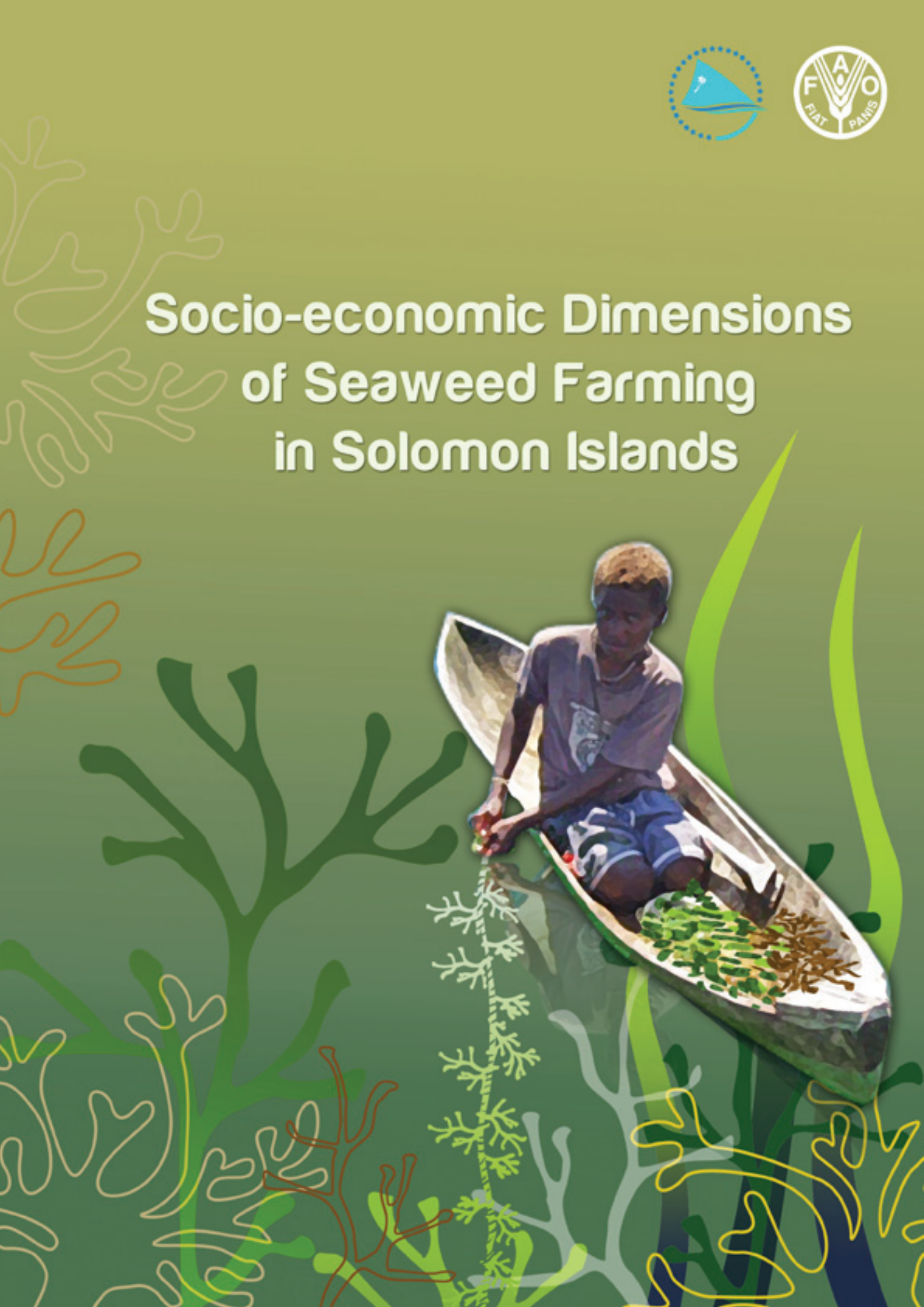
Socio-economic Dimensions of Seaweed Farming in Solomon Islands



Secretariat of the Pacific Community (SPC), Aquaculture Division

Food and Agricultural Organization (FAO)

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Table of Contents

List of Tables

List of Figures

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0. Introduction

The major objective of this study is to provide a comprehensive evaluation of the socio-economic dimensions of seaweed farming in the Solomon Islands as part of a global review of the social and economic dimensions of seaweed aquaculture.

Due to the available time and financial budget provided, the Wagina seaweed farming community, one of the four major seaweed production areas in the Solomon Islands, was selected for carrying out an in-depth field survey. The selection was made in close cooperation with the Aquaculture Division of the Solomon Island's Ministry of Fisheries and Marine Resources (MFMR).

Field survey data collected on Wagina island, Choiseul Province, has been complemented by key informant interviews including staff from relevant governmental and non-governmental institutions, agents and exporters regarding perceptions of the potential of seaweed production, its problems and possible solutions. Secondary information was researched and relevant information summarized to provide a sound historic background on the Solomon Island's seaweed farming, in particular in view of governmental and non-governmental support in the establishment, dissemination and commercialization of seaweed farming activities and produce, marketing channels, production and farm-gate price development.

1. Brief Historic Account of Seaweed Aquaculture in the Solomon Islands

1.1 Introduction of seaweed farming in the Solomon Islands, development of cultivation area by location and size

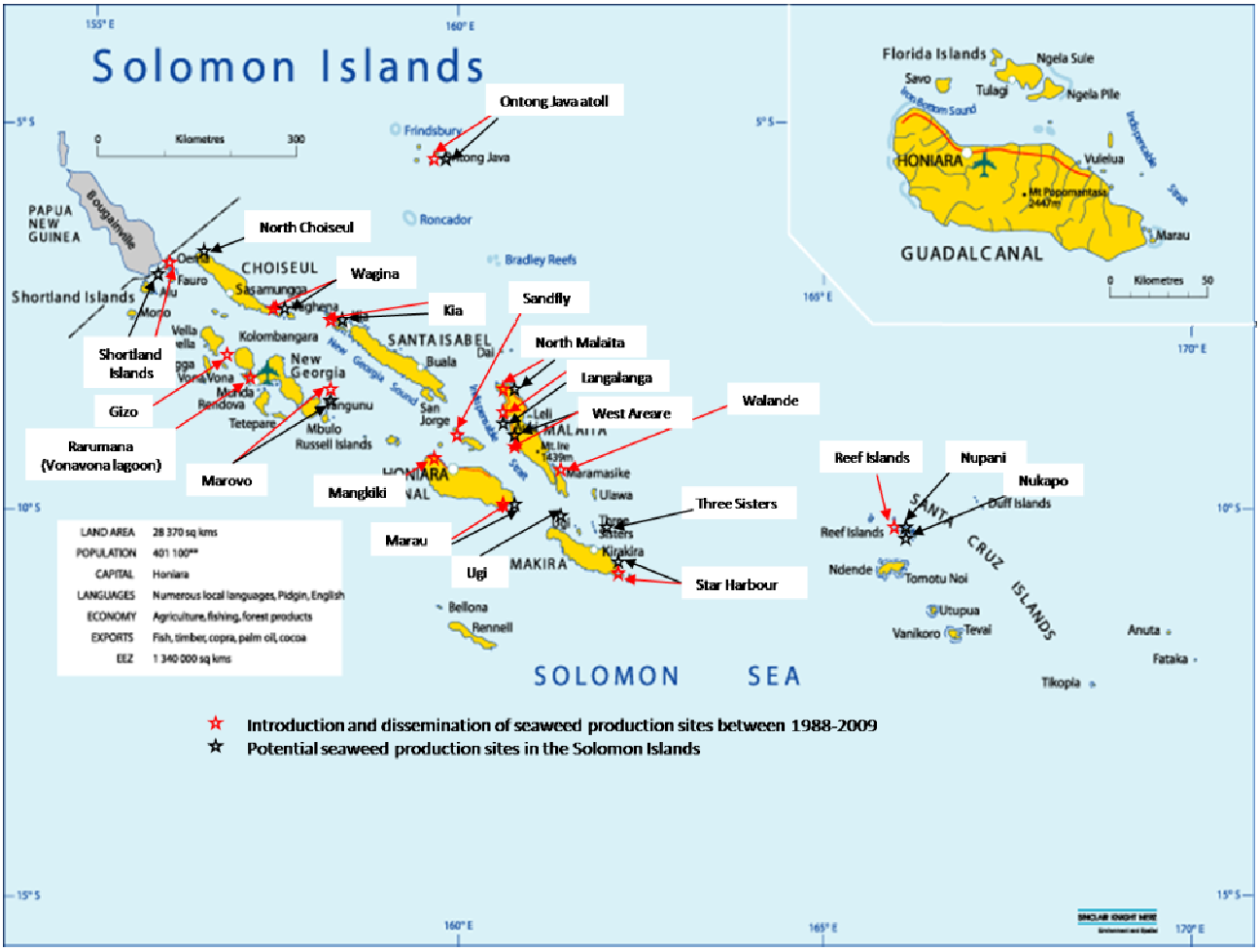
- 1988: First trials of seaweed farming undertaken by the UK Overseas Development Agency (ODA) at Vona Vona Lagoon and Rarumana village in the Western Province in cooperation with MFMR. The one year project demonstrated good growth (>5 t were produced) of Kappaphycus alvarezii that was imported from Fiji (Tiroba & McHugh 2006), however most was effected by fish grazing.
- 2000: the Aquaculture Division of the Ministry of Fisheries and Marine Resources is established and collects seed stocks remaining from the 1988 growth trials in Vona Vona Lagoon.
- 2001: the Aquaculture Division carries out growth trials in Rarumana.
- 2002: >600 kg of dried seaweed was produced in Rarumana. The Rural Fishing Enterprise Project (RFED), funded by the European Union (EU), becomes involved in the seaweed farming. RFED in cooperation with SPC and the MFMR Solomon Islands implements a seaweed training workshop (late November 2002) targeting 30 fisheries officers. Successful growth trials under RFEP at Rarumana finished in 2003.
- 2003: The remaining funds (SI$ 1.5 million, EU STABEX funds) from the RFED project are allocated to provide further support in the framework of a one-year seaweed farm development project. This project provided farm materials, outboard motors, and a warehouse in Rarumana

and the first PF-net (broadband, e-mail) system was set-up to ensure communication between producers and buyers.

- 2004: In July, a warehouse was built in Wagina where the second PF-net was set up. A feasibility study for further support from the EU was carried out.
- 2005: In the beginning of 2005 there were about 130 farmers in Rarumana and the Shortland Islands (Western Province) plus 300 farmers in Wagina, Choiseul Province, and seaweed farming had also expanded to Malaita and Makira-Ulawa. About 7 export licenses were approved, however, only one export licence holder renewed in 2006. As a result, Solomon Seaweed is the only holder of a licence allowing the export of raw seaweed. Agents are paid a commission based on production. Export of seaweed is tax-free, as for copra.
- 2005: In July 2005 a three-year SI$15 million EU funded (STABEX funds) seaweed commercialization project (COSPSI) started, which was extended until January 2009, with focus on sites in Ontong Java Atoll, Reef Islands, Malaita and to continue seaweed farming at Wagina and Rarumana.
- 2005: The International Waters Programme (IWP) (Global Environmental facility, SPREP) with assistance from COSPSI established within the framework of its community development approach a seaweed farming operation in the eastern Marovo Lagoon which is one of the major producers until today.
- 2006: In May the farm-gate price for seaweed drops from 2 to 1.50 SI$/kg due to increasing fuel prices, hences increased national and international freight cost and the versability of international seaweed market.
- 2007: A severe earthquake and associated tsunami on 2nd of April resulted in the loss of some of the best seaweed farming areas in Western Province (Rarumana), and an estimated total loss of 20-30% of the COSPIS project's seaweed production.
- 2008: In July, the farm-gate price for seaweed increased to 3.10 SI$/kg.
- 2009: The remaining COSPSI funds are used to support a seaweed farming advisor based at MFMR for one year (April 2009-March 2010).

Figure 1 shows an overview of the seaweed production sites established between 1988 and 2009, and potential seaweed production sites for future development.

