | D | B | Traditional rope |
| Iare - D | Aivai | Tree | Not seen or identified during survey | Va'apa | FD | S | Firewood |
| Iare - D | Aivai | Tree | Not seen or identified during survey | Puiri | FD | S | Firewood |
| Orokolo coast | Herekela | Climbing palm | *Calamus sp.* | Merovo | H | S | Traditional cane rope used as a replacement for nails (small species) |
| Orokolo coast | Herekela | Climbing palm | *Calamus vitiensis* | Paeva | H | S | Traditional cane rope (large species) |
| Orokolo coast | Herekela | Fern | *Stenochlaena pallustris* | Lala | D | IB | Traditional rope for tying fences and canoes |
| Orokolo coast | Herekela | Herb | *Alpina pulchra* | Orioa | D | L | Leaves used to wrap sago and fish/meat for cooking |
| Orokolo coast | Herekela | Herb | *Alpinia sp.* | Korovo | Cul | SP/S/L | Sap/parts of plant rubbed on body to smell nice for singsing |
| Orokolo coast | Herekela | Herb | *Ammomum sp.* | Oakoru | D | L | Leaves used to wrap sago, fish and meat for cooking |
| Orokolo coast | Herekela | Herb | *ZINGIBERACEAE* | Poroa | M | L | Boil leaf and inhale steam to cure headache or flu |
| Orokolo coast | Herekela | Herb | *ZINGIBERACEAE* | Poroa | F | F | Edible fruit |
| Orokolo coast | Herekela | Palm | *Areca sp.* | Miroro | Cul | F | Substitute for betel nut (Kabibi) |
| Orokolo coast | Herekela | Palm | *Arenga macrocarpa* | Kaukaa | D | L | Leaf rachis used for making broom |
| Orokolo coast | Herekela | Palm | *Arenga macrocarpa* | Kaukaa | H | S | Post for temporary shelter or kitchen house |
| Orokolo coast | Herekela | Palm | *Arenga macrocarpa* | Kaukaa | F | S | Edible new shoots at base of stem |
| Orokolo coast | Herekela | Palm | *Calyptrocalyx albertisianus* | Apo | Hu | S | Stem used to make hunting bows and arrows |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Herekela | Palm | *Caryota rumphiana* | Hapara | Hu | S | Axe handle, hunting bow, arrow head |
| Orokolo coast | Herekela | Palm | *Caryota rumphiana* | Hapara | M | S | Scrape bark, squeeze liquid onto cut wound and dress it as cure for leprosy sores |
| Orokolo coast | Herekela | Palm | *Cocos nucifera* | Na a | D | L | Leaf rachis used to make brooms |
| Orokolo coast | Herekela | Palm | *Cocos nucifera* | Na a | H | S/L | House posts and thatch |
| Orokolo coast | Herekela | Palm | *Cocos nucifera* | Na a | F | F | Staple food |
| Orokolo coast | Herekela | Palm | *Cyrtostachys sp* | Apo | Hu | S | Hunting bow and arrow head |
| Orokolo coast | Herekela | Palm | *Hydriastele costata* | Haea | H | S | Stem split for flooring |
| Orokolo coast | Herekela | Palm | *Korthalsia zippelii* | Paiha | D | S | Traditional cane rope |
| Orokolo coast | Herekela | Palm | *Meteroxylon sagu* | Poi | H | L | House thatch and leaves woven for house walls |
| Orokolo coast | Herekela | Palm | *Meteroxylon sagu* | Poi | F | S | Staple food processed from stem pith - sago starch |
| Orokolo coast | Herekela | Palm | *Nypa fruticans* | Maitai | H | L | House thatch and leaves woven for house walls |
| Orokolo coast | Herekela | Palm | *Orania lauterbachiana* | Hevehemiro | H | S | Stem split for flooring and walls |
| Orokolo coast | Herekela | Shrub | *Cominsia gigantea* | Mailala | D | L | Leaves used for wrapping food prior to cooking |
| Orokolo coast | Herekela | Shrub | *Cominsia gigantea* | Mailala | H | L | Leaves used as a ridge cap for thatched roof |
| Orokolo coast | Herekela | Shrub | *Laportea sp.* | Oe | M | L | Leaves rubbed on skin as pain killer. Important plant |
| Orokolo coast | Herekela | Tree | *Aglaia sp.* | Mahia | H | T | House rafters |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Herekela | Tree | *Alstonia scholaris* | Kavi | M | SP | Collect and drink white sap as cure for a strong cough |
| Orokolo coast | Herekela | Tree | *Alstonia scholaris* | Kavi | M | L, IB | Boil leaf and bark together. Inhale steam to cure body aches |
| Orokolo coast | Herekela | Tree | *Anthocephalus chinensis* | Hupu | H | T | Stem split for flooring and weatherboards |
| Orokolo coast | Herekela | Tree | *Anthocephalus sp.* | Hupu | H | T | Stem split for flooring and weather boards |
| Orokolo coast | Herekela | Tree | *Antiaris toxicaria* | Moa | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Baccaurea papuana* | Aia | H | T | House post |
| Orokolo coast | Herekela | Tree | *Baccaurea papuana* | Aia | F | F | Edible fruit |
| Orokolo coast | Herekela | Tree | *Barringtonia sp.* | Ivaloahao | Cul | F | Cut fruit, dry it in the sun then make fire with it during the planting of new garden so that the food crops will have high yield |
| Orokolo coast | Herekela | Tree | *Bischofia javanica* | Hapokeke | H | T | House bearers and floor joists |
| Orokolo coast | Herekela | Tree | *Bruguiera sp.* | Para | H | T | House bearer, floor joist, stud |
| Orokolo coast | Herekela | Tree | *Buchanania sp.* | Mauveri | H | T | Stem split for flooring |
| Orokolo coast | Herekela | Tree | *Buchanania sp.* | Mauveri | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Calophyllum sp.* | Harova | H | T | House post (No. 1), stud, rafters |
| Orokolo coast | Herekela | Tree | *Canarium sp.* | Uvori | H | T | House posts, bearers, studs |
| Orokolo coast | Herekela | Tree | *Diospyros sp.* | Kauka | H | T | Rafters |
| Orokolo coast | Herekela | Tree | *Ficus sp.* | Laiara | Cul | L | Young leaves boiled to extract red dye to dye grass skirts for singsings |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Herekela | Tree | *Ficus sp. (strangler fig)* | Iropu | M | IB, OB | Cut bark, boil, strain and drink to cure any major sickness. Often used close to death |
| Orokolo coast | Herekela | Tree | *Gnetum gnemon* | Uri | D | IB | Bark fibers used to make string for weaving traditional bilums |
| Orokolo coast | Herekela | Tree | *Gnetum gnemon* | Uri | F | L | Edible new leaves |
| Orokolo coast | Herekela | Tree | *Gnetum gnemon* | Uri | F | F | Edible fruit |
| Orokolo coast | Herekela | Tree | *Gnetum gnemon* | Uri | FD | S | Firewood |
| Orokolo coast | Herekela | Tree | *Goniothalamus sp.* | Ivuru | Cul | SP | Sap used for welcoming guests |
| Orokolo coast | Herekela | Tree | *Haplolobus sp.* | Laia | D | OB | Smoke from bark used to keep insect pests away from garden crops |
| Orokolo coast | Herekela | Tree | *Hernandia sp.* | Malaira | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Hibiscus sp.* | Moi | H | T | Stem split for flooring and walls |
| Orokolo coast | Herekela | Tree | *Hibiscus tilliaceous* | Oro | D | IB/OB | Bark used to make rope/twine |
| Orokolo coast | Herekela | Tree | *Hibiscus tilliaceous* | Oro | FD | S/Be | Firewood |
| Orokolo coast | Herekela | Tree | *Homalium foetidum* | Kavea | H | T | Posts (No. 1), bearers and rafters |
| Orokolo coast | Herekela | Tree | *Hopea sp.* | Moi | H | T | Stem split for flooring and walls |
| Orokolo coast | Herekela | Tree | *Intsia bijuga* | Pira | H | T | Preferred house post, (no.2), bearer |
| Orokolo coast | Herekela | Tree | *Kleinhovia hospita* | Mao | D | IB, OB | Traditional rope |
| Orokolo coast | Herekela | Tree | *Kleinhovia hospita* | Mao | FD | S | Firewood |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Herekela | Tree | *Litsea sp.* | Murita | H | T | House rafters |
| Orokolo coast | Herekela | Tree | *Mangifera sp.* | Mewe | F | F | Edible fruit (wild mango) |
| Orokolo coast | Herekela | Tree | *Mangifera sp.* | Mewe | FD | S | Firewood |
| Orokolo coast | Herekela | Tree | *Mastixodendron sp.* | Mahumahu | H | T | House posts, bearers, studs and rafters |
| Orokolo coast | Herekela | Tree | *Myristica sp.* | Ahao | H | T | Stem split for flooring and walls |
| Orokolo coast | Herekela | Tree | *Myristica sp.* | Peri | Cul | L | Leaf petiole sap used for white body painting/writing |
| Orokolo coast | Herekela | Tree | *Octomeles sumatrana* | Ehohea/Ilimo | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Pometia pinnata* | Ohavu | H | T | House bearers and floor joist |
| Orokolo coast | Herekela | Tree | *Pometia pinnata* | Ohavu | FD | S | Firewood |
| Orokolo coast | Herekela | Tree | *Premna sp.* | Karokaro | H | T | House bearers, floor joists and studs |
| Orokolo coast | Herekela | Tree | *Pterocarpus indicus* | Haravea | H | T | Preferred house post (No.1), bearer and floor joist |
| Orokolo coast | Herekela | Tree | *Pterocarpus indicus* | Haravea | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Rhus taitensis* | Maroaha | Cul | L | Boil young leaves to extract white dye for grass skirt for traditional singsing. |
| Orokolo coast | Herekela | Tree | *Semecarpus sp.* | Hopepe | D | S | Axe handle |
| Orokolo coast | Herekela | Tree | *Sonneratia sp.* | Lokoa | H | T | House bearers |
| Orokolo coast | Herekela | Tree | *Syzygium sp.* | Ovokora | H | T | Stem split for flooring |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Herekela | Tree | *Syzygium sp.* | Ovokora | Can | S | Canoe tree (strong and lasts several years) |
| Orokolo coast | Herekela | Tree | *Talipariti sp.* | None provided during survey | H | T | House studs. Strong timber |
| Orokolo coast | Herekela | Tree | *Terminalia kaernbachii* | Hio | H | T | Bearer, floor joist |
| Orokolo coast | Herekela | Tree | *Terminalia kaernbachii* | Hio | FD | S | Firewood |
| Orokolo coast | Herekela | Tree | *Terminalia kaernbachii* | Hio | F | F | Edible nuts |
| Orokolo coast | Herekela | Tree | *Terminalia sp.* | Kava | H | T | House bearers, joists and studs |
| Orokolo coast | Herekela | Tree | *Terminalia sp.* | Murita | H | T | House bearers and studs |
| Orokolo coast | Herekela | Tree | *Toona sureni* | Kepere | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Trema orientalis* | Larie | Can | S | Canoe tree |
| Orokolo coast | Herekela | Tree | *Vitex cofassus* | Maea | H | T | House bearers, floor joists and rafters |
| Orokolo coast | Herekela | Tree | Not seen or identified during survey | Laia | D | SP | Dry sap (resin) is burned to chase away insects and mosquitos |
| Orokolo coast | Herekela | Not seen during survey | Not seen or identified during survey | Leihou | M | L | Young leaves boiled strained and drunk it to cure all kinds of sickness |
| Orokolo coast | Iuku | Climber/Vine | *Lapidopthera sp* | Paparo | D | S | Traditional rope |
| Orokolo coast | Iuku | Climbing palm | *Calamus sp.* | Merove | D | S | Traditional cane rope (small species) |
| Orokolo coast | Iuku | Fern | *Acrostichum aureum* | Pepeka | F | L | Edible young leaves |
| Orokolo coast | Iuku | Fern | *Stenochlaena pallustris* | Lara | D | S | Inner stem used as rope |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Iuku | Fern | *Stenochlaena pallustris* | Lara | F | L | Edible young leaves |
| Orokolo coast | Iuku | Herb | *Ammomum sp.* | Erau'oa | D | L | For wrapping fish prior to cooking over fire. Gives a nice flavor to the fish |
| Orokolo coast | Iuku | Herb | *Curcuma elonga (planted?)* | Kairu | Cul | R (bulb) | Extract yellow dye for grass skirt and for face painting for singsings |
| Orokolo coast | Iuku | Herb | *Horstedtia scottiana* | Aitai'oa | F | F | Edible fruit |
| Orokolo coast | Iuku | Herb | *Horstedtia scottiana* | Aitai'oa | H | L | Leaves used for house ridge cap |
| Orokolo coast | Iuku | Palm | *Arenga macrocarpa* | Kaukaa | H | S | House post for temporary shelter or outdoor kitchen |
| Orokolo coast | Iuku | Palm | *Arenga macrocarpa* | Kaukaa | D | L | Leaf rachis used for broom |
| Orokolo coast | Iuku | Palm | *Arenga macrocarpa* | Kaukaa | Cul | L | Young leaves used for decoration during special occasions |
| Orokolo coast | Iuku | Palm | *Arenga macrocarpa* | Kaukaa | F | S | Edible new shoots |
| Orokolo coast | Iuku | Palm | *Caryota rumphiana* | Hapara | D | S | Axe handle |
| Orokolo coast | Iuku | Palm | *Caryota rumphiana* | Hapara | Hu | S | Arrow heads |
| Orokolo coast | Iuku | Palm | *Cocos nucifera* | La'a | H | T | House posts and bearers |
| Orokolo coast | Iuku | Palm | *Hydriastele costata* | Haea | H | S | Stem split for flooring |
| Orokolo coast | Iuku | Palm | *Hydriastele costata* | Haea | H | L | Leaf sheath (Haio) for house ridge cap |
| Orokolo coast | Iuku | Palm | *Meteroxylon sagu* | Poi | F | S | Stem pith processed for food |
| Orokolo coast | Iuku | Palm | *Meteroxylon sagu* | Poi | H | L | House thatch |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Iuku | Palm | *Meteroxylon sagu* | Poi | H | S | Leaves woven for house walls |
| Orokolo coast | Iuku | Palm | *Nypa fruticans* | Maitae | H | S | Leaves woven for house walls |
| Orokolo coast | Iuku | Palm | *Nypa fruticans* | Maitae | H | L | House thatch |
| Orokolo coast | Iuku | Palm | *Nypa fruticans* | Maitae | F | F | Edible nut |
| Orokolo coast | Iuku | Pandanus | *Mapania sp.* | Oroho | M | L | Shoots chewed as a cure for snake bite |
| Orokolo coast | Iuku | Pandanus | *Mapania sp.* | Oroho | Cul | L | Stem used to weave traditional floor mats |
| Orokolo coast | Iuku | Pandanus | *Pandanus sp.* | Hau | Cul | L | Leaves used to make traditional floor mats |
| Orokolo coast | Iuku | Shrub | *Desmodium sp. (beach species)* | Kaupa | FD | S | Firewood |
| Orokolo coast | Iuku | Shrub | *Leucosyke sp.* | Keke | D | L | Dried leaves used as steel wool for scrubbing pots and pans. |
| Orokolo coast | Iuku | Shrub | *Leucosyke sp.* | Keke | F | F | Edible fruit |
| Orokolo coast | Iuku | Shrub | *Melastorma sp.* | Kukui | F | F | Edible fruit |
| Orokolo coast | Iuku | Shrub | *Melastorma sp.* | Kukui | Cul | F | Seed boiled with grass skirt to extract purple dye for the grass skirt. |
| Orokolo coast | Iuku | Shrub | *Phyllanthus niruri* | None provided during survey | M | T | Cure for body ache |
| Orokolo coast | Iuku | Shrub | *Senna alata (weed)* | Kepoka | M | L | Rub boiled leaves on skin to cure grille (ringworm) |
| Orokolo coast | Iuku | Shrub | *Sida acuta (weed)* | Harita pailava | M | L | Boil, strain and drink as a cure for stomach and body aches |