Figure 1: Overview of established and future possible seaweed production sites in the Solomon Islands



1.2 Introduction of techniques and changes and introduction of alternative production methods

While no major changes concerning alternative production methods have been made since the start of seaweed production in the Solomon Islands from 2002 onwards, technical improvements include the substitution of simple black plastic sheets to protect seaweed from rain while drying by solar plastic sheets or tents that are transparent and no longer require removement during the drying process regardless the weather conditions. However, the use of solar plastic sheets is much more expensive, and has shown to tear under strong wind impact. Also netting to cover drying tables has been improved by importing a much better quality product. Experiences have also resulted in the selection of better quality ropes that last longer.

1.3 Value-added processes

There are no value-added processes introduced to the Solomon Island seaweed production. All steps of farming including establishment of the farm, harvesting, replanting, maintenance, drying and packing are taken care of by the family production unit. Agents based on site where production takes place only control the quality (dryness) of the product and ship packed bags as presented by farmers to Honiara.

The Solomon Seaweed Company is the only company that has invested in an appropriate warehouse where seaweed quality is checked, seaweed is further dried if necessary and where good quality seaweed material is bailed and exported in containers to Europe.

The second current licence holder for seaweed export, Hon Lin Trading Company, does not verify bags shipped to Honiara and has no bailing machine but packs bags in containers for export, thus reaching a much less transport efficiency as Solomon Seaweeds. This company has only exported three times, one full container of 16 t each to China. The interest of this recently licenced exporter in seaweed is highly questionned.

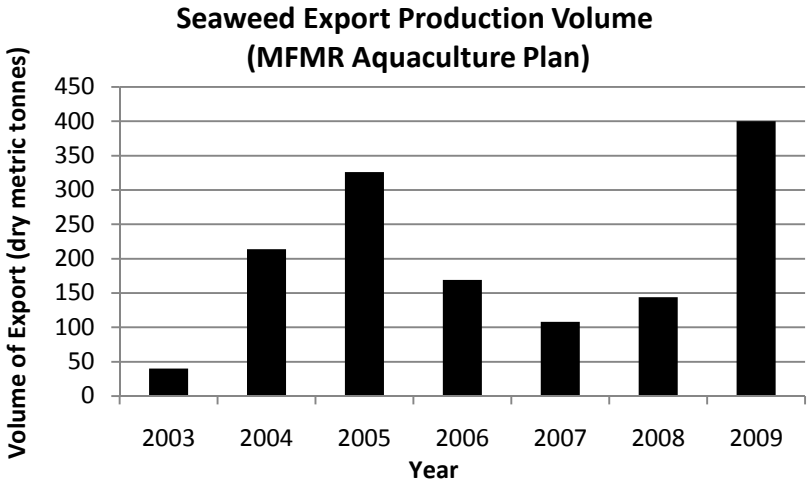
Proper drying at the farm reduces the higher freight costs involved in shipping, eliminates the need for re-drying by the exporter and the weight losses incurred, and ensures a high gel content, resulting in higher prices for the product when it reaches its destination. In 2007/2008 solar tent dryers (transparent plastic sheets) were introduced to improve drying and to mitigate against quality reduction due to rainfall (fresh water contact), thus generally improving quality and value. At some stage a differential price structure was introduced by one buyer in which clean, properly-dried A grade seaweed received a price premium over lower-quality product. During the recent field survey no such grade system was reported, or thought necessary. However, an overall incentive to increase production was reported for Solomon Seawead buying seaweed at Wagina. Each farmer selling 1 t of dried seaweed in a month receives a bonus of SI$ 250. The competitor agent from Han Lin, operating since June 2009 on Wagina provides a production bonus of SI$ 320 if a farmer sells 1 t of dried seaweed at one time. However, there are only 5-7 farmers on Wagina who could meet such a production standard.

It is believed that if the national seaweed production is increased to 1,000-2,000 t/year it would be feasible to install a local processing plant at Honiara to carry our primary processing to produce alkali-treated carrageenan chips. Further to added-value, this activity would also result in additional employment, and a reduction in international freight cost (Preston et al. 2009).

2. Historic Production Statistics

2.1 Development of export volume

Figure 2: Annual seaweed production in the Solomon Islands from 2002-2009



(Sources: 2003-2008 are from MFMR Aquaculture Development Plan)

The national production and export volume fluctuated substantially between 2003 and 2009 (Figure 2), including an annual production and export volume as low as 40 mt and as high as >400 mt of dried seaweed.

Problems encountered in the earlier days were related to fish grazing which can be seasonal and that may be avoided by moving stocks to other areas where fish grazing is minimal.

Farmers at Rarumana and the Shortlands suffered severe losses because of an outbreak of filamenteous epiphyte Polysophonia. This problem could be solved, particularly in the Rarumana area with moving seaweed to better conditions of water temperature and flow, where it recovers and the epiphyte disappears. However, Rarumana is no longer a viable seaweed production site due to the filling of the lagoon as a result of the 2008 tsunami following a major earth quake. Also, some production has been lost due to outbreaks of “ice-ice” whereby the weed loses its pigment becoming white in color. This is the result of stress, usually due to poor salinity or high water tempeartures.

2.2 Development of farm-gate prices and association with the sea cucumber fishery

The beach price for seaweed was initially established under the diversification program of the EU funded Rural Fishing Enterprise Project (RFED). The RFED manager at the time had previously been based with a seaweed farming project in Kiribati and determined that a beach price of SI$ 2 dollars/kg dried seaweed

based on the project's market intelligence and assessment, principally using copra production at a benchmark, would be reasonably attractive to growers.

In the early 2000's when seaweed farming was being rejuvenated the country was in a depressed economic state and cash income was scarce. The Solomon currency exchange rate was favorable to the US dollar (Table 1).

In 2005 Solmon seaweed farmers received a comparable beach price to producers in Fiji, however, a slightly lower beach price if compared to the unsubsidized beach prices paid to Kiribati farmers. Comparison using the records for October 2005 (Pickering, 2006) shows:

- Solomon Islands beach price is USD 0.26/kg dried seaweed (35% water content;
- Fiji beach price set by a country wide MoU issued by the Fiji Ministry of Fisheries at USD 0.27/kg dried seaweed (30% water content
- Kiribati beach price is USD 0.32/kg dried seaweed if deducting the USD 0.10/kg dried seaweed Government subsidy (35% water content).

Comparison of export prices between the 3 countries is difficult as the Fiji export price to FMC Biopolymer is a record of USD 0.55 FOB, while export prices for the Solomon Islands (selling to Degussa) and Kiribati (selling to CP Kelco) are "believed" to range between USD 0.68-0.73 CIF.

In 2006 the beach price paid to Solomon Island's farmers was reduced to SI$ 1.5 dollars/kg dried seaweed. Reportedly in response to recup the high freight charges being paid for domestic and international shippping. An SPC mission (December 2006) observed that the unregulated domestic shipping levied a "commodity based" freight rate for seaweed which was higher then other cargo. The decline in price caused some farmers to become disillusioned and seek alternative livelihoods such as fishing for lobster tails. There was a decline in the 2006 production by almost fifty percent.

However, the lowering of the beach price also coincided with the opening of the sea cucumber fishery. Many seaweed farmers also fish sea cucumber which is considered to be one of the most important sources of cash income for rural coastal communities, of course, provided that stocks are still in an exploitable status. The beach price per kg dried sea cucumber varies, depending on species and quantity fished, and has been reported to range between SI$ 5.5 – SI$ 86.8 dollars. The close association and competition between the Solomon Island's sea cucumber fishery and seaweed production showed in the peak of seaweed production in 2005 when the national sea cucumber fishery was either closed or in a very low production period (2004 – 2006). This association shows again - and opposed to the previous case - in the decline of seaweed production in 2007 as a response to the opening of the sea cucumber fishery which reached reached a production of 279 mt (dry weight) in 2007 at an average beach price of SI 37.4 dollars/kg dried sea cucumber.

In 2008 the beach price was raised to SB$ 3.1 dollars/kg dried seaweed. As a result of the beach price increment but also limited income opportunities from an open but heavily depleted sea cucumber fishery, seaweed production increased noticeably. The beach price increment was made possible by the

combined effects of an increment in international market price and the adoption of a flat rate for inland freight cost which replaced the higher commodity cargo freight rate.

Table 1: Table of seaweed and sea cucumber beach prices (SI$) and annual production (mt) and the annual average Solomon - US dollar exchange rates

Year	Seaweed Beach price (SI$/ Dry kg)	Seaweed production (Dry mt)	Sea-cumber export (Dry mt)	Sea cucumber (SI$/ Dry kg)	Exchange rate of SI$ to US$
2001	n.a	n.a	374.6	12.8	5.28
2002	2.0	4	173.6	11.6	6.75
2003	2.0	40	408.7	5.5	7.51
2004	2.0	214	17.1	23.9	7.48
2005	2.0	326	27.6	35.3	7.53
2006	1.5	169	0.1	86.8	7.61
2007	1.5	108	279	37.4	7.65
2008	3.1	144	3.8	[1)]	7.67
2009	3.1	~400	230.6	38.6	7.92

[1)] purchased from fishermen but not exported due to ban

3. Analysis of Costs and Revenues

During the field survey, data was collected to make possible estimation of net revenues per hour of labour for current cash earning activities on Wagina. Net revenues per hour of labour is considered best to make comparative the different nature of activities pursued for generating income. A general economic approach is difficult, if not impossible due to the following facts:

(a) Labour is generally not considered as a cost factor by rural people. At Honiara, unskilled labour is renumerated with about 30 SI$/day, i.e. an hourly wage of 3.75 SI$/hour. On Wagina, and likewise in other rural areas, such labour may not, or only be paid for in cash (perhaps 10-20 SI$/day) but people rendering such services need to be provided with food items for which costs may or may not accrue, depending whether food and beverage items are sources from subsistence production or purchased in local shops.
(b) Mat weaving material is free of charge, i.e. panadanus leaves grow in the wild and are subject to harvest as requested.
(c) No farm rent or lease is applied for any seaweed growing area, areas are allocated on a community owned or governed system at no charge.
(d) To date, seaweed farms have been set-up for farmers with either governmental or project support including covering all costs that accrued. This includes free provison of materials until the beginning of 2009.
(e) Any secondary housing for seaweed farmers on small islands are not paid for but built using free material, and input of un-accounted labour. The same applies for drying tables and any other sheds or shelters built.

(f) Boat transport is only considered as cost if a fibreglass boat and an outboard engine are purchased. Dig-out canoes are built by villagers at un-accounted cost as materials are free, and labour input is not recognised.
(g) Operational tools including dug-out canoes, knifes, hammers, axes or boiling pots - the latter in the case of mat weaving - are items that are present in almost each household serving various, non-income generating uses.
(h) Fishing gear accounted for lobster and finfishing spear diving, such as masks, snorkels, fins, torches and spear guns may be used by the same fishers to pursue both activities, lobster and finfishing. However, in our scenarios, NPV and costs have been accounted for each activity individually.

Because of the above issues, investment costs for seaweed farming are calculated by applying two scenarios. First, we assumed an average amount of time for labour needed to build drying tables and dug-out canoes, and total hours for each item are added to the total labour reported by each respondent for seaweed farming respectively. In the second scenario, we have assumed costs for both items as considered if an external person to the community would purchase either a drying table and/or a dug-out canoe from somebody in the Wagina community. Also, we did not include any costs or labout for setting-up any of the existing farms due to the above explanations.

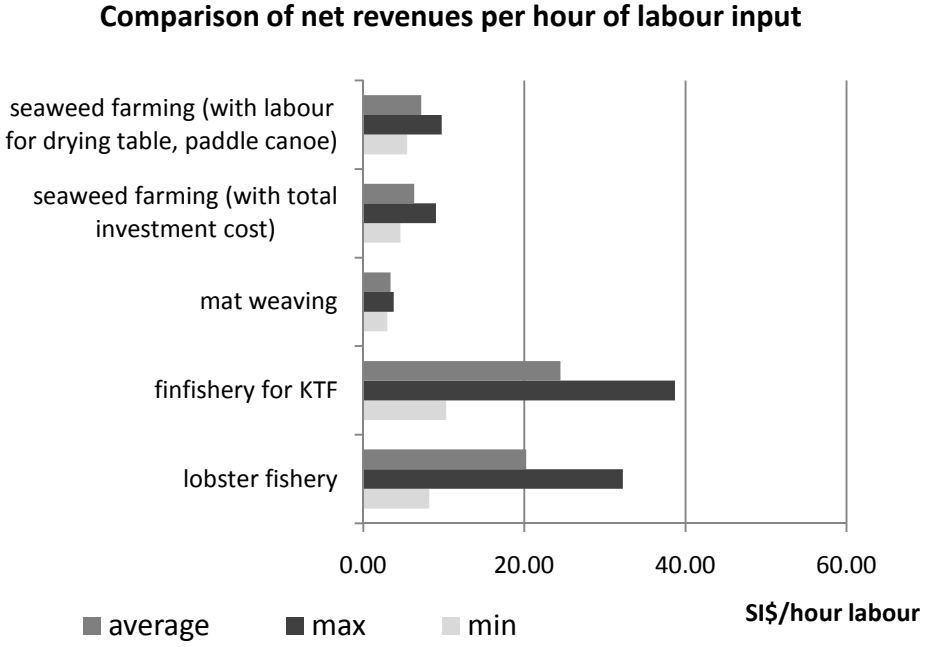
In the case of pandanus, we included NPV and costs for a large boiling pan and a cutting knife. Although mats were not reported to be regularly produced, but rather representing an opportunity to occasionally contribute to household expenditures, we assumed an average production of 12 small and 12 large mats annually for our model.

In the case of finfisheries for KTF and lobster tail fishery associated with other Wagina based agents, we considered each as a separate activity, although some fishers join both, finfisheries and lobster tail diving.

Comparison of net revenues per hour of labour input as presented in Figure 2 clearly highlight that highest revenues are obtained for commercial finfishing, followed by commercial lobster tail diving. Seaweed farming renders a signifcantly lower net revue per hour labour input, however, still is more favorable than mat weaving. All activities, with the exemption of mat weaving, provide better net revenues per hour labour inpout as compared to unskilled wages paid for at Honiara. In the case of seaweed farming, net revenues are on average 70% higher (minimum 22%-maximum 141%) as unskilled labour work at Honiara.

Details of production cost, labour requirements and revenues for each of the activities compared are given in Tables 2 and 3.

Figure 3: Comparison of net revenues per hour of labout for various income earning activities on Wagina Island



Although finfisheries and lobster tail fishery may be at present the most attractive income option for people in Wagina, it must be taken into account that commercial finfisheries has restarted only recently, i.e. October 2009. Status of finfisheries resources and stability of commercial fisnfisheries are not knowing detail, but past experiences suggest that this operation is highly vulnerable due to natural and administrative factors.

According to the local lobster tail export operator, Wagina's lobster resources are depleted and may perhaps support this activity only for another year.

Both arguments are supported by the fact that at present a maximum of 3-4 boats are provided by one Arariki and one Nikumaroro based commercial exporter of lobster tails, who are also lending their fibreglass boats with outboard engines fitted to the few finfishing parties selling catch to KTF. In other words, both options are not only highly arguable in terms of their sustainability, but also do not provide a sound income at the moment but a few families on Wagina.

As shown, and as confirmed during field survey, mat weaving is an opportunitistic source of income for women rather than a regular cash generating activity. Its revenues are not very favorable, and women confirmed that with the introduction of seaweed farming and the chance to get involved in this income generating activity, mat weaving is much less performed.

As depicted in Table 2 and 3, all activities compared also represent significant differences in the possible total annual net revenues. While commercial finfishers and lobster tail fishers can earn ~2,000 to 7,400 SI$ and 1,300-5,200 SI$ per year, mat weaving activities may only render between 1,700 and 2,300 SI$

annually. By comparison, seaweed farmers reach highest annual net revenues from 28,600 to 67,200 SI$ rendering this aquaculture activity the most interesting in terms of annual cash flow.

Table 2: Details of production cost, labour inpout and revenues for finfishery, lobster tail fishery and mat weaving at Wagina

	Finfishery for KTF	**Lobster tail fishery**	**Mat weaving**	
trips/year	24	18	Labour (hours)/mat small	38
total hours/year	192	162	Labour (hours)/mat large	64.75
average minimum finfish (lobster tail) catch kg/fisher/trip	25.83	4.31	sale's price mat small	150
average maximum finfish (lobster tail) catch kg/fisher/trip	58.33	9.72	sale's price mat large	200
operational cost/fisher/trip	67.33	67.33	total annual investment cost	86.78
investment cost/fisher/trip	31.29	31.29	gross annual revenues 12 mats small	1800
gross minimum annual revenues	4339.44	3103.20	gross annual revenues 12 mats large	2400
gross maximum annual revenues	9799.44	6998.40	net annual revenues 12 mats small	1713.77
total annual operational cost	1615.92	1211.94	net annual revenues 12 mats large	2313.77
total annual investment cost	750.96	563.22		
net minimum annual revenues	1972.56	1328.04		
net maximum annual revenues	7432.56	5223.24		
net minimum revenue/hour labour	10.27	8.20	net minimum revenue (large mats)/hour labour	2.98
net maximum revenue/hour labour	38.71	32.24	net maximum revenue (small mats)/hour labour	3.76
average net revenue/hour labour	24.49	20.22	average net revenue/hour labour	3.37

Note: all prices in SI$, December 2009

As shown in Table 3, net revenues from seaweed depend on the size of the farm or its total length of ropes, and hence annual production, and investment costs. In this survey average (~1 t/month) and a rather small sized farms (new starters may produce only 100 kg/month) were investigated as large-scale production (~3 t/month) is only represented by 5-7 farms on Wagina. As shown, net revenues for average sized farms entertaining about 4000 m of production lines render a much more favorable return as smaller sized farms. Net revenues are sensible to high investment cost items, in particular fibreglass

boats with fitted outboard engines. Motorized transport, however, is required to bring dried produce to the selling point. Due to the average farm size on Wagina, and elsewhere in the Solomon Islands, it can be assumed that individual investment in such motorized fibreglass boat transport is not viable. A community owned motorized boat transport for which a token and fuel is charge may be the best alternative.

Table 3: Details of production cost, labour inpout and revenues for seaweed farming at Wagina, applying assumed investment cost for drying tables and dug-out canoes (scenario a), and replacing these by assumed labour input (hours) (scenario b)

Item	Case Ia	Case IIa	Case IIIa	Case Ib	Case IIb	Case IIIb
total length of lines (m)	4000	4000	2400	4000	4000	2400
total yield (kg dried weed)/year	17419	21700	9226	17419	21700	9226
total annual labour (hours)	5064	3666	4628	5120	3666	4684
operational cost/year	2626.28	29955.37	1296.83	2626.28	29955.37	1296.83
	ropes, solar plastic, netting	ropes, solar plastic, netting	ropes, black plastic, netting	ropes, solar plastic, netting	ropes, solar plastic, netting	ropes, black plastic, netting
annual transport costs	1500	9000	1800	1500	9000	1800
	fuel [1)]	Boat & HP[2)]	fuel [1)]	fuel [1)]	Boat & HP[2)]	fuel [1)]
annual investment costs (NPV)	4208.72	8676.72	4208.72	0	4721.35	0
	1 drying table, 1 paddle canoe	1 fibreglass boat 21 ft, 1 outboard 15 HP, 1 drying table	1 drying table, 1 paddle canoe	1 drying table, 1 paddle canoe	1 fibreglass boat 21 ft, 1 outboard 15 HP, 1 drying table	1 drying table, 1 paddle canoe
gross annual revenue	54000	67270	28601	54000	67270	28601
net annual revenues	45665	19637.91	21295.45	49873.72	23593.28	25504.17
net revenue/hour labour	9.02	5.36	4.60	9.74	6.44	5.45

[1)] Fuel cost only, boat transport is borrowed free of charge if selling only; [2)] uses own fibreglass boat 21 ft and outboard 15 HP for farming and selling; all prices in SI$, December 2009

4. Marketing Arrangements

The Solomon Island seaweed production is still in its beginning, and hence there is no involvement of multi-national companies, wholesalers or regional traders.

Today, seaweed is introduced to the selected community by the MFMR's Aquaculture Division. A community approach is applied targeting 20-30 farmers at one site. During a period of 8 months each participating farmer is assisted in setting up first 2 lines with seaweed, followed by training, and during

the second visit another 2 lines and further training are provided. A certain amount of ropes and solar pastic sheets are furnished to the community for their proper distribution to participating farmers. During the remaining time staff from the Aquaculture Division visits the community regularly in about 6-8weeks intervals. The Aquaculture Division takes care of buying dried seaweed until a production of 2 t is reached by the target community. Than, the community is handed over to the Solomon Seaweed Company that establishes a local agent for buying seaweed produce and for organizing its shipping to the company's main packing and export facilities at Honiara. Once a private company has taken over, it is also responsible to provide and sell materials, and to furnish bags free of charge to farmers in the respective community.

The Government of the Solomon Islands through the Aquaculture Division of the MFMR provides licenses upon request with an augmentation in steps of 200 t of dried national annual seaweed production. Licenses are provided based on a documentation of the company's facilities, export links and information on cost for export freight and overseas's market prices.

Inland marine freight and transport is organised between the seaweed companies and the inter-island cargo operators. Today, inter-island cargo operators have accepted to apply freight prices for seaweed as for copra, i.e. SI$ 0.50/kg. The inter-island cargo operator organises and covers cost for small boat transfer of dried seaweed bags from warehouses to the cargo boat. Agents of seaweed buying companies organize and cover cost for transporting bags for shipment to Honiara from warehouses to the transfer boat.

Processing is done by individual farmers, however, some additional drying and quality selection of Honiara landed dried seaweed is exercised by the Solomon Seaweed company in Honiara prior to shipment overseas. It is the merit of the Solomon Seaweed Company that the Solomon Island seaweed produce has a high quality recognition internationally.

5. Instability of Prices

Fluctuations in the local seaweed price are subject to international market balance of demand and supply, fuel prices determining national and international freight cost, as well as export tax, and cargo freight cost as agreed by Solomon Island inter-island cargo transporters.

At the international level, the production of the Solomon Islands represents about 0.2% of the world's production. Thus, the country's production volume, even if considerably developed will hardly have an impact on the world market's demand and supply balance. However, variation in the production of the world's largest producers, the Philippines and Indonesia, coupled with a slow growing global demand, determines fluctuations in world market prices, which in return will also apply for the Solomon Islands.

Such fluctuations in the world market prices in conjunction with increased fuel prices internationally resulted in the price drop from SI$ 2 to 1.50/kg in May 2006. International fluctuations in fuel prices

have a double effect on the Solomon Island's seaweed price, as they not only increase export freight cost but also inland shipping from mostly remote rural areas to Honiara.

In the beginning of the industry, seaweed was regarded as a commodity and thus freight charges applied by the inter-island cargo transporters were equalled to those of beche-de-mer. However, freight costs were corrected when understood that opposed to beche-de-mer, a high value-low volume product, seaweed is in fact the opposite, a low value-high volume commodity. Also, government recognised seaweed as comparable to copra, and thus no export tax is being charged.

Because seaweed is an export commodity and most of the export is shipped to Degussa, France, any inflation of the country's currency is compensated for by revenues received in Euros.

6. National and International Suppport

6.1 National and international institutions currently providing support to the development of seaweed farming in the Solomon Islands, laws and regulations

In 2000, the Solomon Island government established the Aquaculture Division within its MFMR. However, most of the aquaculture activities stopped during the height of the ethnic tensions in 1999-2000. Within the MFMR's 2009-2014 Solomon Islands Aquaculture Development Plan, seaweed (*Kappaphyrus alvarezii*) is given highest priority as commodity. Government allocated a budget for seaweed farming since 2008 which became effective in 2009, and including an amount of about 300,000 SI$. It was hoped that by 2010 a commercial seaweed sector may have been established by reaching a sustainable yearly production of 500-600 t. At present, the Aquaculture Division has 5 full-time staff members, and they are all involved in seaweed dissemination and strengthening. Priority is provided to first consolidate existing seaweed production areas, prior to expansion to new locations. The Aquaculture Division entertains at least 3 visits to each of its 4 production areas per year: Wagina, North Malaita, Marovo Lagoon, Marau.

For seaweed, cooperation with other Ministries and governmental departments is laid down in the development strategy plan. The Ministry of Agriculture and the Ministry of Lands in suppporting the agrarian sector recognize aquaculture as a potential for alternative land use. The Ministry of Lands is associated with seaweed farming regarding land tenure and land survey. The Department of Environment within the Ministry of Environment, Conservation and Meteorology will assist with any environmental assessment that may accrue from seaweed farming activities and expansion of the sector.