| Orokolo coast | Iuku | Shrub | *Not seen or identified during survey* | Kepoka | M | L | Crushed leaf and apply on infected area (ringworm) - grille medicine. |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Iuku | Tree | *Alstonia scholaris* | Kavi | H | T | House doors and furniture |
| Orokolo coast | Iuku | Tree | *Alstonia scholaris* | Kavi | Can | S | Canoe tree |
| Orokolo coast | Iuku | Tree | *Alstonia scholaris* | Kavi | M | SP | Sap drunk to relieve strong cough and for malnourished children to gain weight. |
| Orokolo coast | Iuku | Tree | *Antiaris toxicaria* | Moa | Can | S | Canoe tree |
| Orokolo coast | Iuku | Tree | *Aralia sp ??* | Kerapara | H | T | House posts, bearers, studs and floor joists |
| Orokolo coast | Iuku | Tree | *Artocarpus sp.* | Lauka | F | F | Edible seed |
| Orokolo coast | Iuku | Tree | *Barringtonia sp.* | Haruharu | M | IB | Scrape inner bark, boil, strain and drink to cure all kinds of sickness |
| Orokolo coast | Iuku | Tree | *Bruguiera sp.* | Para | H | T | House posts, floor joists and studs |
| Orokolo coast | Iuku | Tree | *Cananga odorata* | Keroro | H | S | House studs |
| Orokolo coast | Iuku | Tree | *Cananga odorata* | Keroro | Cul | F | Perfumed flowers used during traditional singsing for the pleasant aroma |
| Orokolo coast | Iuku | Tree | *Dracontomelon dao* | Ouha | H | T | House bearers floor joists and studs |
| Orokolo coast | Iuku | Tree | *Dracontomelon dao* | Ouha | H | T | Bearers, studs and floor joists |
| Orokolo coast | Iuku | Tree | *Excoecaria agallocha* | Lara | H | T | House posts |
| Orokolo coast | Iuku | Tree | *Excoecaria agallocha* | Lara | M | SP | Sap is applied to a spot where pierced by string ray or catfish thorn to relieve pain |
| Orokolo coast | Iuku | Tree | *Ficus Polyantha* | Kavaru | Cul | IB | Inner bark used as traditional cloth (tapa cloth) |
| Orokolo coast | Iuku | Tree | *Ficus sp. (strangler fig)* | Ilapu | Can | SP | Putty/glue for patching canoe |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Iuku | Tree | *Glochidion sp.* | Ohehe | H | T | House studs |
| Orokolo coast | Iuku | Tree | *Heritiera litoralis* | Moi | Hu | S | Used to make the triangular frame for the prawn fishing nets |
| Orokolo coast | Iuku | Tree | *Hibiscus sp.* | Oro | D | IB, OB | Bark fibers used to make traditional rope |
| Orokolo coast | Iuku | Tree | *Hibiscus sp.* | Oro | FD | S | Firewood |
| Orokolo coast | Iuku | Tree | *Inocarpus fagifer* | Ipu | H | T | House posts and studs |
| Orokolo coast | Iuku | Tree | *Inocarpus fagifer* | Ipu | F | F | Edible nut |
| Orokolo coast | Iuku | Tree | *Intsia palembanica* | Pila | H | T | Preferred house post (No.1) and bearers |
| Orokolo coast | Iuku | Tree | *Mangifera sp.* | Meve | F | F | Edible fruit (mango) |
| Orokolo coast | Iuku | Tree | *Nauclea sp.* | Hupu | H | T | House bearers and studs |
| Orokolo coast | Iuku | Tree | *Octomeles sumatrana* | Ihohea | Can | T | Canoe tree (No. 1) |
| Orokolo coast | Iuku | Tree | *Pometia pinnata* | Ohavo | H | T | House studs and floor joists |
| Orokolo coast | Iuku | Tree | *Pterocarpus indicus* | Haravea | H | T | Preferred house post (No.2), bearers, studs and floor joists |
| Orokolo coast | Iuku | Tree | *Rhizophora sp.* | Kourau | D | R | Angular stilt roots used to make sago pounders |
| Orokolo coast | Iuku | Tree | *Sonneratia sp.* | Kireve | FD | S | Firewood |
| Orokolo coast | Iuku | Tree | *Sterculia sp.* | Imoi | Can | S | Canoe tree |
| Orokolo coast | Iuku | Tree | *Sterculia sp.* | Imoi | H | T | Stem split for house doors and flooring |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Iuku | Tree | *Terminalia kaernbachii* | Hia | H | T | House posts and bearers |
| Orokolo coast | Iuku | Tree | *Terminalia kaernbachii* | Hia | F | F | Edible nut |
| Orokolo coast | Iuku | Tree | *Terminalia sp.* | Kava | Can | T | Canoe tree |
| Orokolo coast | Iuku | Tree | *Terminalia sp.* | Kava | H | T | House posts |
| Orokolo coast | Iuku | Tree | *Toona sureni* | Kepere | H | T | House bearers and floor joists |
| Orokolo coast | Iuku | Tree | *Trichospermum sp.* | Maraka | D | IB | Bark fibers used to make traditional rope |
| Orokolo coast | Iuku | Tree | *Trichospermum sp.* | Maraka | Can | OB | Slippery bark used to slide canoe tree logs to the river |
| Orokolo coast | Iuku | Tree | *Trichospermum sp.* | Maraka | O | T | Logs used as floats to stop heavy logs sinking when transported along the river |
| Orokolo coast | Iuku | Tree | *Trichospermum sp.* | Maraka | H | IB, OB | House ridge cap |
| Orokolo coast | Iuku | Tree | *Xylocarpus granatum* | Hapuru | H | S | House posts and bearers |
| Orokolo coast | Iuku | Tree | *Xylocarpus sp.* | Kaipu | H | T | House posts, bearers and studs |
| Orokolo coast | Larihairu | Bamboo | *Bambusa sp.* | Keko | H | S | Fencing and rafters for bush house (strong large diameter species) |
| Orokolo coast | Larihairu | Bamboo | *Bambusa sp.* | Keko | H | S | Stem split for house walls (strong large diameter species) |
| Orokolo coast | Larihairu | Bamboo | *Schizostachyum sp.* | Hika | D | S | Sections of the stem used as cooking pots. Placed on fire to steam food (soft bamboo) |
| Orokolo coast | Larihairu | Bamboo | *Schizostachyum sp.* | Hika | H | S | Stem split for house walls (soft bamboo) |
| Orokolo coast | Larihairu | Climber/Vine | *Dyoscoria sp* | Haho | F | Root | Edible yam |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Larihairu | Climbing palm | *Calamus sp.* | Merove | D | S | Traditional cane rope (small species) |
| Orokolo coast | Larihairu | Fern | *Stenochlaena pallustris* | Popoka | D | S | Inner stem used as rope |
| Orokolo coast | Larihairu | Fern | *Stenochlaena pallustris* | Popoka | F | L | Young leaves edible |
| Orokolo coast | Larihairu | Herb | *Ammomum sp.* | Eraoa | D | L | Leaves for wrapping fish prior to cooking over fire |
| Orokolo coast | Larihairu | Herb | *Ammomum sp.* | Eraoa | H | L | Leaves used for house ridge cap |
| Orokolo coast | Larihairu | Herb | *Curkuma sp* | Kairu | Cul | R | Scrape root (rhizome) to extract yellow dye for grass skirt |
| Orokolo coast | Larihairu | Herb | *Homalomena sp* | Helare | M | R | Place diced bulb in a plate with a water container beside. When the cockroach eat it they become thirsty and so try to reach for the water where they drown |
| Orokolo coast | Larihairu | Palm | *Actinorhytis calapparia* | Apo ehere | Hu | S | Stem used for hunting bows and arrow heads |
| Orokolo coast | Larihairu | Palm | *Cocos nucifera* | Laa | H | T | House post and bearers |
| Orokolo coast | Larihairu | Palm | *Cocos nucifera* | Laa | F | F | Staple food |
| Orokolo coast | Larihairu | Palm | *Cocos nucifera* | Laa | H | L | Thatch for temporary shelter |
| Orokolo coast | Larihairu | Palm | *Hydriastele costata* | Haea | H | S | Stem split for flooring |
| Orokolo coast | Larihairu | Palm | *Hydriastele costata* | Haea | H | L | Leaf sheath (Haio) for house ridge cap |
| Orokolo coast | Larihairu | Palm | *Meteroxylon sagu* | Poi | F | S (Pith) | Staple food from processed pith |
| Orokolo coast | Larihairu | Palm | *Meteroxylon sagu* | Poi | H | L | House thatch |
| Orokolo coast | Larihairu | Palm | *Meteroxylon sagu* | Poi | H | S | Leaves woven for house walls |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Larihairu | Palm | *Nypa fruticans* | Maitae | H | S | House thatch and leaves woven for house walls |
| Orokolo coast | Larihairu | Palm | *Nypa fruticans* | Maitae | H | L | Leaves for wrapping sago prior to cooking |
| Orokolo coast | Larihairu | Palm | *Nypa fruticans* | Maitae | F | F | Edible nut |
| Orokolo coast | Larihairu | Palm | *Pandanus sp.* | Hau | D | L | Leaves used to weave traditional floor mat |
| Orokolo coast | Larihairu | Shrub | *Acanthus sp (holly mangrove)* | Haoha | M | SP | Rub white sap where the stingray or catfish has stung to stop the pain |
| Orokolo coast | Larihairu | Shrub | *Ceriops sp* | Karakara | O | S | Fencing |
| Orokolo coast | Larihairu | Shrub | *Ceriops sp* | Karakara | FD | S | Firewood |
| Orokolo coast | Larihairu | Shrub | *Desmodium sp. (beach species)* | Kaupa | FD | S | Firewood |
| Orokolo coast | Larihairu | Shrub | *Etlingera sp. (torch ginger)* | Uhi | M | S | Eat young shoot to stop sourness |
| Orokolo coast | Larihairu | Shrub | *Melastoma sp.* | Kukui | Cul | F | Seed boiled with grass skirt to extract black dye for grass skirt |
| Orokolo coast | Larihairu | Tree | *Albizzia sp* | Haivaea | M | IB | Scrape inner bark, squeeze and drink if lose appetite. |
| Orokolo coast | Larihairu | Tree | *Alstonia scholaris* | Kavi | D | SP | Sap used as a traditional glue |
| Orokolo coast | Larihairu | Tree | *Alstonia scholaris* | Kavi | H | T | Stem split for flooring |
| Orokolo coast | Larihairu | Tree | *Bridellia sp* | Akeave | H | T | House posts |
| Orokolo coast | Larihairu | Tree | *Brownlovia sp* | Hepe | FD | S | Firewood |
| Orokolo coast | Larihairu | Tree | *Bruguiera sp.* | Para | H | T | House bearers and studs |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Larihairu | Tree | *Bruguiera sp.* | Para | FD | S, Be | Firewood |
| Orokolo coast | Larihairu | Tree | *Calophyllum sp.* | Ova | H | T | House studs and flooring |
| Orokolo coast | Larihairu | Tree | *Cananga odorata* | Keroro | D | IB | Bark fibers used to make traditional rope |
| Orokolo coast | Larihairu | Tree | *Cananga odorata* | Keroro | Can | S | O - rollers for pulling canoe tree (log) |
| Orokolo coast | Larihairu | Tree | *Cananga odorata* | Keroro | O | S | Stem split for fencing |
| Orokolo coast | Larihairu | Tree | *Endospermum sp.* | Harahara | O | S | Stem split for fencing |
| Orokolo coast | Larihairu | Tree | *Endospermum sp.* | Harahara | FD | S | Firewood |
| Orokolo coast | Larihairu | Tree | *Gnetum gnemon* | Uri | FD | S | Firewood |
| Orokolo coast | Larihairu | Tree | *Gnetum gnemon* | Uri | F | L | Edible new leaves |
| Orokolo coast | Larihairu | Tree | *Gnetum gnemon* | Uri | Cul | IB | Bark fibers used to make traditional rope for string bags (bilums) |
| Orokolo coast | Larihairu | Tree | *Gnetum gnemon* | Uri | M | L | Chew young leaves and swallow juice to cure malaria |
| Orokolo coast | Larihairu | Tree | *Hibiscus sp.* | Oro | D | IB, OB | Bark fibers used to make traditional rope |
| Orokolo coast | Larihairu | Tree | *Hibiscus sp.* | Oro | FD | S | Firewood |
| Orokolo coast | Larihairu | Tree | *Intsia palembanica* | Pila | H | T | Preferred house posts (No.1) |
| Orokolo coast | Larihairu | Tree | *Leucosyke sp.* | Keke | D | L | Dry leaves used as steel wool for scrubbing pots and pans |
| Orokolo coast | Larihairu | Tree | *Litsea sp.* | Murita | H | T | House studs |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Larihairu | Tree | *Litsea sp.* | Murita | Can | S | Canoe tree |
| Orokolo coast | Larihairu | Tree | *Mastixodendron sp.* | Koava | F | F | Edible fruit |
| Orokolo coast | Larihairu | Tree | *Myristica sp.* | Ahao | M | F | Eat the flesh of the fruit to cure flu or cold |
| Orokolo coast | Larihairu | Tree | *Octomeles sumatrana* | Ihohea | Can | S | Canoe tree (No. 1) |
| Orokolo coast | Larihairu | Tree | *Pometia pinnata* | Ohavo | H | T | House studs and flooring |
| Orokolo coast | Larihairu | Tree | *Premna sp.* | Karokaro | FD | S | Firewood |
| Orokolo coast | Larihairu | Tree | *Premna sp.* | Karokaro | M | L | Leaves placed under the mat to attract bed bugs. The odor makes them run to the nearest water container where they drown |
| Orokolo coast | Larihairu | Tree | *Pterocarpus indicus* | Haravea | H | T | Preferred house post (No.2), bearers, studs and floor joists |
| Orokolo coast | Larihairu | Tree | *Rhizophora sp.* | Kurau | H | T | House bearers |
| Orokolo coast | Larihairu | Tree | *Rhizophora sp.* | Kurau | FD | S, be | Firewood |
| Orokolo coast | Larihairu | Tree | *Rhus taitensis* | Maroaha | Cul | L | Young leaves boiled to extract white dye for grass skirt. |
| Orokolo coast | Larihairu | Tree | *Sonneratia sp.* | Kakaa | H | T | House posts |
| Orokolo coast | Larihairu | Tree | *Sonneratia sp.* | Kireve | FD | S, Be | Firewood |
| Orokolo coast | Larihairu | Tree | *Sterculia sp.* | Hurau | D | IB | Bark fibers used to make traditional rope |
| Orokolo coast | Larihairu | Tree | *Sterculia sp.* | Hurau | O | S | Stem tied to heavy (sinking) logs to keep them afloat for transport |
| Orokolo coast | Larihairu | Tree | *Terminalia sp.* | Kava | H | T | House posts |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo coast | Larihairu | Tree | *Terminalia sp.* | Kava | Can | S | Canoe tree |
| Orokolo coast | Larihairu | Tree | *Terminalia sp.* | Kuruhia | FD | S | Firewood |
| Orokolo coast | Larihairu | Tree | *Thespersia sp* | Lapera | Cul | L | Dried leaves rolled as newspaper for smoking cigarettes |
| Orokolo coast | Larihairu | Tree | *Toona sureni* | Kepere | H | T | House bearers and floor joists |
| Orokolo coast | Larihairu | Tree | *Trichospermum sp.* | Maraka | D | IB | Bark fibers used to make traditional rope |
| Orokolo coast | Larihairu | Tree | *Trichospermum sp.* | Maraka | O | S | Stem tied to heavy (sinking) logs to keep them afloat for transport |
| Orokolo coast | Larihairu | Tree | *Trichospermum sp.* | Maraka | H | IB, OB | Peeled bark used as a house ridge cap |
| Orokolo coast | Larihairu | Tree | *Trichospermum sp.* | Maraka | Can | OB | Bark used as a greasy track to pull canoe trees to the rivers edge for transport |
| Orokolo coast | Larihairu | Tree | *Xylocarpus granatum* | Hapuru | H | T | House posts, bearers, floor joists and studs |
| Orokolo coast | Larihairu | Tree | *Xylocarpus sp.* | Kaipu | H | T | House posts, bearers, floor joists and studs |
| Orokolo coast | Larihairu | Tree | Not seen or identified during survey | Laura | M | IB | Scrape inner bark mix with cold water and rinse mouth to cure tooth ache |
| Orokolo inland | Avavu | Bamboo | *Bambusa sp.* | Hika | H | S | House rafters and walls. Bush huts and hunting huts and shelters |
| Orokolo inland | Avavu | Bamboo | *Bambusa sp.* | Hika | D | S | Traditional cooking pot |