Currently, the last year of EU funded support using the remaining COSPSI project funds is underway that supports the operation of a technical advisor based at the MFMR for ongoing seaweed farming areas complemented by consultancies.

The Secretariat of the Pacific Community (SPC) through its aqaculture program continues to provide support to the Solomon Islands seaweed industry in its role as the inter-governmental focal point for the aqaculture sector but also providing specific technical advise and advocacy to the seaweed industry.

No laws and regulations in place concerning any step involved in seaweed farming and commercialization other than the fact that no export tax is charged, i.e. recognizing seaweed as an export commodity comparable to copra.

6.2 MFMR's Aquaculture seaweed programme:

- Aims at community approach not individual farmers, i.e. 20-30 farmers/community
- Set-ups test plot at each participating farmer's farm, i.e. 2 x 20 m lines with seaweed seedlings, accompanied with training activities;
- Re-visit after 6 weeks to harvest and/or add another 2 x 20 m lines and more training to complete
- Farmers are encouraged to set up more lines on their own
- Re-visit after 6 weeks for harvesting and completion of training
- Monitors a new community for about 8 months, visits about 6 weeks apart,
- First 4 x 20 m ropes and planting materials are free for individual farmers; in addition, each community os provided with a certain amount of ropes, nets (green), solar plastics for free and for distribution amongst themselves;
- Ministry buys harvest and ships to Honiara for export until community reaches a production of 2 t/month; than Ministry hands over to agent, i.e. Solomon Seaweed to set up local buyer and for organising shipment to Honiara and further export.

7. The Future for Seaweed in the Solomon Islands

7.1 Outlook for future growth

Taking into account physical and environmental, complemented by appropriate socio-economic framework conditions – relatively remote rural coastal communities with little alternative income opportunities but serviced at a reasonable frequency and cost by inter-island cargo boat services – there are a number of potential areas in the Solomon Islands where seaweed farming could be expanded to. Potentially promising sites and their estimated target population size as recognized by staff members from the Solomon Islands MFMR's Aquaculture Division are listed in Table 4. Applying the average household size as surveyed in Wagina (7 people/household on average), and a conservative estimate of an average family production of 1.5 t dried seaweed per year, we modelled the possible annual production potential for two scenarios. In the pessimistic scenario we assumed that only 60% of the total households in each target community will participate in seaweed farming, while in the optimistic scenario we assumed a participation of 80% of all households. Accordingly, in an average production year, and assuming that the full production capacity has been established, total annual production may range between 12,500-16,700 t. Whether this is a realistic scenario may be argued. Such a development

will probably require much more efforts, funding and time. However, it provides an estimate of the Soilomon Island's potential.

By comparison to our model, the final report of the COSPSI project stipulates a possible production of 2,000 t/year provided further technical and financial assistance for seaweed development in the Solomon Islands (Preston et al. 2009).

7.2 Challenges and recommended measures to strengthen benefits of the industry to coastal population

Past experiences of seaweed farming in the Solomon Islands has shown high fluctuations and a high likelihood of risks to its production. Natural risk factors including earth quakes, geologic instabilities, activ vulcanism and tsunamis that may contribute to loss of ongoing production and of future production sites will apply. Climatic conditions, such as seawater temperature rises resulting in high mortality rates, prolonged rainy periods that restrict production, and that cause damages or slow down the drying process, as well as strong currents and heavy seas contributing to losses of seeds and reducing harvests, possibly aggravated by climate change associated factors aggravating any of these perturbances and perhaps even adding other stress factors will not be eliminated in the future.

Some locations proved to be chronically grazed by herbivorous fish and grazing losses are too high as to justify seaweed production. Such prroblems may occur in sites included in Table 3 and thus reducing national possible capacity.

Logging and other coastal development activities are likely to continue if not increase and these will cause further sedimentation into coastal areas that will reduce production.

Increments of fuel prices ccabot be rule out either and as shown in the past, are crucial to the viability of the sector. Increments in production costs, inland and export freight prices may render farm operations economically less attractive and perhaps no longer viable. The same effect may be caused by fluctuations in world market prices for seaweed.

Also, alternative income opportunities may be more attractive to local farmers and may trigger loss of interest in producing seaweed. This is particularly true for copra production that is currently not an attractive alternatives. However, future changes in copra prices may alter the present scenario. In addition, political instability and insufficient governmental and external aid funded support for the sector are further risk factors to the industry's development potential.

However, current and possible seaweed production sites in the Solomon Islands are promising as physical, environmental and socio-economic conditions are favourable. The country has a large proportion of rural coastal communities that are highly dependent on diminishing marine and other natural resources. Given the demographic growth rate, land suitable for cultivation is limited and may only sustain income from the agricultural sector for a percentage of the country's coastal rural population. Alternative income from the secondary and tertiary sectors is limited as industrialization is low, and economic conditions in urban and rural areas are limited.

Table 4: Current knowledge and experiences with seaweed farming in the Solomon Islands limit future expansion to a number of locations, including:

Province	Potential sites	Community size [1)]	Total number of households [2)]	Potential farms (80%)[3)]	Potential farms (60%)[3)]	Estimated annual production	
						80% of households participating	60% of household participating
Choiseul	Good potential for 1 more site in the North	1500	214	171	129	1234	926
Vella La Vella	Null		0	0	0	0	0
Shortland	Good potential for 3 site	1000	143	114	86	823	617
		1000	143	114	86	823	617
		1000	143	114	86	823	617
New Georgia	(Ramuana is no longer operational due to tsunami impact)		0	0	0	0	0
	Munda is too much affected by fish grazing		0	0	0	0	0
	Good potential in Marovoo lagoon	5000	714	571	429	4114	3086
Santa Isabelle	Good potential only for 1 site in the North: Kia	1000	143	114	86	823	617
Malaita	Good potentil in the North for 1 site	3000	429	343	257	2469	1851
	Aoke and Langalanga lagoon	1000	143	114	86	823	617
	West Areare lagoon	500	71	57	43	411	309
Guadalcanal	Good potenial in 1 site: Marau	3000	429	343	257	2469	1851
San Christobal	Star Harbour	500	71	57	43	411	309
	Three Sisters	300	43	34	26	247	185
	Uki island	500	71	57	43	411	309
Ontong Java	Has some potential		0	0	0	0	0
Reef Islands	Overall heavy impact of fish grazing		0	0	0	0	0
	Nukapo (outer reef)	400	57	46	34	329	247
	Nupani (outer reef)	600	86	69	51	494	370
					Total production	16,704	12,528

[1)] Total number of people/community; [2)] Approximate number of total households based on an average housheold size of 7 persons/household; [3)] potential number of participating households assuming 80% and 60% of participation respectively

Local land tenure and governance systems allow members of coastal rural communities to be allocated with suitable sites to producing seaweed. Skills can be relatively easily obtained, and basic materials are freely available. However, given the lifestyle and the low financial power of rural coastal people, meeting investment, maintenance and operational cost to ensure a continuous seaweed farming operation present major bottlenecks for further expansion and maintenance of current operations.

Possible solutions are governmental or externaly funded project support to assist farmers in acquiring and adopting financial management, including risk aversion strategies to cater for unfavorable production periods. Financing schemes liaised to local agents in order to retain a feasible amount of cash per each sale of harvest may be a way to help farmers meeting operation and maitenance cost. Technical and financial training of farmers should include information of farm size related production cost, cash flow needed to cover operation cost, and net return achievable on a regular basis.

As shown in the case of Wagina, seaweed farming provides an interesting source of income for rural coastal people, in particular in remote areas, given a certain farm size is reached (≥4000 m of lines). Efforts should continue to promote the 4-6 weekly production cycle to ensure regular cash flow and income to farmers.

As shown by the results of the Wagina field survey, seaweed production involves all members of the household. Women actively participate in seaweed farming, and their contribution is crucial as shown by the positive correlation between the number of women involved in one farming activity and income reported by the household. However, care should be given to the fact that farm sites are often too far away from the family's regular home as to allow farmer to commute on a daily basis. Thus, family members may be either separated for extende time periods, or children do no longer attend school as they accompany their parents to farming sites, or are even involved in seaweed farming themselves.

The establishment of community owned and managed motorized boat transport, or alternatively transport provided by local agents for seaweed could assist farmers beyond economic viable production to ensure the necessary transfer of their harvests to selling points. However, it is recommended to provide any such services on a financial recovery scheme rather than free of charge.

Government may need to establish a minimum price guarantee for seaweed production to subsidize local farm-gate prices when world market prices drop below a non-acceptable threshold to encourage local farmers in continuing production. Cost to re-establish seaweed farms after a major drop-out may involve much higher costs than the occasional subsisdies, and will ensure continuation of national agent and exporter networks.

Government may also assist in increasing reliability of inter-island cargo freight facilities by negoitiating with the existing operators a guaranteed freight volume for seaweed harvested. Thus, frustrations shared between farmers and local agents in not being able to purchase harvest or to export regularly may be reduced or erradicated. Given a future growth in national seaweed production, the establishment of specialized inter-island seaweed cargo freight, perhaps at least on certain routes, may be assessed.

Government in cooperation with the national Solomon Seaweed Company should evaluate purchase of high quality low price materials internationally, and its regular provision at all farming sites. Local agents purchasing seaweed harvested should be used, as already started, to build up a national distribution network.

From an environmental viewpoint, impact assessments need to be undertaken in view of disposal of plastic sheets, ropes and wood material from sheds, drying tables and other buildings errected on farm sites. Drying tables seen on Wagina are not effectively built requiring each a considerable amount of indigenous trees. The development, dissemination and application of effectively built drying tables for which a minimum wood inout is required will help to reduce the felling of local native trees. However, for large-sized farms the introduction of permanent drying tables made from aluminium or plastic materials that are more resistant to weather conditions, thus having a much longer lifespan as locally built tables, may be worth an option to be assessed.

The same argument applies for local mangrove resources that are used to produce pegs for errecting ropes and lines in shallow seawater. The impact of their disposal into nearshore areas, particularly given future increments of farm areas, may also be assessed.

In the long run, environmental impact assessment may also include possible effects of shallow coastal sea areas under seaweed farming if production areas reach significant percentages of coastal zones.

In summary, seaweed farming in the Solomon Islands is considered as an easy and promising income opportunity by farmers, rural communities, agents and exporters. Seaweed farming is given priority for developmetn by the government, and supported by an annual budget of SI$ 300,000. Under present conditions, seaweed farming is also economically attractive to coastal rural populations with little alternative income opportunities. Possible sites for future expansion are numerous and offer significant increments of the national production. The country benefits from a local export company that has invested and gained experiences in quality control, bailing and which have lead to the high quality recognition of the country's seaweed crop internationally. Problems will continue to cause fluctuations in the national production given the facts that natural conditions can not, and socio-economic conditions can only be partially controlled and mitigated. However, taken into consideration past experiences, the present socio-economic framework, the potential for future expansion of production at other sites in the country, seaweed is considered as having a future to contribute to the livelihood of rural coastal communities with limited other income alternatives in the Solomon Islands. Given the limited governmental budget provided for its support and extension, it is however believed mandatory to acquire further financial and technical assistance to make major progress in the national production.

8 Results socio-economic survey

8.1 Approach and methods

A socio-economic survey was designed in accordance to the TOR as laid down in the FAO contract (Annex I) and by providing focus on one of the four seaweed producing regions in the Solomon islands, i.e. Wagina in Choiseul province.

Fully-structured closed questionnaires were developed to provide quantitative and qualitative data referring to the 19 issues of interests to be addressed concerning various socio-economic and institutional dimensions of seaweed farming.

The field survey was jointly implemented by the consultant, the Chief Fisheries Officer Aquaculture and 4 junior staff members of the Aquaculture setion of the Solomon Island's MFMR. The field survey was further supported by village elders and the former project leader of the EU funded COSPSI «Commercialization of seaweed production in the Solomon Islands » seaweed project. Those of the junior staff members who had no prior experience in socio-economic surveying were trained to fully participate in the survey.

Field work was carried out from Saturday 21 to Tuesday 20 November 2009 covering each of the three communities on Wagina. In total 58 households were surveyed, 69% farming seaweed, 31% being not involved in seaweed farming. Sampling and demographic details of the socio-economic seaweed survey are provided in Tables 5 and 6. Representation is based on the currently ongoing population census that provided an updated estimate of the total active households in each village surveyed.

Table 5 : Sampling details of socio-economic survey undertaken in Wagina, Solomon Islands

	Arariki	Tengangea/Kukutin	Nikumaroro	Wagina
Data (estimated) from 2009 census				
Total number of households	70	79	60	209
Data from FAO seaweed socio-economic survey November 2009				
Average household size	6	8	7	7
Number of households	19	22	17	58
Number of seaweed farming households	14	14	12	40
Number of non-seaweed farming households	5	8	5	18
Total population estimated	399	593	390	1382
Total population surveyed	108	164	110	382
Population and household survey sample (%)	27	28	28	28

Table 6: Demographic details of socio-economic survey undertaken in Wagina, Solomon Islands

	Arariki	Tengangea/Kukutin	Nikumaroro	Wagina
Total number of men respondents	15	22	13	50
Total number of women respondents	4	0	4	8
Total number of men surveyed	60	89	59	208
Total number of women surveyed	48	75	51	174
Total number of adult men (≥15 years) surveyed	30	52	31	113
Total number of adult women (≥15 years) surveyed	29	41	22	92
Total number of boys (≤15 years) surveyed	30	37	28	95
Total number of girls (≤15 years) surveyed	19	34	29	82
Total number of adults (≥15 years)	59	93	53	205
Total number of persons (≤15 years)	49	71	57	177

Demographic structure of all three villages is comparable. No significant difference was found (t-test) between any of the three villages, nor between seaweed farming and non-seaweed farming households on Wagina for any of the demographic variables depicted in Table 6.

8.2 Background information relevant to the Wagina socio-economic seaweed survey

The Solomon Islands are believed to have been inhabited by Melanesian people for thousands of years. The United Kingdom established a protectorate over the Solomon Islands in the 1890s. The British administration deliberately resettled people from the overcrowded Gilbertese Islands (Kiribati) to the islands of Wagina and Titiana in Western Solomons in the 1950s and 1960s. By 1980, they and their descendents numbered around 3,000 people.

At present, the total population on Wagina may not exceed 1,500 people as estimated on the basis of the 2009 census and the November 2009 FAO seaweed survey results. The total population is divided into three communities, Tengangea/Kukutin being the largest with about 600 people, followed by Aririki with 390 and Nikumaroro with about 390 people. While Tengangea/Kukutin (often referred to as Kukutin only) is Catholic, Arariki and Nikomaroro belong to the United Church. The two communities of Tengangea/Kukutin and Arariki are adjacent to each other, while Nikumaroro is located further east.

In the late 1960s, an Australian family established a pearl oyster farm to cultivate *Pinctada margaritifera* and *P. maxima* pearl oysters. The original family farm run only until the mid 1970's because of the low price of pearls at that time.

The islands of the Arnavon Marine Conservation Area (AMCA) lays midway between the islands of Santa Isabel and Choiseul. They support a great diversity of marine resources, including key species. The islands are the most important rookery in the western Pacific for the endangered Hawksbill sea turtle

and home to one of the world's largest nesting populations of the species (SPC 1996). Although the islands of AMCA are uninhabited, there are a number of communities from Isabel and Choiseul provinces who claim traditional ownership to the islands, and who are users of the resources for both subsistence and commercial purposes. While people from Kia and Posarae have traditional ownership rights, the Gilbertese people of Wagina, one-and-a-half hours by motor-boat to the north of the Arnavon Islands, are the main users of the marine resources. Collection rates increased dramatically in the 1980s in response to a sharp increase in prices for shellfish and other products, triggering a series of "boom and bust" cycles of harvesting. To reverse this decline in invertebrate species and to increase conservation success The Nature Conservancy (TNC) project got underway in 1995 with the recruitment of six conservation officers – two from Wagina –to establish the Arnavon Island Community Marine Conservation Area (CMCA), to develop a management plan including the provision of viable alternative marine enterprises. First progress was reported for Wagina in 1996, where TNC sponsered the establishment and operation of an ice machine to support the local fisheries centre. According to interviews TNC efforts resulted in the organization of local fishermen on Wagine between end 1990's and 2007. However, more recently, about 2 months ago, an employee paid for by TNC restarted operating the local ice machine again which supports commercial finfish and lobster fishery and export to Honiara.

The Rural Fisheries Enterprise Project run over a period of 6-8 years and started in 1994 with the aim to homogenize fisheries centres established with Japanese aid in 4 provinces. At the end of the project Government tried to tie seaweed farming to the activities supported by the fisheries centre, however, this idea was not succesful as the location of fisheries centre did not generally match the location of seaweed production. Although this idea was again taken up under the COSPSI project, and the fact that a fisheries centre was established on Wagina, the project built a seaweed warehouse on the island to provide the necessary store facilities.

The local fisheries centre is now privately operated, starting on 19th October 2009, by the KTF company (Kauai Tete Family) buying finfish from local fishers for fortnightly export to Honiara. KTF pays the local TNC employee for the production of ice. Costs are equivalent to 60l of fuel for the first load, and 30l of fuel for each following load. KTF needs 3 loads to equip 5 eskies with sufficent ice blocks. One load costs approximately 650 SI$ and provides 21 blocks of ice. KTF exports regularly 5 eskies of a volume of 250l on the fortnightly inter-island cargo boat to Honiara, each esky holding about 100 kg of cleaned fish or fish fillets and ice. Transport cost for filled eskies is 300 SI$/esky, return freight for empty eskies is 100 SI$/esky. KTF has a Honiara based agent for marketing. Thus, the KTF company and the TNC operated ice machine represent the most important current alternative income opportunities for Wagina's fishers.

Alternative income opportunities from finfisheries and lobster fisheries include:

- One local person who operates from Arariki (Jack Rabaua), and one from Nikomaroro. The Nikomaroro operator, however, entertains only one fibreglass boat with fitted outboard engine as compared to the Arariki lobster exporter who has 3 motorized fibreglass boats to loan out to local fishermen groups. Both export lobster tails by airfreight on a weekly basis to their Honiara based agent, from where some of the produce is further exported to Australia. The Arariki

operation started 7 years ago with about 300 kg lobster tails/week, but catch rates slowed progressively down. Today it is sometimes not possible to meet 40-50 kg of lobster tail weekly. Lobster tails are air freight on a weekly basis to Honiara agents. Also the size of lobster decreased visibly over time. Lobster resources around Wagina are considered overfished and the Arariki operator thinks that one year into future he may stop the operation totally. Lobster resources in Choiseul are considered better but their harvesting requires extended boat transport to reach suitable fishing ground. Operators paid 25SI$/kg tail in 2002, and since 2007 the price is steady at 40SI$/kg tail.

- The lobster operations are linked with spear diving finfishing groups, i.e. the Arariki operator also maintains 3 finfishing groups that he furnishes with the same motorized fibreglass boats. Fishing groups pay 1/6 of the value of the catch for boat transport, but sell their catch to the KTF fisheries centre, and pay for fuel.

8.3 Household Income Diversification and Income

- Seaweed framing helps to increase household income diversity, an acknowledged risk avoidance mechanism, in particular for rural and traditional communities.

Overall, household income diversification (Table 7) in Wagina was found to be high with 35% and 19% of all households surveyed (n=58) having two or three income sources respectively. Half of all non-seaweed earning households have less than two income sources, while by comparison, seaweed earning households are more diversified as 92.5% have more than two income households.

Table 7: Diversification of income on Wagina

Number of income sources	*0*	*1*	*2*	*3*	*4*	*5*
Total (n=58)	3.4	17.2	34.5	24.1	19.0	1.7
non-seaweed households (n=18)	11.1	38.9	27.8	22.2	0.0	0.0
seaweed households (n=40)	0.0	7.5	37.5	25.0	27.5	2.5

- Income opportunities in Wagina are limited. Copra production is no longer viable. Commercial finfisheries and lobster tail fishing depends on access to regular transport to Honiara, ice, cooling and storage facilities. Income from commercial finfisheries was made possible through past efforts, including the establishment of a fishing centre (funded by Japonese aid in cooperation with the Ministry of Fisheries), and the provision and operation of an ice plant (funded by the NGO TNC). However, respondents reported that both, the fishing centre and the ice machine were not always operational. The ice machine is also a necessary input to allow for the privately organised lobster tail commercialization by weekly air freight. At present, the ice machine is operational and the fishing centre is taken over by a private enterprise, the KTF company. Thus, commercial finfishing (spear diving) and lobster tail fisheries (spear diving) are pursued by 3 fishing groups based at Kukutin/Arariki and 1 group based at Nikumaroro. Lobster

resources in Wagina's fishing grounds are declining, and believed to provide perhaps only another year for commercial exploitation.

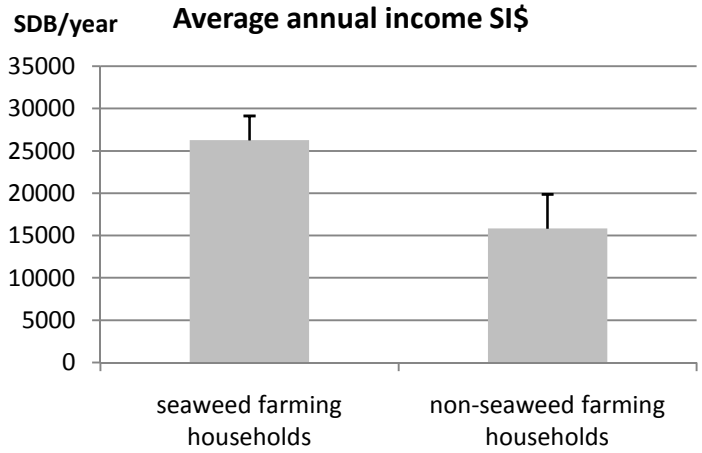
Beche-de-mer fisheries is no longer sustainable. However, some seaweed farmers use their stay on the small atoll islands where they grow seaweed to dive at night for beche-de-mer which may at times render a small supplemntary income. Beche-de-mer and lobster resources in Choiseul province are believed to be still in better shape. There are also indications that fishers with access to motorized boat transport may exploit the Avalon island resources that are under conservation management.

Local income is limited to a few small island stores, a limited number of people working receiving salaries from governmental and church services, and the occasional selling of garden produce or pigs. Only one couple was identified that generates main income from gardening.

- Seaweed farming households have on average more income than those households that do not participate in this aquaculture.

Survey data revealed that seaweed farming households in Wagina have on average about 10,400 SI$ more per year cash income as compared to other non-seaweed earning households (Figure 4). For seaweed farming households, seaweed accounts on average for 42.4% of the total annual household income.

Figure 4: Average annual income of households on Wagina



8.4 Socio-economic changes for seaweed farming households and communities

- Increase in income, better life and food security are the most important changes in the life of households farming seaweed, complemented by better food and focussing more on farming than other household responsibilities , as perceived and reported by respondents (n=40) (Table 8).

Table 8: Changes as perceived by repondents from Wagina due to the introduction of seaweed farming

Changes perceived and reported	Rank	% of all respondents
income increase	1	90
better life	2	40
food security	3	32.5
better food	4	30
focus more on farming than household responsibilities	5	10

- 23 (53.7%) households farming seaweed reported to have reduced their finfishing activities to a varying degree (Table 9):

Table 9: Changes in personal activities with the introduction of seaweed farming

	Activities have been reduced by:				Numbers of fishers concerned	
	100%	75%	50%	25%	Men	Women
Finfishing (% of households)	30	9	39	22	33	5
Beche-de-mer and/or trochus (% of households)	30	22	26	22	41	5

- Overall, all respondents, regardless whether they participated or not in seaweed farming believe that most changes for the community that they consider as a result of seaweed farming are positive. Important changes perceived positive include increased and more regular income, equipment of households with either privately owned, diesel fueled generators or small photovoltaic lightning. Respondents also consider purchasing power to buy food in local stores as an improvement, which goes hand in hand with reduced numbers of finfishers, less fishing activities and more buying of fresh fish from local fishers, and/or reduced fresh fish consumption (Table 10).