| Orokolo inland | Avavu | Climber/Vine | *Flegellaria sp.* | Mariri | D | S | Traditional rope |
| Orokolo inland | Avavu | Climber/Vine | *Rhaphidophora sp.* | Papareva (no.1) | D | S | Inner stem used as a traditional rope |
| Orokolo inland | Avavu | Climber/Vine | *Rhaphidophora sp.* | Papareva (no.2 | D | S | Inner stem used as a traditional rope |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Avavu | Climber/Vine | *Tetrastigma sp.* | Mekanou | D | S | Stem used as a traditional rope |
| Orokolo inland | Avavu | Climbing palm | *Calamus sp.* | Paiva | D | S | Traditional cane rope (large species) |
| Orokolo inland | Avavu | Climbing palm | *Calamus vitiensis* | Merovo | H | S | Traditional cane rope |
| Orokolo inland | Avavu | Fern | *Stenochlaena pallustris* | Neraea | F | S | Edible young shoots |
| Orokolo inland | Avavu | Fern | *Stenochlaena pallustris* | Neraea | D | S | Stem used as a traditional rope |
| Orokolo inland | Avavu | Herb | *Curcuma sp.* | Kairu | Cul | R | Yellow dye extracted from roots to dye grass skirt |
| Orokolo inland | Avavu | Herb | *Donax canniformis* | Hepee | M | L | Liquid from young leaf stalk used as eye drop to cure sore eye |
| Orokolo inland | Avavu | Herb | *Holochlamys beccarii* | Hikoio | D | L | Traditional plate or food wrapper |
| Orokolo inland | Avavu | Palm | *Arenga macrocarpa* | Kaukoo | H | S | Post for temporary shelter or outdoor kitchen |
| Orokolo inland | Avavu | Palm | *Arenga macrocarpa* | Kaukoo | F | S | Edible new shoots at base of stem |
| Orokolo inland | Avavu | Palm | *Arenga macrocarpa* | Kaukoo | D | L | Leaf rachis used to make brooms |
| Orokolo inland | Avavu | Palm | *Caryota rumphiana* | Hoporo | D | S | Axe handle and for making coconut husker |
| Orokolo inland | Avavu | Palm | *Cocos nucifera* | Na a | H | S | House posts |
| Orokolo inland | Avavu | Palm | *Cocos nucifera* | Na a | F | F | Staple food |
| Orokolo inland | Avavu | Palm | *Cocos nucifera* | Na a | D | L | Leaves used to make brooms and baskets |
| Orokolo inland | Avavu | Palm | *Cyrtostachys sp* | Apo | H | S | House posts and studs (temporary) |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Avavu | Palm | *Hydriastele costata* | Haea | H | S | Stem split for flooring |
| Orokolo inland | Avavu | Palm | *Hydriastele costata* | Haea | D | I | Inflorescence used as a broom |
| Orokolo inland | Avavu | Palm | *Meteroxylon sagu* | Poi | H | L | Leaves woven to make house walls |
| Orokolo inland | Avavu | Palm | *Meteroxylon sagu* | Poi | F | S | Staple food |
| Orokolo inland | Avavu | Palm | *Nypa fruticans* | Metai | H | L | Leaves used for house thatch |
| Orokolo inland | Avavu | Pandanus | *Pandanus sp.* | Kiri | Cul | L | Leaves used to weave traditional floor mat |
| Orokolo inland | Avavu | Pandanus | *Pandanus sp.* | Kiri | H | R | Long prop rots split to use as rafters to tie thatch to |
| Orokolo inland | Avavu | Tree | *Aglaia sp.* | Poroita | H | T | House bearers, floor joists, studs and rafters |
| Orokolo inland | Avavu | Tree | *Anthocephalus chinensis* | Hupu | H | T | House studs |
| Orokolo inland | Avavu | Tree | *Anthocephalus chinensis* | Hupu | Can | S | Canoe tree and paddle |
| Orokolo inland | Avavu | Tree | *Antiaris toxicaria* | Moa | Can | S | Canoe tree |
| Orokolo inland | Avavu | Tree | *Baccaurea papuana* | Aia | H | T | House posts |
| Orokolo inland | Avavu | Tree | *Baccaurea papuana* | Aia | F | F | Edible fruit |
| Orokolo inland | Avavu | Tree | *Bridellia penangiana* | Marihanikiri | H | T | House post |
| Orokolo inland | Avavu | Tree | *Bruguiera sp.* | Kauri | H | T | House bearers, floor joist, studs, and rafters |
| Orokolo inland | Avavu | Tree | *Calicarpa sp.* | Wape | H | T | House studs and rafters |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Avavu | Tree | *Calophyllum sp.* | Avare | H | T | House bearers, studs, floor joists and rafters |
| Orokolo inland | Avavu | Tree | *Celtis sp.* | Irihi | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Cryptocarya sp.* | Haiou | Can | S | Canoe tree |
| Orokolo inland | Avavu | Tree | *Cryptocarya sp.* | Haiou | H | T | House studs, flooring and joists |
| Orokolo inland | Avavu | Tree | *Dracontomelon dao* | Ouha | H | T | House bearers, floor joists, studs and rafters |
| Orokolo inland | Avavu | Tree | *Dysoxylum sp.* | Havenoia | H | T | Bearers, studs, floor joists and rafters |
| Orokolo inland | Avavu | Tree | *Dysoxylum sp.* | Orokio | H | T | House posts, bearers, floor joists and studs |
| Orokolo inland | Avavu | Tree | *Ficus copiosa* | Eko | F | L | Edible new shoots |
| Orokolo inland | Avavu | Tree | *Ficus sp. (strangler fig)* | Iropu | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Ficus sp. (strangler fig)* | Iropu | D | IB | Traditional rope |
| Orokolo inland | Avavu | Tree | *Garuga floribunda* | Kepere Kakiakakia | H | T | House bearers, studs and rafters |
| Orokolo inland | Avavu | Tree | *Gnetum gnemon* | Uri | F | L, F | Edible new shoots and fruit |
| Orokolo inland | Avavu | Tree | *Gnetum gnemon* | Uri | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Gnetum gnemon* | Uri | D | IB | Inner bark fibers used to make traditional string for knitting bilums |
| Orokolo inland | Avavu | Tree | *Heritiera litoralis* | Pairi | H | T | House bearers, floor joists, studs and rafters |
| Orokolo inland | Avavu | Tree | *Inocarpus fagifer* | Kudokudo | F | F | Edible fruit |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Avavu | Tree | *Inocarpus fagifer* | Kudokudo | M | L | Young shoots boiled and drunk as a cure for a strong cough |
| Orokolo inland | Avavu | Tree | *Intsia bijuga* | Pira miro | H | T | Preferred house post (No.1) and bearer |
| Orokolo inland | Avavu | Tree | *Intsia palembanica* | Pira parehari | H | T | Preferred house post (No.2) and bearer |
| Orokolo inland | Avavu | Tree | *Kleinhovia hospita* | Mao | H | S | House studs |
| Orokolo inland | Avavu | Tree | *Kleinhovia hospita* | Mao | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Kleinhovia hospita* | Mao | D | IB, OB | Bark fibers used to make traditional rope |
| Orokolo inland | Avavu | Tree | *Leucosyke sp.* | Hekeheke | H | T | House rafters and house ridge cap enforcer |
| Orokolo inland | Avavu | Tree | *Litsea sp.* | Murita | Can | S | Canoe tree |
| Orokolo inland | Avavu | Tree | *Macaranga aleuritoides* | Pokoa | H | T | House rafters and studs |
| Orokolo inland | Avavu | Tree | *Mangifera sp.* | Meve | M | IB | Cut bark, boil and wash body to relive body aches |
| Orokolo inland | Avavu | Tree | *Mangifera sp.* | Meve | F | F | Edible fruit (wild mango) |
| Orokolo inland | Avavu | Tree | *Mangifera sp.* | Meve | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Mastixodendron sp.* | Houkupe | H | T | House bearers, studs, floor joists and rafters |
| Orokolo inland | Avavu | Tree | *Myristica sp.* | Ahao | M | F | Flesh of the fruit eaten to treat malaria |
| Orokolo inland | Avavu | Tree | *Myristica sp.* | Ahao | H | T | House studs and rafters |
| Orokolo inland | Avavu | Tree | *Octomeles sumatrana* | Ehohea | Can | S | Canoe tree (No. 1) |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Avavu | Tree | *Pometia pinnata* | Ohavu | H | T | House bearers and floor joists |
| Orokolo inland | Avavu | Tree | *Pometia pinnata* | Ohavu | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Pometia pinnata* | Ohavu | F | F | Edible fruit |
| Orokolo inland | Avavu | Tree | *Pterocarpus indicus* | Haravea | H | T | Preferred house post (No.3), bearers, floor joists and studs |
| Orokolo inland | Avavu | Tree | *Pterocarpus indicus* | Haravea | Can | S | Canoe tree |
| Orokolo inland | Avavu | Tree | *Rhizophora sp.* | Poro | H | T | House bearers |
| Orokolo inland | Avavu | Tree | *Sonneratia sp ??* | Keke | H | T | House bearers, floor joists and studs |
| Orokolo inland | Avavu | Tree | *Sonneratia sp ??* | Keke | Can | S | Canoe paddle |
| Orokolo inland | Avavu | Tree | *Sonneratia sp ??* | Pairae | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Terminalia kaernbachii* | Hio | H | T | House post, bearers and floor joists |
| Orokolo inland | Avavu | Tree | *Terminalia kaernbachii* | Hio | FD | F | Seed case is used as a firewood. Burns very hot |
| Orokolo inland | Avavu | Tree | *Terminalia kaernbachii* | Hio | F | F | Edible nut |
| Orokolo inland | Avavu | Tree | *Terminalia sp.* | Kavo | H | T | House bearers and studs |
| Orokolo inland | Avavu | Tree | *Terminalia sp.* | Kavo | Can | S | Canoe tree |
| Orokolo inland | Avavu | Tree | *Thespersia sp* | Lapera | H | T | Post for temporary shelter or outdoor kitchen |
| Orokolo inland | Avavu | Tree | *Thespersia sp* | Lapera | FD | S | Firewood |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Avavu | Tree | *Toona sureni* | Kepere | Can | S | Canoe tree (No. 2) |
| Orokolo inland | Avavu | Tree | *Toona sureni* | Kepere | H | T | House bearers and studs |
| Orokolo inland | Avavu | Tree | *Toona sureni* | Kepere | Can | S | Canoe tree |
| Orokolo inland | Avavu | Tree | *Trichospermum sp.* | Moroka | H | IB, OB | Bark used as a ridge cap for the house |
| Orokolo inland | Avavu | Tree | *Trichospermum sp.* | Moroka | FD | S | Firewood |
| Orokolo inland | Avavu | Tree | *Trichospermum sp.* | Moroka | D | IB | Bark fibers used to make a traditional fiber rope |
| Orokolo inland | Avavu | Tree | *Vitex cofassus* | Maea | H | T | House post |
| Orokolo inland | Avavu | Tree | *Xylocarpus sp.* | Hapuru | H | T | House bearers, studs, floor joists and rafters |
| Orokolo inland | Paevera | Bamboo | *Bambusa sp.* | Pio | Cul | S | Used to make mouth harp (musical instrument) (small bamboo species) |
| Orokolo inland | Paevera | Bamboo | *Bambusa sp.* | Paika hika | Hu | S | String for hunting bow (soft bamboo species) |
| Orokolo inland | Paevera | Bamboo | *Bambusa sp.* | Keko | Hu | S | Stem used to make hunting bows (strong large diameter species) |
| Orokolo inland | Paevera | Bamboo | *Bambusa sp.* | Keko | H | S | Fencing and for construction of haus win (strong large diameter species) |
| Orokolo inland | Paevera | Bamboo | *Bambusa sp.* | Pio | D | L | Leaves for wrapping sago prior to cooking it over the fire (small bamboo species) |
| Orokolo inland | Paevera | Bamboo | *Bambusa sp.* | Paika hika | D | S | Traditional cooking pot (soft bamboo species) |
| Orokolo inland | Paevera | Bamboo | *Schizostachyum sp.* | Hika | H | S | Used as construction posts/ bearers etc. for cook houses/shelters (soft bamboo) |
| Orokolo inland | Paevera | Climber/Vine | *Merremia peltata* | Poi laihou | D | S | Traditional rope for tying bundles of firewood |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Paevera | Climber/Vine | *Tetrastigma sp.* | Meka | Cul | S | Young rope is cut and placed in a stream and will move like an eel and later becomes an eel |
| Orokolo inland | Paevera | Climber/Vine | *Tetrastigma sp.* | Meka | D | S | Traditional rope |
| Orokolo inland | Paevera | Climbing palm | *Calamus sp.* | Merove | H | S | Traditional cane rope (small species) |
| Orokolo inland | Paevera | Herb | *Cominsia gigantea* | Mailala | H | L | Leaves used as a house ridge cap |
| Orokolo inland | Paevera | Herb | *Cominsia gigantea* | Mailala | D | L | Leaves used for wrapping food prior to cooking |
| Orokolo inland | Paevera | Herb | *Curculigo sp.* | Lauakoro | H | L | Leaves used as a house ridge cap |
| Orokolo inland | Paevera | Herb | *Curculigo sp.* | Lauakoro | D | L | Leaves used for wrapping food prior to cooking |
| Orokolo inland | Paevera | Palm | *Actinorhytis sp.* | Loporo | H | S | Stem split for flooring |
| Orokolo inland | Paevera | Palm | *Actinorhytis sp.* | Loporo | F | L | Young shoots are edible |
| Orokolo inland | Paevera | Palm | *Areca sp.* | Biroro | Cul | F | Substitute for betel nut (Kabibi) |
| Orokolo inland | Paevera | Palm | *Arenga macrocarpa* | Kaukaa | H | S | Post for temporary shelter or outdoor kitchen |
| Orokolo inland | Paevera | Palm | *Arenga macrocarpa* | Kaukaa | F | S | Young shoot is edible |
| Orokolo inland | Paevera | Palm | *Arenga macrocarpa* | Kaukaa | D | L | Leaves used to make baskets and brooms |
| Orokolo inland | Paevera | Palm | *Calamus vitiensis* | Heao paiva | D | L | Leaves for wrapping sago prior to cooking it over the fire |
| Orokolo inland | Paevera | Palm | *Calamus vitiensis* | Heao paiva | D | S | Traditional cane rope and fire tongs |
| Orokolo inland | Paevera | Palm | *Caryota rumphiana* | Hapara | Hu | S | Arrow head |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Paevera | Palm | *Caryota rumphiana* | Hapara | D | S | Axe handle |
| Orokolo inland | Paevera | Palm | *Cocos nucifera* | Laa | H | T | House posts |
| Orokolo inland | Paevera | Palm | *Cyrtostachys sp* | Hariava | Hu | S | Hunting bow and arrow heads |
| Orokolo inland | Paevera | Palm | *Hydriastele costata* | Haea | H | T | Stem split for flooring |
| Orokolo inland | Paevera | Palm | *Hydriastele costata* | Haea | F | S | Edible new shoots from base of palm |
| Orokolo inland | Paevera | Palm | *Licuala lauterbachii* | Erera | H | T | House post for temporary shelter or outdoor kitchen |
| Orokolo inland | Paevera | Palm | *Licuala lauterbachii* | Erera | Hu | T | Hunting bow and arrow heads |
| Orokolo inland | Paevera | Palm | *Licuala lauterbachii* | Erera | Cul | L | Young leaves used for decoration during special occasions |
| Orokolo inland | Paevera | Palm | *Meteroxylon sagu* | Hoi/Poi | H | L | House thatch and walls (Hero) |
| Orokolo inland | Paevera | Palm | *Meteroxylon sagu* | Hoi/Poi | F | S | Staple food |
| Orokolo inland | Paevera | Palm | *Orania sp.* | Maria | H | T | Stem split for flooring |
| Orokolo inland | Paevera | Palm | *Orania sp.* | Maria | F | S | Edible new shoots from base of palm |
| Orokolo inland | Paevera | Palm | *Orania sp.* | Maria | F | S | Edible grubs harvested from rotten stem |
| Orokolo inland | Paevera | Palm | *Pandanus sp.* | Hau | D | L | Leaves used for weaving traditional floor mats |