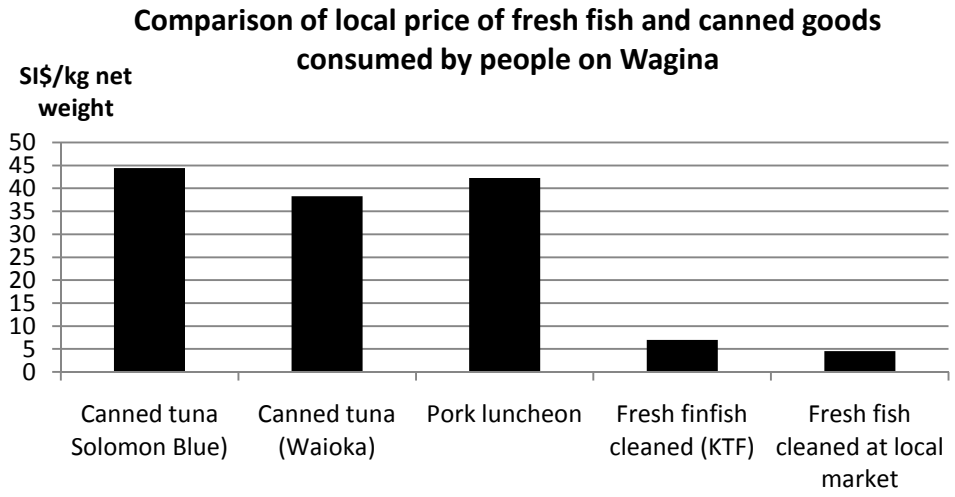
Table 10: Changes in the community's activities with the introduction of seaweed farming

Change	Rank	% of respondents (total n=58)
More income	1	95
People buy more canned and food from village stores	1	97
Electricity (private generator and solar energy)	2	78
People buy more finfish from local fishers	2	78
Income is more regular	3	69
Finfishing activities are reduced	4	60
Beche-de-mer and/or trochus harvesting is reduced	4	57
Skills of people in the community are improved	5	50
People eat less fresh fish	6	47
Community receives more fisheries support	6	47
Less active fishers	7	34
More new and/or improved buildings	8	26
Number of boats and/or outboard engines increased	9	22
Women are involved in farming	10	12

From a nutritious point of view, this perception is rather alarming as store food mainly substitutes garden produce and fresh seafood with processed, mostly canned fish and meat products, sugar, flower and oil. Tobacco and bethelnut consumption are not only common but also high amongst men and women. Gilbertese people have culturally little history and affiliation with gardening due to their mainly atoll home islands. However, once they had been displaced on Wagina with a high agricultural potential and little income opportunities, households got involved into home gardening. Nevertheless gardening is of no high social value and therefore was dropped the moment regular and more cash income was generated with seaweed allowing garden produce substitution by store food.

In addition, the substitution of fresh fish and presumably garden produce by store food items is considerably more expensive. As shown in Figure 5, canned tuna and porc luncheon is 7 to 8 times more expensive as compared to the average price paid locally (average price for finfish is the mean between door-to-door sale's prices and the farm-gate price paid by KTF to commercial finfishers).

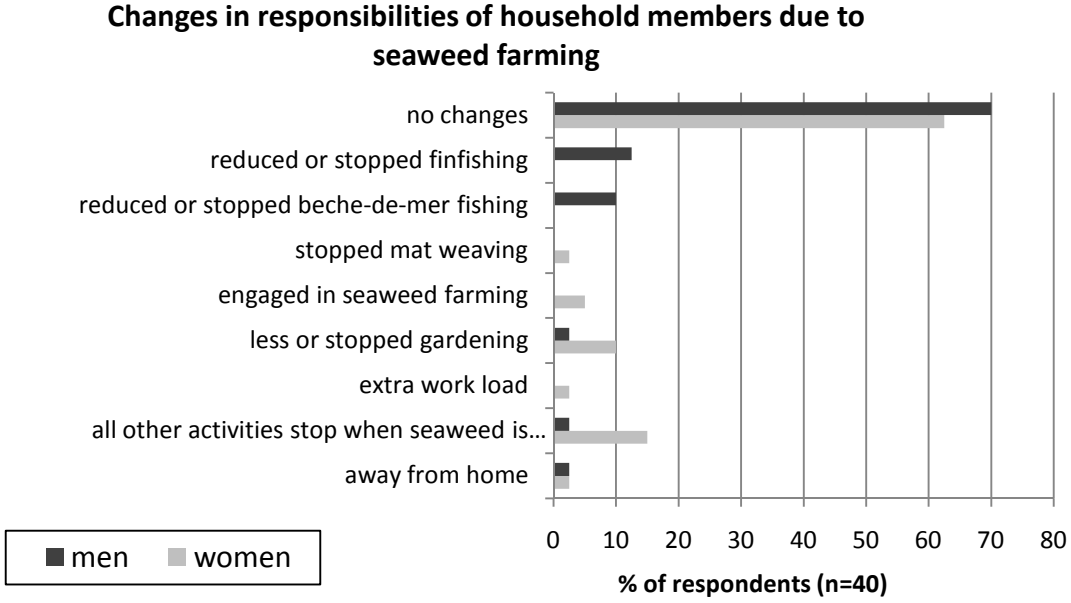
Figure 5: Comparison of local prices of fresf fish and canned goods



- Seaweed farming is done as a family enterprise with all steps including setting up the farm, harvesting, replanting, maintenance, drying, packaging and transporting to the local agent for sale shared by family members. At present, there are two agents based on the island. One agent represents Solomon Seaweed and is based at the Wagina Seaweed warehouse that was built in the framewotk of the EU funded COSPSI project. Solomon Seaweed is the only national seaweed company that has bailing facilities at Honiara and that exports regularly since the sector started to produce seaweed at a small-scale commercial rate. Since June 2009 another local agent has started operations for the Honiara based Han Lin company that has no bailing facilities, and that fills containers for export of dried beche-de-mer with seaweed or other goods obtainable.

- While most respondents believe that the responsibilities and engagement of their household members have not changed with seaweed farming, reduction or abandoning finfishing and beche-de-mer fishing were the most quoted changes for men, and reducing or abandonment of gardening and less time spent on any other housework were the most recognized changes for women (Figure 6).

Figure 6: Changes in responsibilities of hosuehold members due to seaweed farming



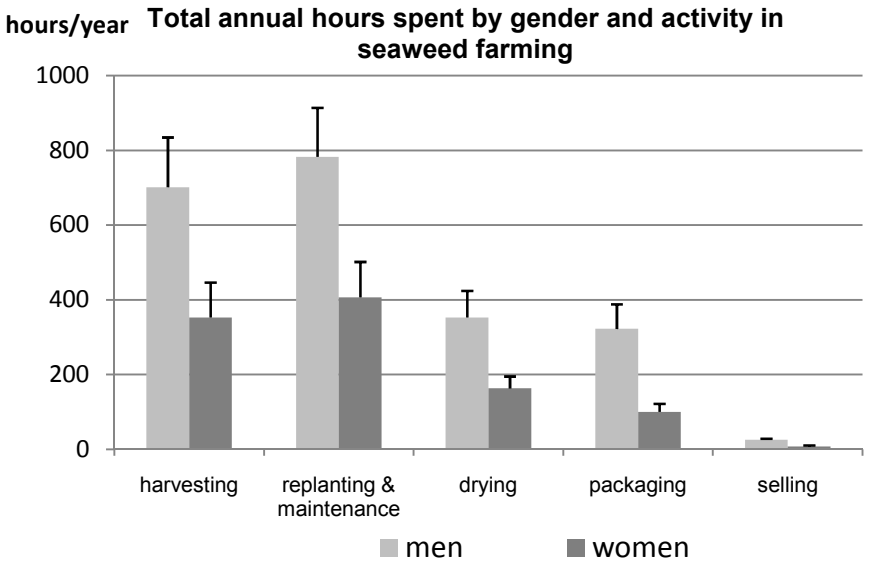
- Respondents varied in reporting their perceived changes concerning the community's social structures and institutions as a result of seaweed farming. More than half (57%) of people interviewed generally believed that there is no major impact. Social networking, and a tight family system with an approach to help each other are considered as traditional values, and these have persisted since seaweed is grown on Wagina. However, 38% of the respondents think that seaweed has improved the social networking, has contributed to form stronger groups of families sharing the same interest, and at times even resulted in families operating more on their own as before. Frequently, improvement of social services in the community, including school, church and youth was quoted. Most believed that seaweed has triggered a positive competition amongst farmers and families.

  17% of respondents voiced an increment in jealousy, and complained about people stealing ropes, seaweed and other materials. However, overall such negative impacts associated with the production of seaweed were not considered as main issues.

8.5 Labour requirements and gender participation

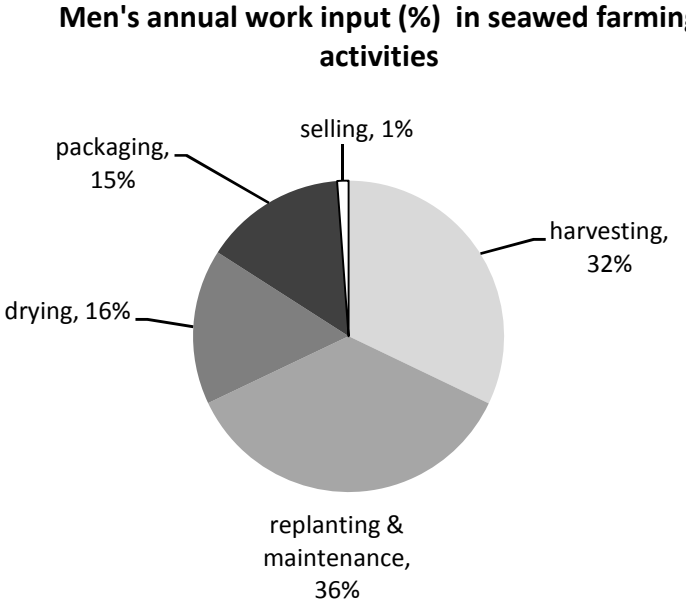
- Seaweed farming is done as a family enterprise including women, men and children. However, men account for most of the reported annual working time, i.e. 68% as compared to the share met by women (32% of total annual working time). As shown in Figure 7 below, on average women invest about half of the annual time for harvesting, replanting and maintenance, and drying as compared to men, however, men are mainly responsible for packing and selling.

Figure 7: Total annual hours spent by gender and activity in seaweed farming



On average, most of the time invested by men in seaweed farming is dedicated to replanting and maintenance (35%) and harvesting (32%) (Figure 8). Time spent for drying and packaging both count for 15-16% of the total annual labour. Least time is required for selling (1%).

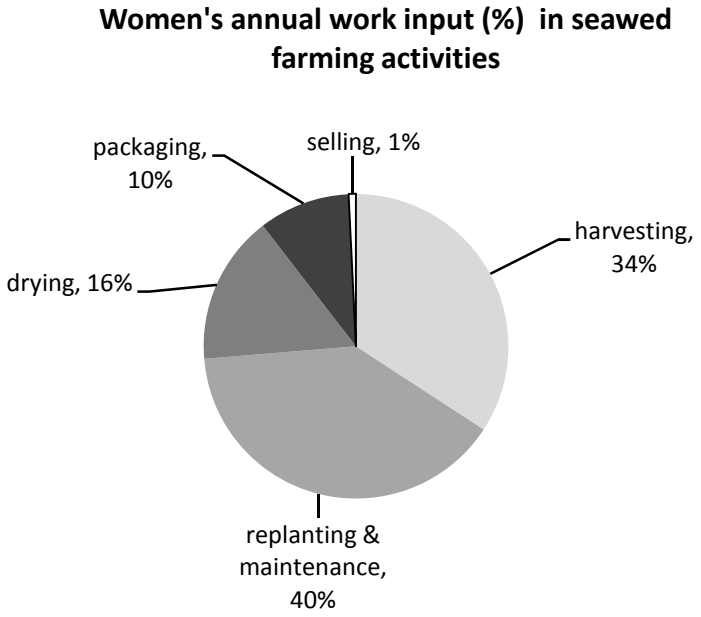
Figure 8: Men's annual work input in seaweed farming activities



By comparison, also most of the time invested by women in seaweed farming is dedicated to replanting and maintenance (40%) and harvesting (34%) (Figure 9). Time spent for drying and

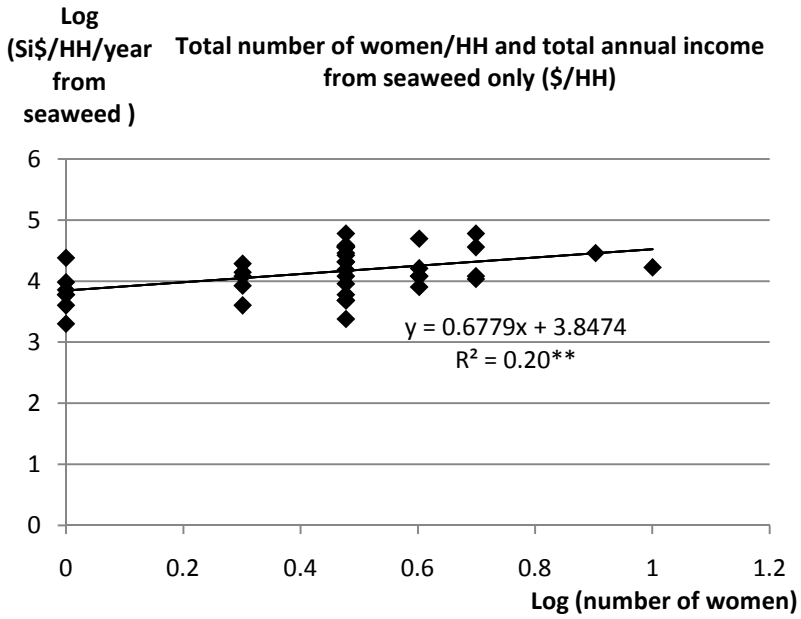
selling is comparative to men (16% and 1% respectively) while only 10% of the total annual labour of women is invested in packaging.

Figure 9: Women's annual work input in seaweed farming activities



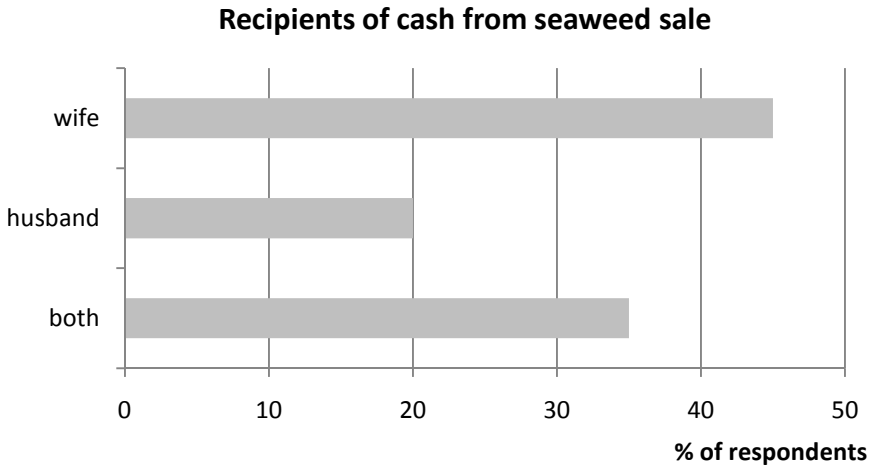
- The importance of gender in seaweed farming is highlighted by the positive and statistically significant relationship between the total number of women in a seaweed producing household and its annual income. The more women, the higher the income pinpointing the important contribution of women to the annual household income in this sector (Figure 10).

Figure 10: The relationship between total number of women per household and total annual income from seweed farming



- Although comparable amount of time is spent on selling seaweed, in most cases (45%) women, or both partners (35%) receive the cash rather than men (20%) (Figure 11).

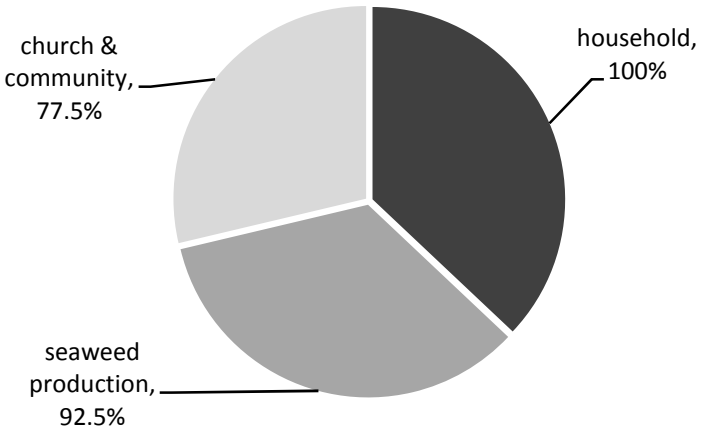
Figure 11: Recipients of cash from seaweed sale



8.6 Revenues from seawed farming

- While all respondents agreed that cash revenues from seaweed farming serve to cover household expenditures and living cost, answers regarding its use for covering operational and future investment cost for seaweed farming were more reluctant, and less frequent. More than three-third of all households also use these cash revenues to cover social and church contributions which is consistent with the general perception that seaweed has improved social services in the community (Figure 12).

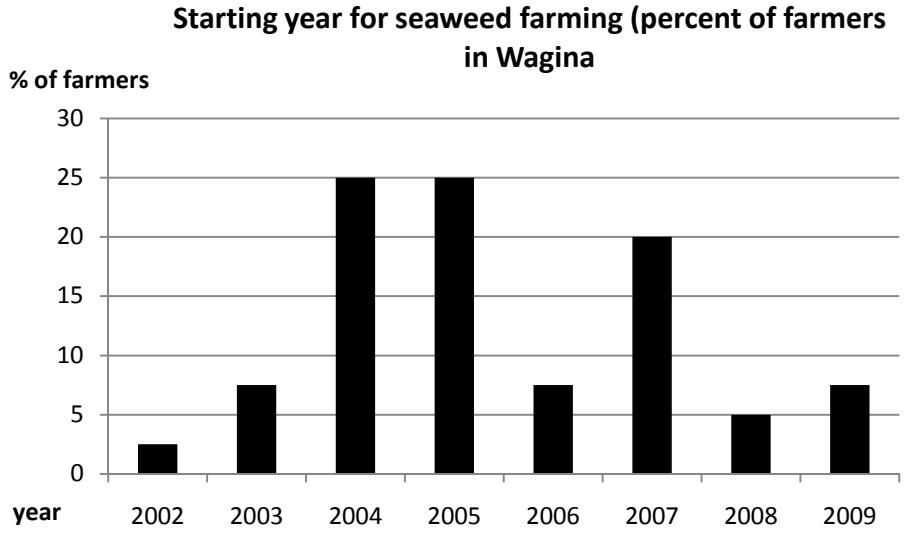
Figure 12: Relative frequency of answers (%, n=58) what cash earned from selling seaweed is used for



8.7 Development of seaweed farming in Wagina

- Most seaweed farming activities were started in 2004 and 2005 when the EU funded COSPSI project activities got under way. Another peak is reported for 2007, presumably a consequence of people realizing that local beche-de-mer resources were already depleted and no longer representing a reasonable income opportunity (Figure 13).

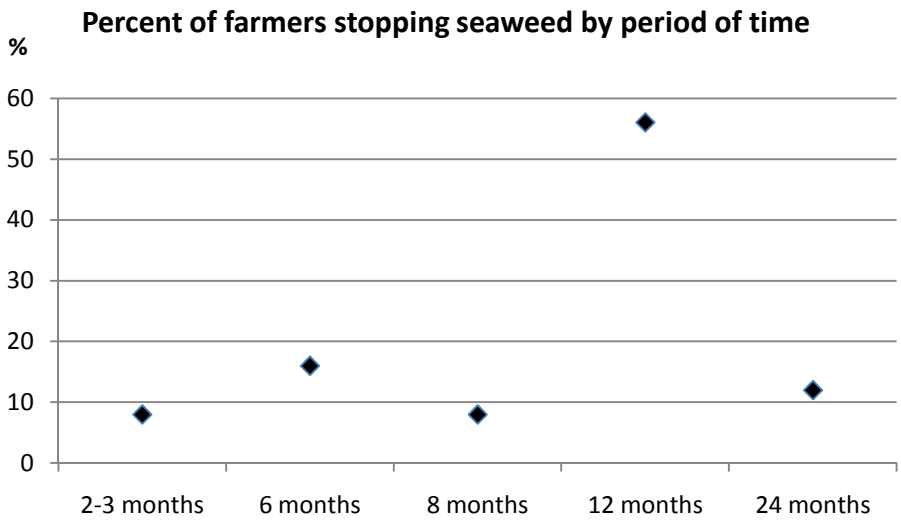
Figure 13: Starting year for seaweed farming in Wagina



- Seaweed farming is subject to external conditions. Overall, 62.5% of all actual seaweed farmers stopped their operation once, 37.5% of today's farmers never stopped. From the 25 farmers who stopped seaweed production at some stage, most stopped for a period of one year, others

between 2 to 8 months, and a few for about 2 years (Figure 14). The major reason quoted by respondents is the drop in seaweed farm gate price to 1.50 SI$/kg dried seaweed which most believe happened in 2007 (84%), and only one farmer dated this price fall back to 2006. Three farmers (12%) stopped their operation in 2008.

Figure 14: Percent of farmers stopping seaweed by period of time

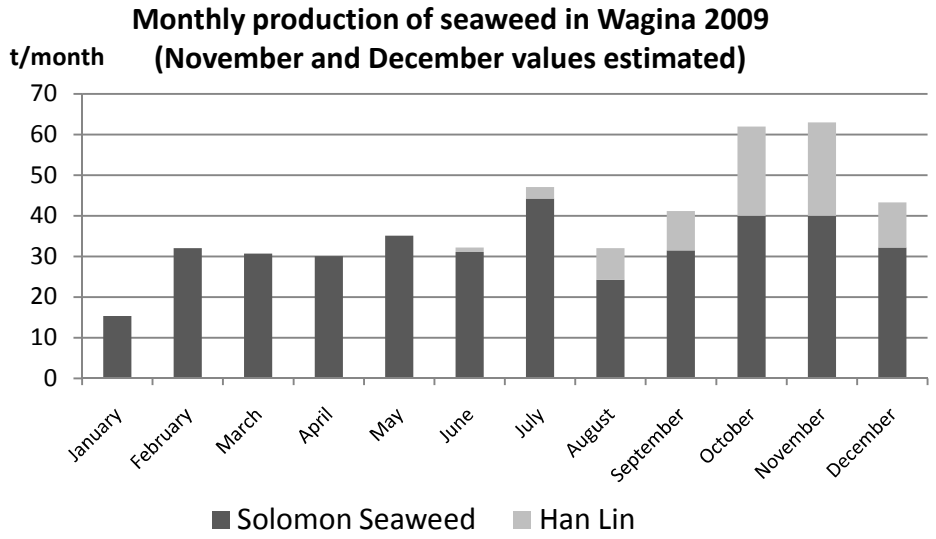


- For the majority of farmers the reason to stop their seaweed operation was the price fall and the alternative given at the same time through opening of the beche-de-mer season, an activity believed to be much more profitable by comparison. Reasons given by farmers who stopped in 2008 were different, and included other work commitments, stealing of their materials (ropes) and too heavy losses due to fish grazing.

  Information obtained does not support the reasoning provided. Firstly, the drop in seaweed farm gate price occurred in May 2006, and prices recovered two years later in May 2008 to 2.10 SI$, however, the lowest price of SI$ 1.50/kg dried seaweed was never applied to the Wagina community where agents maintained the 2.00 SI$/kg dried seaweed price. Indeed, the major reason for farmers aiming at a more promising income opportunity was the reopening of the beche-de-mer fishery that was decided by the Solomon government as a relief measure after the earth quake and tsunami catastrophe in April 2007. The beche-de-mer season was stopped in 2008 but reopened in 2009. At present, government voiced intentions to close the beche-de-mer fishery again by the end of the year.