| Orokolo inland | Paevera | Shrub | *Donax canniformis* | Pepe | M | L | Sap from young leaf petiole used as eye drop to cure sore eye |
| Orokolo inland | Paevera | Shrub | *Donax canniformis* | Pepe | Cul | L | Leaf sheath blown to make snake call |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Paevera | Shrub | *Goniothalamus aruensis* | Perari | FD | S | Firewood |
| Orokolo inland | Paevera | Shrub | *Goniothalamus aruensis* | Perari | M | IB | Scrape bark mix with water and drink to treat pig belly, especially children |
| Orokolo inland | Paevera | Shrub | *Goniothalamus aruensis* | Perari | M | S | Burned in food gardens as an insect repellent (similar smell to citronella) |
| Orokolo inland | Paevera | Shrub | *Goniothalamus aruensis* | Perari | Cul | S | Dry plant, make fire with it when clearing new garden resulting in high yield |
| Orokolo inland | Paevera | Tree | *Alstonia scholaris* | Kavi | H | T | Stem split for house doors |
| Orokolo inland | Paevera | Tree | *Alstonia scholaris* | Kavi | Cul | S | Wood used for traditional carving |
| Orokolo inland | Paevera | Tree | *Alstonia scholaris* | Kavi | M | SP | White sap used as a cure for strong cough |
| Orokolo inland | Paevera | Tree | *Anthocephalus chinensis* | Hupu | H | T | House flooring |
| Orokolo inland | Paevera | Tree | *Anthocephalus chinensis* | Hupu | F | S | Mushrooms harvested from dead tree |
| Orokolo inland | Paevera | Tree | *Artocarpus sp.* | Lauka | FD | T | Firewood |
| Orokolo inland | Paevera | Tree | *Artocarpus sp.* | Lauka | F | S | Edible grubs harvested from rotten timber |
| Orokolo inland | Paevera | Tree | *Artocarpus sp.* | Lauka | F | F | Edible seed |
| Orokolo inland | Paevera | Tree | *Baccaurea papuana* | Perepea | F | F | Edible fruit |
| Orokolo inland | Paevera | Tree | *Caesaeria sp.* | Heita | H | T | House bearers, floor joists and studs |
| Orokolo inland | Paevera | Tree | *Caesaeria sp.* | Heita | FD | S | Firewood |
| Orokolo inland | Paevera | Tree | *Calophyllum sp.* | Harova | H | T | House bearers and floor joists |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Paevera | Tree | *Canarium sp.* | Mahe | H | T | House bearers and floor joists |
| Orokolo inland | Paevera | Tree | *Canarium sp.* | Mahe | F | F | Nut is edible |
| Orokolo inland | Paevera | Tree | *Canarium sp.* | Koroa | D | SP | Resin exudate (eikia) is lit like a candle |
| Orokolo inland | Paevera | Tree | *Celtis philippensis* | Kuuva | H | T | House bearers, floor joists and studs |
| Orokolo inland | Paevera | Tree | *Celtis philippensis* | Kuuva | FD | S | Firewood |
| Orokolo inland | Paevera | Tree | *Cinnamomum sp* | Paiha | Cul | B | To drive away any evil spells especially for new born babies. Place a piece of bark onto the bilum to keep away evil spirits from taking the baby |
| Orokolo inland | Paevera | Tree | *Diospyros sp.* | Kora'auro | H | T | House bearers, studs and floor joists |
| Orokolo inland | Paevera | Tree | *Dracontomelon dao* | Ouha | H | T | House bearers and studs |
| Orokolo inland | Paevera | Tree | *Ficus copiosa* | Eko | F | L | Young leaves edible |
| Orokolo inland | Paevera | Tree | *Ficus sp. (strangler fig)* | Ilapu | FD | S | Firewood |
| Orokolo inland | Paevera | Tree | *Ficus sp. (strangler fig)* | Ilapu | Hu | R | Straight roots used for hunting spear |
| Orokolo inland | Paevera | Tree | *Ficus sp. (strangler fig)* | Ilapu | Hu | F | Hunting tree. Birds and other animals feed on fruit |
| Orokolo inland | Paevera | Tree | *Ficus wasa* | Lauheke | F | L | New leaves edible when boiled |
| Orokolo inland | Paevera | Tree | *Ficus wasa* | Lauheke | D | L | Traditional sandpaper |
| Orokolo inland | Paevera | Tree | *Glochidion sp.* | Keke | H | T | House bearers and floor joists |
| Orokolo inland | Paevera | Tree | *Gnetum gnemon* | Uri | FD | S | Firewood |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Paevera | Tree | *Gnetum gnemon* | Uri | F | L, F | New leaves leaf and fruit are edible |
| Orokolo inland | Paevera | Tree | *Gnetum gnemon* | Uri | D | IB | Inner bark fibers woven into rope for string bag (bilum) |
| Orokolo inland | Paevera | Tree | *Homalium foetidum* | Kavea | H | T | House posts, bearers and flooring |
| Orokolo inland | Paevera | Tree | *Homalium foetidum* | Kavea | FD | T | Firewood (No. 2) |
| Orokolo inland | Paevera | Tree | *Intsia bijuga* | Pira miro | H | T | Preferred house post, (no.1), bearer |
| Orokolo inland | Paevera | Tree | *Litsea sp.* | Murita | H | T | House studs and floor joists |
| Orokolo inland | Paevera | Tree | *Mastixodendron sp.* | Lupa | H | T | House bearers, studs and floor joists |
| Orokolo inland | Paevera | Tree | *Myristica sp.* | Ahao | M | F | Flesh of the fruit eaten to treat malaria, headache and cough |
| Orokolo inland | Paevera | Tree | *Myristica sp.* | Ahao | H | S | House rafters |
| Orokolo inland | Paevera | Tree | *Nageia wallichiana* | Hepe | H | T | House bearers, joists and studs |
| Orokolo inland | Paevera | Tree | *Octomeles sumatrana* | Ihohea | H | T | Stem split for flooring |
| Orokolo inland | Paevera | Tree | *Octomeles sumatrana* | Ihohea | Can | S | Stem sold to other villages to make canoe |
| Orokolo inland | Paevera | Tree | *Pometia pinnata* | Ohavu | H | T | House bearers  flooring and studs |
| Orokolo inland | Paevera | Tree | *Pterocarpus indicus* | Haravea | H | T | Preferred house post, (no.2), bearer, stud, floor joist |
| Orokolo inland | Paevera | Tree | *Stenochlaena pallustris* | Lala | D | S | Traditional rope |
| Orokolo inland | Paevera | Tree | *Terminalia kaernbachii* | Hia | H | T | House posts, bearers, floor joists and studs |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Orokolo inland | Paevera | Tree | *Terminalia kaernbachii* | Hia | F | F | Edible nut |
| Orokolo inland | Paevera | Tree | *Terminalia sp.* | Munita | H | T | House bearers |
| Orokolo inland | Paevera | Tree | *Vitex cofassus* | Maea | H | T | House posts, bearers and joists |
| Orokolo inland | Paevera | Tree | Not seen or identified during survey | Ekahera | H | S | Stem split for house flooring and studs |
| Orokolo inland | Paevera | Tree | Not seen or identified during survey | Ekahera | F | F | Grape-like fruit is edible |
| Orokolo inland | Paevera | Tree | Not seen or identified during survey | Ekahera | Hu | IB | Bark scrapped, mixed with soup and give to dog to improve hunting ability |
| Orokolo inland | Paevera | Tree | Not seen or identified during survey | Mui | H | T | House bearers floor joists studs and rafters |
| Orokolo inland | Paevera | Tree | Not seen or identified during survey | Mui | Hu | S | Frame for circular fishing used by women |
| Orokolo inland | Paevera | Tree | Not seen or identified during survey | Heri | H | T | House bearers, floor joists and studs |
| Pawaia | Poroi | Bamboo | *Bambusa sp.* | Soru | D | S | Section of the stem used as cooking pots. Placed on fire to steam food inside |
| Pawaia | Poroi | Climber/Vine | *Derris sp.* | Perebi | Hu | R | Root beaten to release fish killing poison. Placed on surface of small ponds and slow flowing creeks |
| Pawaia | Poroi | Climber/Vine | *Flagellaria indica* | Ai'e | H | S | Cane rope used for house construction |
| Pawaia | Poroi | Climber/Vine | *Flagellaria indica* | Ai'e | M | L/S | New shoots and young leaves are soaked in water for a few minutes. The water is then drunk to relieve a cough |
| Pawaia | Poroi | Climber/Vine | *Flagellaria indica* | Heiso | D | S | Used as rope |
| Pawaia | Poroi | Climber/Vine | *Merremia peltata* | Emibo | M | SP | Sap from the tip used for healing sores. |
| Pawaia | Poroi | Climber/Vine | *Uncaria sp.* | Jahoripo | F | S | Stem cut to release drinking water when in the forest away from a stream |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Poroi | Climber/Vine | Not seen or identified during survey | Umepu | M | S | The Climber/Vine sheath/skin is eaten to cure a bad cough |
| Pawaia | Poroi | Climbing palm | *Calamus aruensis* | Weigemi | M | SP | Sap drunk to relive a cough |
| Pawaia | Poroi | Climbing palm | *Calamus aruensis* | Weigemi | Hu | S | Cane stem split to make bow strings |
| Pawaia | Poroi | Climbing palm | *Calamus aruensis* | Weigemi | D | L | Leaves used to wrap sago for cooking |
| Pawaia | Poroi | Climbing palm | *Calamus sp.* | Omogemi | H | S | Cane rope used as a replacement for nails for house construction. One of the smaller canes |
| Pawaia | Poroi | Climbing palm | *Calamus sp.* | Minigemi | D | S | Large strong cane rope. Can be used for pulling canoes and logs |
| Pawaia | Poroi | Climbing palm | *Calamus warburgii* | Singemi | H | S | Cane rope used as a replacement for nails for house construction |
| Pawaia | Poroi | Climbing palm | *Korthalsia zippelii* | Aegemi | H | S | Cane rope used as a replacement for nails for house construction |
| Pawaia | Poroi | Climbing palm | *Korthalsia zippelii* | Aegemi | D | L | Leaves used to wrap sago for cooking |
| Pawaia | Poroi | Fern | *Diplazium esculentum* | Jo'o sin | F | L | Edible new shoots (leaves). Usually cooked |
| Pawaia | Poroi | Grass | *Saccharum sp.* | Ua | H | L | Replacement for kunai grass (Imperata cylindrica) for house ridge cap. Cut when dry. Grows by the Purari River |
| Pawaia | Poroi | Herb | *Ageratum conyzoides** | Meja | M | L | Leaves boiled and rubbed on skin to relive skin pain. Mashed up leaves placed on skin sores to heal |
| Pawaia | Poroi | Herb | *Alpinia sp.* | Hamu'sin | M | SP | Sap drunk to relieve cough |
| Pawaia | Poroi | Herb | *Cominsia gigantea* | Pinsin | H | L | Large leaves used as roofing for bush huts and hunting huts |
| Pawaia | Poroi | Herb | *Cominsia gigantea* | Wensin | H | L | Large leaves used as roofing for bush huts and hunting huts |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Poroi | Herb | *Homalomena aromatica* | Huabosin | Hu | L | Leaf mixed with the poison Derris vine root to kill fish. Placed on surface of small ponds and slow flowing creeks |
| Pawaia | Poroi | Herb | *Horstedtia scottiana* | Hun'go | F | F | Edible f+J644:J903ruit |
| Pawaia | Poroi | Liana | Not seen or identified during survey | Sori pu | D | S | Dry sections of the stem are used as a smoldering match |
| Pawaia | Poroi | Palm | *Actinorhytis calapparia* | Bapi | H | S | Stem split for flooring |
| Pawaia | Poroi | Palm | *Actinorhytis calapparia* | Bapi | Cul | S | Nut chewed as a replacement for buai to act as a stimulant |
| Pawaia | Poroi | Palm | *Arenga macrocarpa* | Me'opare | F | S | Edible new shoots |
| Pawaia | Poroi | Palm | *Caryota rumphiana* | Ee'hua | F | S | Stem used to make axe handles |
| Pawaia | Poroi | Palm | *Cyrtostachys sp* | Mo | M | S | Sap used to cure diarrhea |
| Pawaia | Poroi | Palm | *Cyrtostachys sp* | Mo | F | S | Edible new shoots |
| Pawaia | Poroi | Palm | *Hydriastele costata* | Haia | H | S | Flooring |
| Pawaia | Poroi | Palm | *Licuala lauterbachii* | Ka'ar | Hu | S | Stem used for arrow heads and hunting bows |
| Pawaia | Poroi | Palm | *Meteroxylon sagu* | Hua'a | H | L | Leaves used to make walls and roof thatch |
| Pawaia | Poroi | Palm | *Meteroxylon sagu* | Hua'a | F | S | Stem processed to extract edible starch |
| Pawaia | Poroi | Palm | *Orania sp.* | Pae | D | F | Fruit burned to produce smoke to keep pigs away from food gardens |
| Pawaia | Poroi | Tree | *Aglaia sp.* | Lalapuri | H | S | House post |
| Pawaia | Poroi | Tree | *Aglaia sp.* | Lalapuri | FD | T | Preferred firewood (no 2) |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Poroi | Tree | *Antiaris toxicaria* | Nemi | Can | S | Preferred canoe tree |
| Pawaia | Poroi | Tree | *Artocarpus sp.* | Jao | F | F | Edible fruit |
| Pawaia | Poroi | Tree | *Artocarpus sp.* | Jao | M | SP | Sap drunk to stop diarrhea |
| Pawaia | Poroi | Tree | *Burkella sp.* | Huaja | H | T | Floor joist and studs |
| Pawaia | Poroi | Tree | *Burkella sp.* | Wahaja'ee | H | S | Bearer |
| Pawaia | Poroi | Tree | *Calophyllum sp.* | Tee'a | H | S | Bearer |
| Pawaia | Poroi | Tree | *Campnosperma montana* | Me | M | IB, OB | Scrape inner bark and squeeze onto the sore and use bark for sore dressing |
| Pawaia | Poroi | Tree | *Campnosperma montana* | Me | M | IB, OB | Bark scrapings placed on sore to heal |
| Pawaia | Poroi | Tree | *Campnosperma montana* | Me | D | SP | Wound the tree and collect sap (oil) and wash with it to grow hair |
| Pawaia | Poroi | Tree | *Cananga odorata* | Keroro | H | S | Stem split for house walls (palang) - a soft wood |
| Pawaia | Poroi | Tree | *Dillenia papuana* | Ju | Cul | OB | Dry bark placed on fire to make smoke which will bring rain |
| Pawaia | Poroi | Tree | *Dillenia papuana* | Ju | H | T | Bearer, floor joist |
| Pawaia | Poroi | Tree | *Elmerrillia papuana* | Uu | Can | S | Preferred canoe tree (No 1) |
| Pawaia | Poroi | Tree | *Endospermum sp.* | Kie | H | T | Bearer, rafter |
| Pawaia | Poroi | Tree | *Ficus adenosperma* | Jali | FD | T | Preferred firewood (no 4) |
| Pawaia | Poroi | Tree | *Ficus copiosa* | Si | F | F/L | Fruit and young leaves are edible. Leaves usually cooked |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Poroi | Tree | *Ficus sp.* | Ainsii | F | F/L | Edible fruit and leaves |
| Pawaia | Poroi | Tree | *Garcinia sp.* | Kuruai | H | T | Post |
| Pawaia | Poroi | Tree | *Garcinia sp.* | Kururai | Can | S | Stem used to make canoe paddles |
| Pawaia | Poroi | Tree | *Gardenia sp* | Wi'iri | Hu | F | Broken fruit smoked and then cooked with fish and fed to dog to improve hunting performance |
| Pawaia | Poroi | Tree | *Gnetum gnemon* | So | Cul | IB/SP | Bark fibers used to make bilums (string bags) |
| Pawaia | Poroi | Tree | *Gnetum gnemon* | So | F | L | Young leaves are edible. Usually cooked |
| Pawaia | Poroi | Tree | *Gynotroches sp.* | Suami | H | S | Joists |
| Pawaia | Poroi | Tree | *Hibiscus sp.* | Ja | FD | T | Preferred firewood (no 3) |
| Pawaia | Poroi | Tree | *Hibiscus sp.* | Ja | D | B | Traditional rope. |
| Pawaia | Poroi | Tree | *Homalium foetidum* | Jeni'i | H | S | Preferred house post (third favorite) |
| Pawaia | Poroi | Tree | *Homalium foetidum* | Jeni'i | FD | T | Most preferred firewood (no 1) |
| Pawaia | Poroi | Tree | *Intsia palembanica* | Ola | H | S | Preferred house post and bearer |
| Pawaia | Poroi | Tree | *Intsia palembanica* | Ola | Can | S | Used to make canoe paddles |
| Pawaia | Poroi | Tree | *Lithocarpus sp.* | U'u | Hu | F | Wild pigs feed off fallen nuts where they are hunted. Grows I hill forest |
| Pawaia | Poroi | Tree | *Lithocarpus sp.* | Kari | Can | S | Paddle for canoe |
| Pawaia | Poroi | Tree | *Lithocarpus sp.* | Kari | Hu | F | Hunting tree. Wild pigs eat fallen nuts and are hunted |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Poroi | Tree | *Macaranga sp.* | Piko | H | L | Large leaves used as a roofing cap underneath kunai grass thatch |
| Pawaia | Poroi | Tree | *Macaranga sp.* | Soa'a | D | T | Used to make fire using the friction method |
| Pawaia | Poroi | Tree | *Macaranga sp.* | So'a | D | Br | Used to make fire using the friction method |
| Pawaia | Poroi | Tree | *Mastixodendron sp.* | Tui | H | S | Bearer and studs |
| Pawaia | Poroi | Tree | *Melicope elleryana* | Su | H | S | General house construction timber |
| Pawaia | Poroi | Tree | *Melicope elleryana* | Su | D | T | Used to smoke fish for preserving. Green timber used |
| Pawaia | Poroi | Tree | *Myristica sp.* | So'abu | M | F | Fruit eaten to relieve a cough |
| Pawaia | Poroi | Tree | *Nageia wallichiana* | Peri | H | S | Preferred species for house bearers |
| Pawaia | Poroi | Tree | *Nauclea sp.* | Jeni | H | S | studs, floor joist |
| Pawaia | Poroi | Tree | *Nauclea sp.* | Jeni | M | IB | Scrape inner bark, squeeze sap onto a snake bite and wrap wound with squeezed bark. |
| Pawaia | Poroi | Tree | *Octomeles sumatrana* | Suri | Can | S | Canoe tree |
| Pawaia | Poroi | Tree | *Podocarpus nerifolius* | Ho'one | H | S | House bearer |
| Pawaia | Poroi | Tree | *Pometia pinnata* | Hena | FD | T | Preferred firewood species |
| Pawaia | Poroi | Tree | *Pometia pinnata* | Hena | F | F | Edible fruit |
| Pawaia | Poroi | Tree | *Pometia pinnata* | Hena | H | T | Bearer and floor joist |
| Pawaia | Poroi | Tree | *Pouteria sp.* | Muberi | H | S | Stem split for walling. Preferred species (no 2) |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Poroi | Tree | *Pterocarpus indicus* | Huru | H | T | Bearer and studs |
| Pawaia | Poroi | Tree | *Spondias sp.* | Jari | F | LF | Edible new shoots and fruit. |
| Pawaia | Poroi | Tree | *Terminalia kaernbachii* | Te | F | F | Edible nuts |
| Pawaia | Poroi | Tree | *Terminalia sp.* | Ju'o | F | F | Edible nut |
| Pawaia | Poroi | Tree | *Terminalia sp.* | Ju'o | Can | S | Canoe tree |
| Pawaia | Poroi | Tree | *Terminalia sp.* | Meri | Can | S | Canoe tree |
| Pawaia | Poroi | Tree | *Terminalia sp.* | Meri | H | S | Stem split for house studs |
| Pawaia | Poroi | Tree | *Toona sureni* | Kepere | Can | S | Canoe tree |
| Pawaia | Poroi | Tree | *Trichospermum sp.* | Kuru | H | S | Stem split for house walls (palang) - a soft wood |
| Pawaia | Poroi | Tree | *Trichospermum sp.* | Kuru | D | IB | Inner bark used for traditional rope |
| Pawaia | Poroi | Tree | Not seen or identified during survey | Pania | H | S | Preferred tree used for house construction |
| Pawaia | Poroi | Tree | Not seen or identified during survey | Gereru | H | S | Stem split for walling (palang). (Soft timber) |
| Pawaia | Poroi | Tree | Not seen or identified during survey | Semihalo | D | T | Dead broken timber used as a smoldering match |
| Pawaia | Poroi | Tree fern | *Cyathea sp.* | Wabosin | F | L | Edible new shhots. Usually cooked |
| Pawaia | Subu | Bamboo | *Bambusa sp.* | Tabo | H | S | Stem split to make house walls |
| Pawaia | Subu | Bamboo | *Bambusa sp.* | Tapo | F | S | Young shoots edible |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Subu | Bamboo | *Bambusa sp.* | Tabo | D | S | Sections of the stem used as cooking pots. Placed on fire to steam food |
| Pawaia | Subu | Bamboo | *Bambusa sp.* | Tapo | D | S | Traditional cooking pot, fetching water |
| Pawaia | Subu | Climber/Vine | *Faradaya sp.* | Sari'he | Can | S | Woody climber used to pull a canoe from where it has been made in the forest to the nearest creek |
| Pawaia | Subu | Climber/Vine | *Merremia peltata* | Emiko | M | SP | Sap from the tip applied on fresh cut wound |
| Pawaia | Subu | Climber/Vine | *Merremia peltata* | Emiko | D | S | Climber/Vine used as rope, often for tying firewood bundles |
| Pawaia | Subu | Climber/Vine | Not seen or identified during survey | Sari'i | D | S | Traditional rope |
| Pawaia | Subu | Climbing palm | *Calamus aruensis* | Wujemi (large) | O | S | Traditional cane rope |
| Pawaia | Subu | Climbing palm | *Calamus aruensis* | Wujemi (large) | D | L | Leaves used for wrapping sago for cooking |
| Pawaia | Subu | Climbing palm | *Calamus sp.* | Ajemi (large) | M | S | Water from the stem is used for cough medicine |
| Pawaia | Subu | Climbing palm | *Calamus sp.* | Injemi omujemi-small size | H | S | Cane rope for house construction |
| Pawaia | Subu | Climbing palm | *Calamus sp.* | Injemi wijemi/Karaujemi - large size | H | S | House batten for securing thatch |
| Pawaia | Subu | Climbing palm | *Calamus sp.* | Wijemi | Hu | S | Stem used to make hunting bows |
| Pawaia | Subu | Climbing palm | *Calamus sp.* | Ajemi (large) | D | S | Traditional rope |
| Pawaia | Subu | Climbing palm | *Calamus sp.* | Injemi wijemi/Karaujemi - large size | D | S | Can be used as a torch or for starting up fire (friction method) |
| Pawaia | Subu | Climbing palm | *Korthalsia zippelii* | Ae'jemi | H | S | Replacement for nails |
| Pawaia | Subu | Fern | *Sphaerostephanos sp.* | O'polu | M | L | Tips of new shoots boiled in water and mixture drunk to relieve a cough |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Subu | Grass | *Miscanthus floridulus* | Su'keni | Hu | S | Stem used for arrow shafts. Native grass but planted locally |
| Pawaia | Subu | Herb | *Alpinia sp.* | Humu | Hu | S | Aromatic stem pushed into eel holes to force eel out |
| Pawaia | Subu | Herb | *Cominsia gigantea* | Weneosin | H | L | Used as ridge cap for house |
| Pawaia | Subu | Herb | *Cominsia gigantea* | Weneosin | D | L | Leaf used to wrap food prior to cooking |
| Pawaia | Subu | Herb | *Holochlamys beccarii* | So'wosin | H | L | Leaves used for roof caps and for bush/hunting house thatch |
| Pawaia | Subu | Herb | *Homalomena aromatica* | Huobosi | M | L | If feeling symptoms of cough, squeeze leaf and inhale the aromatic smell |
| Pawaia | Subu | Herb | *Horstedtia scottiana* | Hun'kwo | F | F | Edible fruit |
| Pawaia | Subu | Herb | *Riedellia sp.* | Boensing | H | L | Thatch for bush house/hunting hut |
| Pawaia | Subu | Herb | *Riedellia sp.* | Boensiimg | F | S | New shoots edible |
| Pawaia | Subu | Palm | *Areca sp.* | Midolo | Cul | F | Substitute for betel nut (Kabibi) |
| Pawaia | Subu | Palm | *Arenga macrocarpa* | None provided during survey | H | S | Temporary post for bush or fishing huts |
| Pawaia | Subu | Palm | *Arenga macrocarpa* | None provided during survey | FD | S | Young shoots are edible |
| Pawaia | Subu | Palm | *Black palm* | Puru | H | S | Stem split for flooring |
| Pawaia | Subu | Palm | *Caryota rumphiana* | Si'a pale | F | S | Stem pith used as a replacement for sago when short of food |
| Pawaia | Subu | Palm | *Caryota rumphiana* | Si'a pale | D | S | Stem used to make axe handles and hunting bows |
| Pawaia | Subu | Palm | *Cyrtostachys sp* | Bo'o | H | S | Stem split for flooring |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Subu | Palm | *Cyrtostachys sp* | Bo'o | F | S | Edible new shoot (from base of stem) |
| Pawaia | Subu | Palm | *Hydriastele costata* | U'aa | D | I | Old flower head used as a broom |
| Pawaia | Subu | Palm | *Meteroxylon sagu* | Hua'a | H | S | Leaves woven to make house walls |
| Pawaia | Subu | Palm | *Meteroxylon sagu* | Hua'a | F | S | Starchy food extracted from beating stem. Staple food |
| Pawaia | Subu | Palm | *Pandanus sp.* | Houwe'ee | M | SP | Scrape sap off from the stem, squeeze and drink for bone repair |
| Pawaia | Subu | Pandanus | *Pandanus sp.* | Habuso's (long hanging (prop) roots) | H | R | Split roots for support for thatch (rafter) |
| Pawaia | Subu | Pandanus | *Pandanus sp.* | Habuso's (long hanging (prop) roots) | D | R | Split for traditional fire tongs |
| Pawaia | Subu | Tree | *Anthocephalus chinensis* | Jenee | M | B | Scrape bark and squeeze onto snake bite and use bark as dressing. |
| Pawaia | Subu | Tree | *Anthocephalus chinensis* | Jenee | H | T | Studs, floor joist, rafter |
| Pawaia | Subu | Tree | *Antiaris toxicaria* | Nemi | Can | S | Canoe |
| Pawaia | Subu | Tree | *Calophyllum sp.* | Tie | H | T | Bearer, rafter, stud, floor joist |
| Pawaia | Subu | Tree | *Campnosperma montana* | Me | M | SP | Oily sap rubbed in hair to promote dreadlocks (cosmetic) and drink sap for gaining weight if losing weight due to illness |
| Pawaia | Subu | Tree | *Cerbera floribunda* | Wi'i | M | SP | Treatment for sore. |
| Pawaia | Subu | Tree | *Cerbera floribunda* | Wi'i | Cul | B | Bark dried, burn into ash mix with food/soup and give to dog to hunt for cassowaries only. Improves hunting ability |
| Pawaia | Subu | Tree | *Cinnamomum sp* | U'uhei | M | B | Traditional medicine for cough (scrape bark mix with water and drink). Drive away spells or evil spirits |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Subu | Tree | *Elmerrillia papuana* | U'u | Can | S | Preferred species for large motor canoes |
| Pawaia | Subu | Tree | *Ficus copiosa* | Sai | F | L | Edible new leaves |
| Pawaia | Subu | Tree | *Ficus pungens* | Jale | F | L | Edible new leaves |
| Pawaia | Subu | Tree | *Ficus sp.* | Jale | Cul | L | Young leaves boiled to extract red dye for grass skirts |
| Pawaia | Subu | Tree | *Garcinia sp.* | Kuruai | H | S | House post, bearer (most preferred species) |
| Pawaia | Subu | Tree | *Garcinia sp.* | Kuruai | Can | S | Canoe paddle (most preferred speices) |
| Pawaia | Subu | Tree | *Gnetum gnemon* | So | O | IB | Traditional rope for making string bag |
| Pawaia | Subu | Tree | *Gnetum gnemon* | So | F | F, L | Fruit and leaf is edible |
| Pawaia | Subu | Tree | *Hernandia sp.* | Kapale | H | T | Studs, walling |
| Pawaia | Subu | Tree | *Homalium foetidum* | Hu'uni | H | S | House post (preferred species), bearer |
| Pawaia | Subu | Tree | *Homalium foetidum* | Hu'uni | FD | T | Preferred firewood (No 2) |
| Pawaia | Subu | Tree | *Intsia palembanica* | Ola | H | S | Preferred house post and bearer besides Jeni'i |
| Pawaia | Subu | Tree | *Litsea sp.* | Hoajai'i | H | T | Studs, floor joist, rafter |
| Pawaia | Subu | Tree | *Macaranga sp.* | Pidoi | H | L | Leaf used as ridge cap for housing |
| Pawaia | Subu | Tree | *Maniltoa sp* | Anakain | Cul | B | Remove bark facing sunset. Place it under the pillow, scrape and mix with water and drink before going to fight. Provided protection |
| Pawaia | Subu | Tree | *Mastixodendron sp.* | Tui | H | T | Bearer, studs |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Subu | Tree | *Mastixodendron sp.* | Tui | H | T | Rafter |
| Pawaia | Subu | Tree | *Myristica sp.* | Ma'aumi | M | M | Eat flesh of the fruit and not the seed for curing cough or cold |
| Pawaia | Subu | Tree | *Myristica sp.* | Ipi | Cul | SP | Sap from leaf petiole used for face painting and body decoration for singsing |
| Pawaia | Subu | Tree | *Myristica sp.* | Ipi | FD | T | Firewood for smoking pig meat and fish |
| Pawaia | Subu | Tree | *Myristica sp.* | So'obu | H | T | Rafter |
| Pawaia | Subu | Tree | *Nageia wallichiana* | Peri | H | T | Rafter |
| Pawaia | Subu | Tree | *Octomeles sumatrana* | Suri | Can | S | Canoe tree. Second best species |
| Pawaia | Subu | Tree | *Pangium edule* | Je'e | F | F | Seed soaked in water to remove any impurities before cooked in boiling water, rinsed and then eaten. |
| Pawaia | Subu | Tree | *Pangium edule* | Je'e | F | F | Edible seed. Must be soaked in water for 24 hours or more to remove toxins |
| Pawaia | Subu | Tree | *Paraserianthes falcataria* | So'o | M | B | Scrape bark and squeeze into infected foot to treat tinea |
| Pawaia | Subu | Tree | *Pittosporum sinuatum* | O'e | M | F | Seed is swallowed for curing spleen pain |
| Pawaia | Subu | Tree | *Planchonia papuana* | Si'nee | M | IB | Beat bark, boil and wash with it if having skin or body ache, e.g. malaria |
| Pawaia | Subu | Tree | *Podocarpus nerifolius* | Kipere | H | T | Bearer, studs, floor joist |
| Pawaia | Subu | Tree | *Pometia pinnata* | Hoena | FD | T | Most preferred firewood speices |
| Pawaia | Subu | Tree | *Pouteria sp.* | Muberi | H | T | Studs, floor joist, rafter, walls (soft timber easy to split) |
| Pawaia | Subu | Tree | *Pseudovaria sp.* | So'obo | H | B | Best bark for flooring and walls |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Subu | Tree | *Pseudovaria sp.* | So'obo | FD | S | Preferred for starting fire using the friction method with cane (Wijemi) |
| Pawaia | Subu | Tree | *Pterocarpus indicus* | Huru or Holo | H | S | House post, bearer |
| Pawaia | Subu | Tree | *Pterocarpus indicus* | Huru or Holo | M | IB | Scrape inner bark, mix with water and drink to cure body aches |
| Pawaia | Subu | Tree | *Pterocarpus indicus* | Huru or Holo | M | SP | Cut bark, collect sap and drink to cure strong cough and dysentery |
| Pawaia | Subu | Tree | *Syzygium sp.* | Olu | H | T | House bearer and studs |
| Pawaia | Subu | Tree | *Syzygium sp.* | Kule | F | F | Edible fruit |
| Pawaia | Subu | Tree | *Terminalia sp.* | Komakai/Meri | H | T | Bearers and rafters |
| Pawaia | Subu | Tree | *Terminalia sp.* | Komakai/Meri | FD | T | Firewood |
| Pawaia | Subu | Tree | *Trichospermum sp.* | Kulu | H | B | Walling, flooring |
| Pawaia | Subu | Tree | *Ziziphus sp.* | Omu | O | S | Used to make sago pounding tool |
| Pawaia | Subu | Tree | Not seen or identified during survey | Terihei | M | B | Traditional medicine for all kinds of aches (head, body, etc.). Scrape bark and mix with water and drink |
| Pawaia | Subu | Tree | Not seen or identified during survey | Se'eru | M | B | Traditional medicine for all kinds of aches (body, tooth, etc.) and ailment. Scrape bark, mix with water and drink |
| Pawaia | Subu | Tree | Not seen or identified during survey | Soipo | Hu | IB | Traditional rope for tying the spear |
| Pawaia | Subu | Tree fern | *Cyathea sp.* | Wabosin | F | S/L | Edible new shoots and leaves |
| Pawaia | Ura | Climber/Vine | *Derris sp.* | Perebi | Hu | R | Root bashed and white sap extracted used to kill fish |
| Pawaia | Ura | Climber/Vine | *Flagellaria indica* | Heiso | F | L | Matured dry leaves burned to ashes to make traditional salt |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Ura | Climber/Vine | *Flagellaria indica* | Heiso | M | S | Chew young shoot and swallow the juice to cure cough |
| Pawaia | Ura | Climber/Vine | *Merremia peltata* | Emibo | M | SP | Break off tip and collect white sap and drink it to cure strong cough |
| Pawaia | Ura | Climber/Vine | *Uncaria sp.* | Jauraibo | D | S | Climber/Vine cut to drink water from if thirsty when out in the forest |
| Pawaia | Ura | Palm | *Hydriastele costata* | Ua | H | S | Stem split for flooring |
| Pawaia | Ura | Palm | *Hydriastele costata* | Wa | H | S | Stem split for flooring |
| Pawaia | Ura | Palm | *Hydriastele costata* | Wa | D | I | Inflorescence used for broom |
| Pawaia | Ura | Palm | *Hydriastele costata* | Wa | D | L | Leaf sheath used as bucket for collecting water or sago starch |
| Pawaia | Ura | Palm | *Licuala lauterbachii* | Sokodu (Poni) | Hu | S | Stem sharpened into bow and arrow head |
| Pawaia | Ura | Pandanus | *Pandanus sp.* | Kega | Cul | L | Leaf used for weaving mat |
| Pawaia | Ura | Pandanus | *Pandanus sp.* | Wi'i | H | L | Thatching for roof |
| Pawaia | Ura | Shrub | *Mussaenda sp.* | Kabari | M | L | Young leaves (the white ones) squeezed and sap rubbed onto the eye to cure sore eye |
| Pawaia | Ura | Tree | *Barringtonia sp.* | None provided during survey | Hu | IB | Bark scrapings mixed with bark of Pometia pinnata to kill fish |
| Pawaia | Ura | Tree | *Calophyllum sp.* | Tihe | H | S | Bearer and rafter |
| Pawaia | Ura | Tree | *Campnosperma montana* | Me | D | SP | Wound the tree and collect sap (oil) and wash with it to grow hair |
| Pawaia | Ura | Tree | *Cananga odorata* | Keroro | H | S | Rafters |
| Pawaia | Ura | Tree | *Dillenia papuana* | Ju | H | S | Bearer |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Ura | Tree | *Elmerrillia papuana* | U'u | Can | S | Preferred species for making dugout canoes |
| Pawaia | Ura | Tree | *Elmerrillia papuana* | U'u | M | IB | Bark used for healing tooth ache |
| Pawaia | Ura | Tree | *Endospermum molucana* | Tipida | M | IB | Scrape inner bark, squeeze juice out and give to pig if it has diarrhea |
| Pawaia | Ura | Tree | *Homalium foetidum* | Jeni'i | H | S | Most preferred house post, bearer |
| Pawaia | Ura | Tree | *Homalium foetidum* | Jeni'i | FD | S | Firewood |
| Pawaia | Ura | Tree | *Lithocarpus sp.* | Kari | H | S | Bearer and floor joist |
| Pawaia | Ura | Tree | *Lithocarpus sp.* | Kari | FD | S | Firewood |
| Pawaia | Ura | Tree | *Macaranga sp.* | Soain | H | S | Rafters |
| Pawaia | Ura | Tree | *Maniltoa sp* | None provided during survey | H | S | Bearer |
| Pawaia | Ura | Tree | *Myristica sp.* | Ipi | M | L | Young leaves chewed and placed onto a fresh cut wound. |
| Pawaia | Ura | Tree | *Osmoxylon sp.* | Ponu | M | S | Scrape inner bark, wrap in a leaf and place it in the ashes and squeeze juice onto a fresh cut or an old wound |
| Pawaia | Ura | Tree | *Planchonia papuana* | Sini | M | IB | Scrape inner bark, boiled in water and wash with it for any body ailments |
| Pawaia | Ura | Tree | *Pometia pinnata* | Hena | H | S | Bearer |
| Pawaia | Ura | Tree | *Pometia pinnata* | Hena | FD | S | Firewood |
| Pawaia | Ura | Tree | *Pometia pinnata* | Hena | F | F | Fruit edible |
| Pawaia | Ura | Tree | *Premna sp.* | Sui'i | M | L | Boil leaves and inhale steam to cure malaria |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Ura | Tree | *Premna sp.* | Sui'i | Cul | L | Women use it to get rid of the second wife by placing the leaf under the husband's pillow |
| Pawaia | Ura | Tree | *Pterocarpus indicus* | Huru | H | S | House post |
| Pawaia | Ura | Tree | *Saurauia sp.* | Maitopimei'i | Hu | F | Fruit cooked over the fire, mixed with food and feed dog for good hunting |
| Pawaia | Ura | Tree | *Saurauia sp.* | Seri'i | Cul | B | To keep pigs away from disturbing gardens, break off a branch and place it in the direction of the pig |
| Pawaia | Ura | Tree | *Saurauia sp.* | Seri'i | Cul | L | Women use it to get rid of the second wife by placing the leaf under the husband's pillow |
| Pawaia | Ura | Tree | *Terminalia kaernbachii* | Komakai | H | S | Bearer |
| Pawaia | Ura | Tree | *Terminalia kaernbachii* | Komakai | F | F | Nut is edible |
| Pawaia | Ura | Tree | *Terminalia kaernbachii* | Komakai | FD | S | Firewood |
| Pawaia | Ura | Tree | *Terminalia sp.* | Meri | H | T | Bearer and studs. Most preferred species |
| Pawaia | Ura | Tree | *Trichospermum sp.* | Kuru | H | T | Rafters |
| Pawaia | Ura | Tree | *Trichospermum sp.* | Kuru | FD | S | Firewood |
| Pawaia | Ura | Tree | *Trichospermum sp.* | Kuru | H | IB | Inner bark used for making rope |
| Pawaia | Ura | Tree | *Trichospermum sp.* | Kuru | H | IB | Stem split for walling (palang) |
| Pawaia | Ura | Tree | Not seen or identified during survey | Jolu | FD | S | Firewood |
| Pawaia | Ura | Tree | Not seen or identified during survey | Sola | FD | S | Firewood |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Ura | Tree fern | *Angiopteris evecta* | Uriepe | M | S | Scrape inner stem, wrap it in a leaf and place it under charcoal then place it onto a swollen groin to stop the pain and swelling |
| Pawaia | Wabo | Bamboo | *Bambusa sp.* | Kabo | F | L | New shoots edible when cooked |
| Pawaia | Wabo | Bamboo | *Bambusa sp.* | Kabo | D | S | Used as cooking pot or for carrying water |
| Pawaia | Wabo | Climber/Vine | *Flagellaria indica* | Heiso | D | L | Matured dry leaves burned to ashes to make traditional salt. |
| Pawaia | Wabo | Climber/Vine | *Flagellaria indica* | Heiso | D | S | Used as rope |
| Pawaia | Wabo | Climber/Vine | *Merremia peltata* | Opa'omeni | M | SP | Sap is used to heal sores |
| Pawaia | Wabo | Climber/Vine | *Merremia peltata* | Opa'omeni | D | S | Used as rope for tying bundles of firewood |
| Pawaia | Wabo | Climbing palm | *Calamus sp.* | Injemi | H | S | Used as rope or as replacement for nail for house construction |
| Pawaia | Wabo | Climbing palm | *Calamus sp.* | Kaure | M | Sp | Sap drunk to ease a cough (large species) |
| Pawaia | Wabo | Climbing palm | *Calamus sp.* | Jo jemi | H | S | The cane rope is a substitute for nail for house construction (small species) |
| Pawaia | Wabo | Climbing palm | *Calamus sp.* | Kaure | D | S | Used as rope and as a replacement for nails, particularly in house construction and for tethering canoes (large species) |
| Pawaia | Wabo | Fern | *Diplazium esculentum* | U'wapo | F | L | Edible new shoots (leaves). Usually cooked |
| Pawaia | Wabo | Fern | *Stenochlaena pallustris* | Pe'ya | F | L | Edible new shoots. Usually boiled |
| Pawaia | Wabo | Grass | *Miscanthus floridulus* | Sugeni | Hu | S | Stem used for arrow shafts |
| Pawaia | Wabo | Herb | *Riedellia sp.* | Wen'a | H | L | The large leaves are used as roofing for bush houses/hunting huts |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Wabo | Palm | *Caryota rumphiana* | Ha'een | Hu | S | Stem used for making bow and arrow head |
| Pawaia | Wabo | Palm | *Caryota rumphiana* | Ha'een | F | S | Stem pith used as a replacement for sago when short of food. |
| Pawaia | Wabo | Palm | *Caryota rumphiana* | Ha'een | D | S | Axe handles. Tool for pounding sago |
| Pawaia | Wabo | Palm | *Hydriastele costata* | Ua | H | S | Flooring |
| Pawaia | Wabo | Palm | *Hydriastele costata* | Ua | O | F | Influences used as broom |
| Pawaia | Wabo | Palm | *Hydriastele costata* | Ua | O | L | Leaf sheath used as bucket for collecting water or sago starch |
| Pawaia | Wabo | Palm | *Hydriastele microspadix* | Wes'aa | Hu | S | Sharpened stem used for arrow heads |
| Pawaia | Wabo | Palm | *Licuala lauterbachii* | Ku'o | Hu | S | Stem used to make bows and arrow heads |
| Pawaia | Wabo | Palm | *Meteroxylon sagu* | Hua'a | F | S | Starch for food. Main staple food |
| Pawaia | Wabo | Palm | *Meteroxylon sagu* | Hua'a | H | L | Thatched roof |
| Pawaia | Wabo | Palm | Not seen or identified during survey | Pei | H | T | Stem split for flooring |
| Pawaia | Wabo | Pandanus | *Pandanus sp.* | Woo | H | R | Flooring |
| Pawaia | Wabo | Pandanus | *Pandanus sp.* | Woo | H | L | Thatched roof |
| Pawaia | Wabo | Tree | *Alphitonia incana* | O'o | H | T | Rafter |
| Pawaia | Wabo | Tree | *Alphitonia incana* | O'o | M | S | Bark is scraped, squeeze juice out and drink for curing spleen and body aches |
| Pawaia | Wabo | Tree | *Alstonia scholaris* | Pu'u (Soain) | Cul | SP | Collect sap and drink for curing strong cough. |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Wabo | Tree | *Alstonia scholaris* | Pu'u (Soain) | M | IB | Bark scraped and boiled in water, strain and drink to cure malaria. |
| Pawaia | Wabo | Tree | *Alstonia scholaris* | Pu'u (Soain) | H | T | Walling |
| Pawaia | Wabo | Tree | *Alstonia scholaris* | Pu'u (Soain) | Can | S | Stem used for dugout canoes |
| Pawaia | Wabo | Tree | *Antiaris toxicaria* | Nemi | FD | T | Firewood |
| Pawaia | Wabo | Tree | *Antiaris toxicaria* | Nemi | Can | S | Canoe |
| Pawaia | Wabo | Tree | *Artocarpus sp.* | Jao | F | F | Edible fruit - bread fruit |
| Pawaia | Wabo | Tree | *Artocarpus sp.* | Jao | M | SP | Sap from inner bark used for asthma. Bark is beaten and juice drunk. After which the patient vomits and feels better |
| Pawaia | Wabo | Tree | *Calophyllum sp.* | Tie | H | T | Bearer, floor joist and rafter |
| Pawaia | Wabo | Tree | *Calophyllum sp.* | Tihe | H | S | Post and bearer |
| Pawaia | Wabo | Tree | *Campnosperma montana* | Me | D | SP | Cut bark and collect sap as cosmetics for growing hair into dreadlocks |
| Pawaia | Wabo | Tree | *Canarium sp.* | Pu | H | T | House post |
| Pawaia | Wabo | Tree | *Canarium sp.* | Pu | F | F | Edible nut |
| Pawaia | Wabo | Tree | *Canarium sp.* | Pu | FD | S | Firewood |
| Pawaia | Wabo | Tree | *Canarium sp.* | Pu | D | SP | Sap used for candles |
| Pawaia | Wabo | Tree | *Dillenia papuana* | Ju | H | T | Bearer |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Wabo | Tree | *Dillenia papuana* | Ju | Cul | IB/OB | Bark used as a love potion. Bark placed between teeth. Go direct to the woman interested in without talking to other woman. Greet the woman and she shall be yours |
| Pawaia | Wabo | Tree | *Dillenia papuana* | Ju | H | S | General house construction timber |
| Pawaia | Wabo | Tree | *Elmerrillia papuana* | U'u | Can | T | Most preferred tree for dugout canoe making |
| Pawaia | Wabo | Tree | *Elmerrillia papuana* | U'u | M | IB | Inner bark scraped and placed in between the teeth for curing tooth ache |
| Pawaia | Wabo | Tree | *Elmerrillia papuana* | U'u | H | S | House post |
| Pawaia | Wabo | Tree | *Endospermum sp.* | Kee | H | S | Stem split for flooring |
| Pawaia | Wabo | Tree | *Endospermum sp.* | Kee | Can | S | Canoe tree |
| Pawaia | Wabo | Tree | *Endospermum sp.* | Kee | M | IB | Inner bark used for cough/asthma. Bark scraped and sap used as medicine |
| Pawaia | Wabo | Tree | *Endospermum sp.* | Kie | M | S | Scrape bark mix with water and drink for curing cough and headache |
| Pawaia | Wabo | Tree | *Endospermum sp.* | Kie | H | T | Bearers/rafter |
| Pawaia | Wabo | Tree | *Ficus damaropsis* | P'use | F | F | Edible fruit |
| Pawaia | Wabo | Tree | *Garcinia sp.* | Kuruai | H | T | Post |
| Pawaia | Wabo | Tree | *Gnetum gnemon* | So | FD | T | Firewood |
| Pawaia | Wabo | Tree | *Gnetum gnemon* | So | F | F | Seeds edible |
| Pawaia | Wabo | Tree | *Gnetum gnemon* | So | F | L | Leaves used for greens |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Wabo | Tree | *Gnetum gnemon* | So | O | S | Inner bark used for making string bag or used as rope |
| Pawaia | Wabo | Tree | *Homalium foetidum* | Jeni'i | H | T | Most preferred house post (no.1). Lasts up to 15 years |
| Pawaia | Wabo | Tree | *Homalium foetidum* | Jeni'i | FD | S | Preferred firewood |
| Pawaia | Wabo | Tree | *Homalium foetidum* | Jeni'i | Can | S | Stem used for making canoe paddle |
| Pawaia | Wabo | Tree | *Horstedtia scottiana* | Min | M | IB | Scrape inner bark, squeeze out sap and drink to cure asthma. Bark beaten, heated and put on sores |
| Pawaia | Wabo | Tree | *Lithocarpus sp.* | Kari | H | T | Bearers and flooring |
| Pawaia | Wabo | Tree | *Lithocarpus sp.* | Kari | H | S | Stem split for walling and flooring. Stem used for house posts |
| Pawaia | Wabo | Tree | *Lithocarpus sp.* | Kari | Hu | F | Tree used as hunting sites for wild pigs when fruit ( nuts) ripen. Nuts eaten by wild pigs |
| Pawaia | Wabo | Tree | *Macaranga sp.* | Soa'a | H | T | Rafters |
| Pawaia | Wabo | Tree | *Melicope elleryana* | Su | O | SP | Sap used as a candle/torch |
| Pawaia | Wabo | Tree | *Melicope elleryana* | Su | D | SP | Sap used as for glue |
| Pawaia | Wabo | Tree | *Octomeles sumatrana* | Suri | Can | S | Second best tree for making canoes. Only lasts a few years |
| Pawaia | Wabo | Tree | *Osmoxylon sp.* | Ponu | M | S | Scrape inner bark, wrap and place it in the hot ashes then squeeze juice onto fresh cut or old wound to be cured |
| Pawaia | Wabo | Tree | *Pometia pinnata* | Hena | H | T | Bearer |
| Pawaia | Wabo | Tree | *Pometia pinnata* | Hena | FD | S | The best firewood. Still burns well when wet |
| Pawaia | Wabo | Tree | *Pometia pinnata* | Hena | F | F | Fruit edible |

| Language Group | Village | Lifeform | Species | Local name | Use | Part of plant | Use and preparation |
|---|---|---|---|---|---|---|---|
| Pawaia | Wabo | Tree | *Pometia pinnata* | Hena | M | IB | Inner bark mixed with passion fruit flower. Used to cure a cough |
| Pawaia | Wabo | Tree | *Pouteria sp.* | Saipe | H | S | Post and bearer |
| Pawaia | Wabo | Tree | *Pouteria sp.* | Saipe | Can | S | Stem used for canoe paddles |
| Pawaia | Wabo | Tree | *Premna sp.* | O'e | M | IB | Inner bark and leaves squeezed to extract sap. Sap mixed with water and drunk to ease malaria |
| Pawaia | Wabo | Tree | *Pterocarpus indicus* | Huru | H | T | House post |
| Pawaia | Wabo | Tree | *Pterocarpus indicus* | Huru | D | SP | Sap used as glue |
| Pawaia | Wabo | Tree | *Sloania sp.* | Jo'ore | H | S | Strong house post |
| Pawaia | Wabo | Tree | *Terminalia kaernbachii* | Ti | Can | T | Stem used for dugout canoes |
| Pawaia | Wabo | Tree | *Terminalia kaernbachii* | Ti | F | F | Nut is edible |
| Pawaia | Wabo | Tree | *Terminalia sp.* | Meri | H | T | Bearer and floor joist |
| Pawaia | Wabo | Tree | *Terminalia sp.* | Meri | H | S | House posts and stem split for walling (Palang) |
| Pawaia | Wabo | Tree | *Terminalia sp.* | Meri | Can | S | Canoe tree |

# APPENDIX F

# MAJOR HABITATS AND ASSOCIATED ANIMAL RESOURCES OF THE ECOLOGICAL ZONES WITHIN THE PAOI

## Table 1. The major habitats and associated resources of the Middle Purari Hills ecological zone

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| Hill forest | Very extensive | 1. Wallabies, tree kangaroo, echidnas<br>2. Cassowaries and eggs<br>3. Feral pigs<br>4. Pythons and monitor lizards<br>5. Bush fowl and eggs<br>6. Smaller terrestrial vertebrates (mammals, birds, reptiles, frogs)<br>7. Land crabs<br>8. Beetle larvae<br>9. Other invertebrates<br>10. Honey | Most all year; some seasonality in bush fowl and cassowary eggs |
| Alluvial forest | Localized but numerous patches | As above but some contrasts in species occurrence and abundance | Most all year; some seasonality in bush fowl and cassowary eggs |
| Sago plantations | Localized but many examples | 1. Sago grubs<br>2. Eels<br>3. Small scalefish<br>4. Frogs and tadpoles | All year |
| Gardens | Localized but many examples | 1. Small vertebrates (mammals, birds, reptiles, frogs)<br>2. Flying foxes | All year; flying foxes mostly during flowering and fruiting activity |
| Caves | Localized; few examples | 1. Colonies of cave roosting fruit bats<br>2. Colonies of insectivorous bats | All year but possibly more during breeding seasons |
| Elevated swamps | Localized but many examples | 1. Shrimps<br>2. Eels<br>3. Small scalefish<br>4. Swamp Tortoises and eggs<br>5. Frogs and tadpoles | Most all year; turtle eggs seasonal |
| Headwater streams | Localized but many examples | 1. Shrimps<br>2. Small scalefish<br>3. Eels (occasional)<br>4. Frogs | All year |
| Tributary streams (clear and mixed near confluences) | Numerous | 1. Shrimps<br>2. Eels<br>3. Small to largescalefish<br>4. Swamp Tortoises<br>5. Pig-nosed and soft-shelled turtles and their eggs<br>6. Crocodiles and eggs | Most all year; seasonal for pig-nosed and soft-shelled turtle eggs |
| Purari – main channel and tributary confluences | Localized but extensive | 1. Shrimps<br>2. Eels<br>3. Small to large scalefish<br>4. Sharks (occasional)<br>5. Swamp Tortoises<br>6. Pig-nosed and soft-shelled turtes and their eggs<br>7. Crocodiles and eggs<br>8. Snub-fin dolphin (occasional)<br>9. Freshwater bivalves | All year; seasonal for turtle eggs |

## Table 2. The major habitats and associated resources of the Southeat Hills ecological zone

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| Hill forest | Extensive; significant areas heavily impacted by logging | 1. Wallabies<br>2. Cassowaries and eggs<br>3. Feral pigs<br>4. Pythons and monitor lizards | Most all year; some seasonality in bush fowl and cassowary eggs |

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| | | 5. Bush fowl and eggs<br>6. Smaller terrestrial vertebrates (mammals, birds, reptiles, frogs)<br>7. Land crabs<br>8. Beetle larvae<br>9. Other invertebrates<br>10. Honey | |
| Alluvial forest | Extensive areas but fragmented; large areas partially converted to gardens and/or heavily impacted by logging | As above but some contrasts in species occurrence and abundance | As above |
| Headwater streams | Localized but many examples | 1. Shrimps<br>2. Small scalefish<br>3. Frogs | All year |
| Sago plantations | Localized but many examples | 1. Sago grubs<br>2. Eels<br>3. Small scalefish<br>4. Frogs and tadpoles | All year |
| Gardens | Localized but many examples | 1. Small vertebrates (mammals, birds, reptiles, frogs)<br>2. Flying foxes | All year; flying foxes mostly during flowering and fruiting activity |
| Tributary streams (clear) | Numerous | 1. Shrimps<br>2. Eels<br>3. Small to large scalefish<br>4. Swamp Tortoises<br>5. Pig-nosed and soft-shelled turtles and their eggs<br>6. Crocodiles and eggs<br>7. Frogs<br>8. Freshwater bivalves and gastropods | Most all year; seasonal for pig-nosed and soft-shelled turtle eggs |

## Table 3. The major habitats and associated resources of the Delta Swamps and Plans ecological zone

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| Alluvial forest | Extensive; marginal areas heavily impacted by logging | 1. Wallabies<br>2. Cassowaries and eggs<br>3. Feral pigs<br>4. Pythons and monitor lizards<br>5. Bush fowl and eggs<br>6. Smaller terrestrial vertebrates (mammals, birds, reptiles, frogs)<br>7. Land crabs<br>8. Beetle larvae<br>9. Other invertebrates<br>10. Honey | Most all year; some seasonality in bush fowl and cassowary eggs |
| Hill forest | Localized but numerous patches, all near boundary with MPH ecological zone | As above but some contrasts in species occurrence and abundance | As above |
| Headwater streams | Localized along boundary with MPH ecological zone | 1. Shrimps<br>2. Small scalefish<br>3. Frogs | All year |
| Sago plantations | Localized but numerous examples; mostly near boundary with MPH ecological zone | 1. Sago grubs<br>2. Eels<br>3. Small scalefish<br>4. Frogs and tadpoles | All year |
| Gardens | Localized but many examples; mostly | 1. Small vertebrates (mammals, birds, reptiles, frogs) | All year; flying foxes mostly during flowering and fruiting activity |

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| | near boundary with MPH ecological zone | 2. Flying foxes | |
| Upper reaches of tributary streams (clear) | Numerous | 1. Shrimps<br>2. Eels<br>3. Small to large scalefish<br>4. Swamp Tortoises<br>5. Pig-nosed and soft-shelled turtles and their eggs<br>6. Crocodiles and eggs<br>7. Frogs<br>8. Freshwater bivalves and gastropods | Most all year; seasonal for pig-nosed and soft-shelled turtle eggs |
| PRL-15 Oxbow wetlands | Localized | 1. Shrimps<br>2. Eels<br>3. Small to large scalefish<br>4. Swamp Tortoises and eggs<br>5. Crocodiles and eggs<br>6. Nesting birds and eggs<br>7. Frogs<br>8. Freshwater bivalves and gastropods<br>9. Flying fox camps | Most all year; seasonal for flying fox camps |
| Swamp woodlands | Localized but many examples | As above | As above |
| Swamp grasslands | Localized but many examples | As above but no flying fox camps | All year |
| Purari – main channel and major tributaries (turbid) | Localized but extensive | 1. Shrimps<br>2. Eels<br>3. Small to large scalefish<br>4. Sharks<br>5. Pig-nosed and soft-shelled turtles and their eggs<br>6. Crocodiles and eggs<br>7. Snub-fin Dolphin (occasional)<br>8. Freshwater bivalves and gastropods<br>9. Flying foxes | Most all year; seasonal for flying fox camps |

## Table 4. The major habitats and associated resources of the Mangroves ecological zone

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| Main channel and major tributaries (turbid) | Numerous channels | 1. Small to large scalefish<br>2. Sharks<br>3. Pig-nosed and soft-shelled turtles and eggs<br>4. Crocodiles and eggs<br>5. Snub-fin Dolphin<br>6. Marine bivalves and gastropods<br>7. Mangrove worms | Most all year; seasonal for flying fox camps |
| Tidal mudflats | Localized but numerous areas | 1. Crabs<br>2. Estuarine bivalves and gastropods<br>3. Mangrove worms | All year |
| Mangrove forest | Very extensive | 1. Crabs<br>2. Estuarine bivalves and gastropods<br>3. Oysters<br>4. Mangrove worms<br>5. Pythons and monitor lizards<br>6. Cuscuses and other arboreal vertebrates (mammals, birds, reptiles)<br>7. Flying fox camps | Most all year; seasonal for flying fox camps |
| Gardens | Localized to levee banks but many examples | 1. Small vertebrates (mammals, birds, reptiles)<br>2. Flying foxes | All year; flying foxes mostly during flowering and fruiting activity |

## Table 5. The major habitats and associated resources of the Southeast Coast ecological zone

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| Alluvial forest | Extensive; some areas heavily impacted by logging | 1. Wallabies<br>2. Cassowaries and eggs<br>3. Feral pigs<br>4. Pythons and monitor lizards<br>5. Bush fowl and eggs<br>6. Flying foxes<br>7. Smaller terrestrial vertebrates (mammals, birds, reptiles, frogs)<br>8. Land crabs<br>9. Terrestrial gastropods<br>10. Beetle larvae<br>11. Other invertebrates<br>12. Honey | Most all year; some seasonality in bush fowl and cassowary eggs |
| Hill forest | Localized along borders with Southeast Hill ecological zone; some areas heavily impacted by logging | As above but some contrasts in species occurrence and abundance | As above |
| Headwater streams | Localized along boundary with Southeast Hill ecological zone | 1. Shrimps<br>2. Eels<br>3. Small scalefish<br>4. Freshwater bivalves and gastropods<br>5. Swamp Tortoises and eggs<br>6. Frogs | All year |
| Shallow tributary streams of the lower Purari system | Localized examples | 1. Shrimps<br>2. Eels<br>3. Small to medium-sized scalefish<br>4. Freshwater bivalves and gastropods<br>5. Swamp Tortoises and eggs<br>6. Pig-nosed and soft-shelled turtles and eggs<br>7. Crocodiles and eggs<br>8. Frogs | Most all year; larger turtle and crocodile eggs are seasonal |
| Ephemeral freshwater swamps | Lowlying swales in dune complex | 1. Shrimps<br>2. Eels<br>3. Small to medium-sized scalefish<br>4. Flying foxes<br>5. Freshwater bivalves and gastropods<br>6. Swamp Tortoises and eggs<br>7. Crocodiles<br>8. Frogs | All year; swamps flooded mainly during wet season. |
| Sago plantations | Localized but numerous examples; mostly near boundary with MPH ecological zone | 1. Sago grubs<br>2. Eels<br>3. Small scalefish<br>4. Swamp Tortoises and eggs<br>5. Frogs and tadpoles<br>6. Freshwater bivalves and gastropods<br>7. Flying foxes | All year |
| Coastal scrub | Narrow band in foredunes of Orokolo Bay | 1. Flying foxes<br>2. Smaller terrestrial vertebrates (mammals, birds, reptiles)<br>3. Beetle larvae<br>4. Terrestrial gastropods | Most all year; flying foxes mostly during flowering and fruiting activity |
| Coconut and betel nut plantations | Extensive areas behind coastal dunes | 1. Flying foxes<br>2. Smaller terrestrial vertebrates (mammals, birds, reptiles, frogs)<br>3. Beetle larvae<br>4. Terrestrial gastropods | Most all year; flying foxes mostly during flowering and fruiting activity |

| Habitat | Areal extent | Major animal resources | Availability/access |
|---|---|---|---|
| | | 5. Other invertebrates | |
| Gardens | Localized in areas behind coastal dunes and along tidal tributaries | 1. Small vertebrates (mammals, birds, reptiles, frogs)<br>2. Flying foxes<br>3. Beetle larvae<br>4. Terrestrial gastropods | Most all year; flying foxes mostly during flowering and fruiting activity |
| Tidal tributaries (turbid) | Numerous examples | 1. Small to large scalefish<br>2. Sharks<br>3. Pig-nosed and soft-shelled turtles and eggs<br>4. Crocodiles and eggs<br>5. Snub-fin Dolphin<br>6. Shrimps<br>7. Marine bivalves and gastropods<br>8. Mangrove worms | Most all year; seasonal for pig-nosed and soft-shelled turtle eggs |
| Mangrove forest | Fringing tidal inlets and some inland tributaries | 1. Mud and mangrove crabs<br>2. Estuarine bivalves and gastropods<br>3. Oysters<br>4. Mangrove worms<br>5. Pythons and monitor lizards<br>6. Cuscuses and other arboreal vertebrates (mammals, birds, reptiles)<br>7. Flying fox camps | All year |
| Coastal tidal creeks | Localized along Orokolo Bay | 1. Shrimps<br>2. Mangrove and mud crabs<br>3. Eels<br>4. Small to medium scalefish<br>5. Sharks<br>6. Crocodiles (occasional)<br>7. Estaurine bivalves and gastropods<br>8. Octopus and squid | All year |
| Coastal wetlands | Localized to eastern end of Orokolo Bay | 1. Shrimps<br>2. Eels<br>3. Small to medium scalefish<br>4. Crocodiles (occasional)<br>5. Estaurine bivalves and gastropods<br>6. Sand crabs | As above |
| Beach and swash zone | Length of Orokolo Bay | 1. Prawns<br>2. Sand crabs<br>3. Small scalefish<br>4. Octopus and squid<br>5. Marine bivalves and gastropods<br>6. Sea urchins | All year but resource levels and access vary in response to storms and wave energy |
| In-shore marine | Full ocean frontage of PAOI | 1. Prawns<br>2. Sand crabs<br>3. Small to large scalefish<br>4. Sharks, saw-fishes and rays<br>5. Octopus and squid<br>6. Snub-fin and Bottlenose Dolphins | All year but resource levels and access vary in response to storms and wave energy |
| Off-shore marine | Full ocean frontage of PAOI | 1. Prawns<br>2. Small to large scalefish<br>3. Sharks and saw-fishes<br>4. Squid<br>5. Bottlenose Dolphin | All year but resource levels and access vary in response to storms and wave energy |