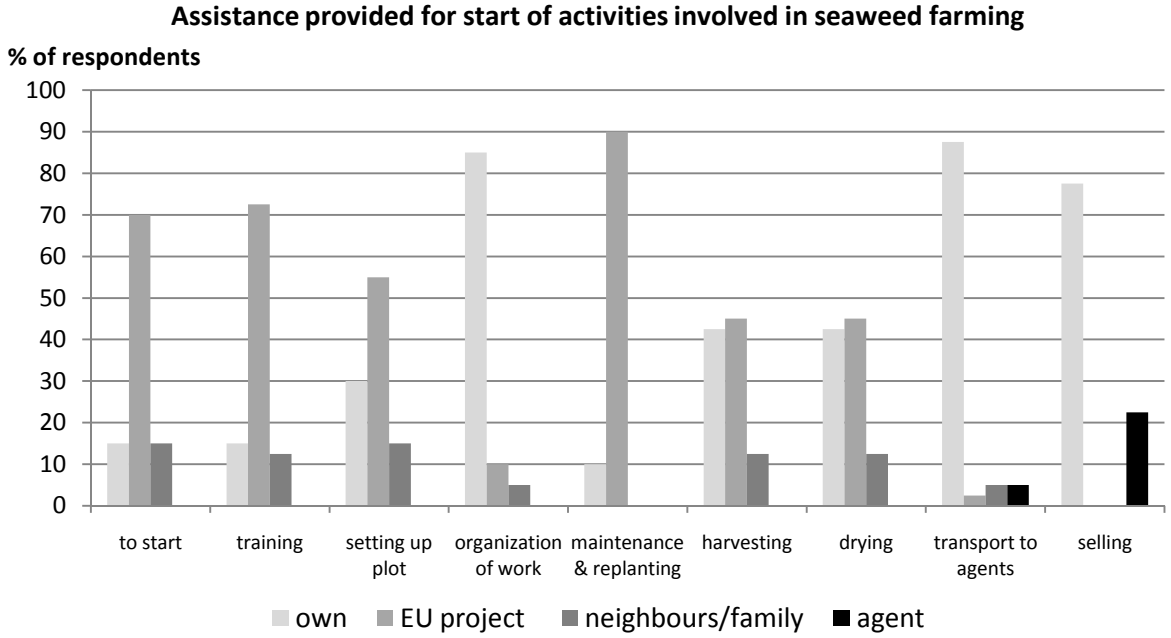
- The 2009 seaweed production is considered as favorable. Production figures provided by the two locally based seaweed agents stipulate an annual production of about 464 t (Figure 15).

Figure 15: Monthly production of seaweed in Wagina 2009



- Seaweed farming is a new activity for rural coastal communities, including Wagina. Survey results confirm that most assistance to setting up a new farm, training, maintenance and repair, harvesting and drying activities was provided by the EU funded COSPSI project (Figure 16). However, organization of the work, including engagement and assignment of tasks to the various family members, transport of seaweed produce to the agent and its selling are activities that were mainly acquired by farmers themselves. Depending on the time when farming was started, a snowball effect in terms of learning from other family or community members also happened, as shown in 10-15% of all reported cases. The locally based Solomon Seaweed agent first helped in collecting seaweed produce on farm-site, however, this service was not provided in the long-term. It should also be noted that since the beginning of 2009 farmers no longer receive any materials for free and must cater for their own maintenance, or in cases of new starters, for covering their investment cost.

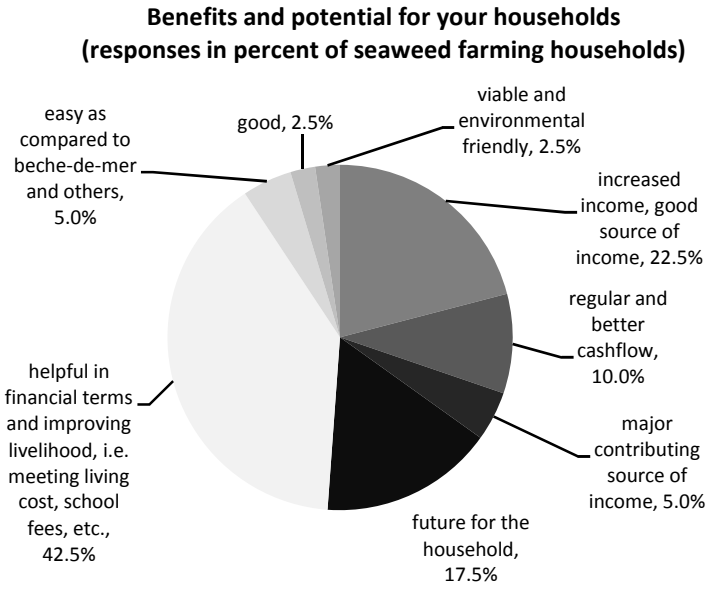
Figure 16: Assistance provided for start of activities involved in seaweed farming



8.8 Benefits and future potential of seaweed farming as perceived by individual households and for the community

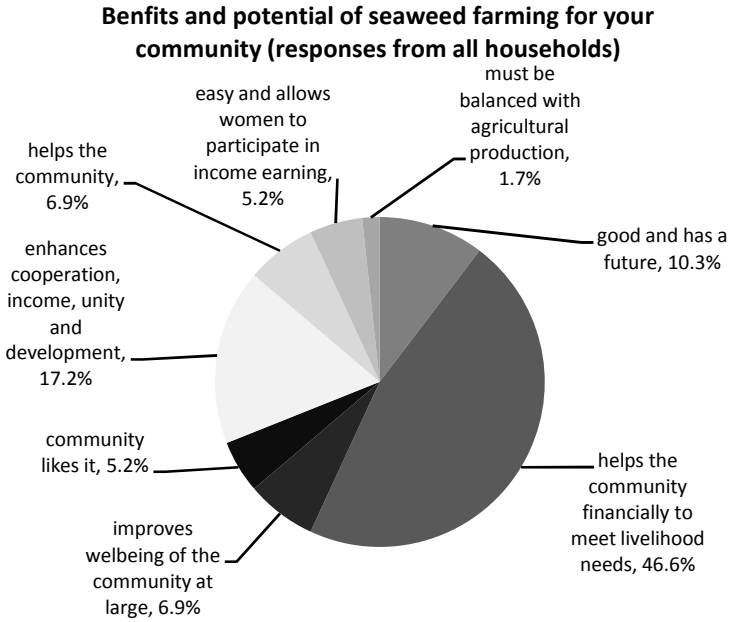
- In summary, respondents from most seaweed farming households are convinced that this acquaculture is a helpful option to financially help in ascertaining livelihood, meeting living cost, school fees and other financial obligations. It is considered to increase income, to provide a better and regular cash flow as compared to other options, it is considered easy to operate and providing a future for the household (Figure 17).

Figure 17: Benefits and potential for households



- All respondents mainly highlighted that seaweed farming helps the community financially in meeting livelihood needs, it has contributed to increase cooperation, unity within and development of the community, as it is also seen as the future for the community (Figure 18). Few respondents voiced the participation of women in income generating activities, the environmental friendliness of seaweed farming, and the fact that there is a need to balance agricultural and seaweed production.

Figure 18: Benefits and potential for the community



8.9 Problems and solutions perceived by respondents from Wagina

Table 11: Frequency of problems and proposed solutions voiced by all respondents (n=58) in seaweed farming applicable to farming households and the community

Problems in seaweed farming	***Household***	***Community***	***Solutions***
Bad weather (rain, currents, stormy days, high tide, rough sea)	13	13	Part of nature
			Stop planting during rainy periods
			Avoid areas with risk of strong currents
Transport (access to fibreglass boats with outboard engine fitted)	23	21	Agent should collect bags and charge the farmers for the service
			Agent should provide transport
			Government should assist farmers with provision of fibreglass boats and outboard engines
			The community should be provided with a fibreglass boat with outboard engine to serve farmers
Shortage of materials (ropes, plastics, nets, etc.)	21	24	Buyers or government should provide high quality materials
			Provision of proper equipment
Price of materials (ropes, plastics, nets, etc.)	24	21	Prices should be cheaper and affordable (from buyer or government)
			Provide loans
			Government should continue to provide materials free of charge or at a much cheaper price
			Retain part of the cash from sale to establish a loan system for purchasing materials when needed
Lack of sufficient bags	3	2	Agent should provide more bags regularly
Low price	3	3	Buyers should increase price
			Maintain selling price
			Should keep up quality of seaweed
			Establish more buyer centres and storage houses on the island
			Community members should help
Availability of space for expansion of farms, space may get limited	1	1	Technical assistance needed
Causes sickness, in particular pneumonia	2	1	Technical assistance needed
Fish grazing (seasonal)	17	17	Avoid planting through grazing seasons
			Move plantations to non-grazing areas
Turtle grazing (seasonal)	1	1	Avoid planting through grazing seasons
Stealing of ropes and weeds	1	1	Make community more aware of stealing
Epiphytic attacks	2	2	Technical assistance needed
Lack of water tanks on islands where farms are established	1	1	Technical and governmental assistance needed
Materials provided were not fairly distributed	1	1	Adopt a more honest way of distributing materials

8.10 Other problems and challenges observed in Wagina

During the field survey, a number of issues were observed and informally discussed with several members of the community, including:

- The establishment of seaweed farms involves the cutting down of local mangroves to obtain the necessary pegs;
- For drying tables, farmers cut down a considerable amount of native trees for poles, and many of the tables seen are not very effectively build. This problem is aggravated by tha fact that locally built drying tables don't have a long lifespan.
- Family members involved in seaweed farming may be away from their family and community for extended periods of time if they decide to have their children benfit from school education. In that case, either children are placed under the care of another family member, and thus being separated from their parents, or the mother is staying back to care for the school children. The latter competes with the mother's participation in seaweed farming.
- Families may also decide that children may as well participate in the seaweed farming process which means that they leave school at an early stage, and no longer have access to secondary and perhaps tertiary education.
- Gardening, a socially not highly regarded activity amongst Gilbertese, and culturally not an important component for people coming mainly from atoll environments was easily dropped when cash flow was improved with seaweed farming. The perceived improvements of substituting grown garden vegetables and fresh fish by canned and processed food are highly questionable. Also, the reported and increasing substitution of fresh fish by canned food may be questioned financially. As shown, prices paid for canned fish and pork meat at the local shops if compared to a local average price for fresh fish (average between farm-gate price paid for commercial finfishers by KTF and at local market on Wagina) are between 6.7 to 7.7 times higher than fresh finfish. By comparison, a pack of local cigarettes cost between 21 and 25 SI$ and smoking, as well as the chewing of bethel nut is a wide-spread habit by men and women.

8.11 Problems and challenges perceived by governmental staff, agents and exporters

In summary (Table 11), physical constraints due to bad sea and weather conditions, and also fish grazing are considered as limiting factors where little can be done. Areas subject to regular strong currents will always involve a high loss of production as seaweed will be washed off lines. Severe fish grazing does not allow to establish farms in the area, while seasonal fish grazing may be acceptable within limits.

Seaweed farming is an income option to rural coastal communities with little cash flow and capital. Thus, the need for motorized boat transport to reach farming sites and to transport harvest to selling points will continue to be a problem. Seaweed farmers need to reach a considerable production (>3 t/month) before the individual purchase and maintenance of motorized boat transport may become an option. Thus, community owned motorized boat transport, that could be made available on a loan or fee

system, or charging for the provision of transport of harvest to selling point made available by agents may be possible solutions.

The fact that seaweed farming was introduced in the Solomon Islands in the framework of technical cooperation project and governmental aid, furnishing materials, seedlings and training all free of charge to farmers may have contributed to the lack of farmer's financial management. However, rural populations have had little need to develop financial management skills in general, as livelihood is basically determined by subsistence production, non-monetray exchange system between community members, complemented by more or less occasional activities to earn income when needed. Training and assistance are required to aquaint seaweed farmers with the fact that seaweed farming requires a certain cash flow to cover material and operational costs, to make provision for safeguarding against unfavorable production periods, and to cater for the household's and the farming needs on an annual basis in relation to income earned.

Table 12: Problems and challenges as perceived by governmental staff, agents and exporters

Informant	Problem	Description	Solution
Former seaweed project manager CROPSI	Price for seaweed was too low in the beginning as to be competitive to copra production		With price increment to 1.50 SI$/kg, seaweed became a more interesting option
Former seaweed project manager CROPSI	Fish grazing		Very difficult to solve, will continue to restrict areas of production
Former seaweed project manager CROPSI	Rain and unfavorable weather conditions	rain water, currents and strong seas all are destructive to seaweed production	Solar plastics to cover seaweed during drying process solves the problem of loss due to contact with fresh water, however, other weather conditions will continue to limit production
Seaweed Agent Wagina		Nearly half of the annual production is adversely affected by bad weather conditions	
Former seaweed project manager CROPSI	Farmer's financial management planning	Farmers do not have any financial plan but spent cash received not regarding the financial needs to cover cost for materials	The project tried to assist farmers in setting up a financial plan, however, further assistance is still needed
Seaweed Agent Wagina		Farmers demand for the provision of materials that they cannot pay for	Educative program and assistance in setting up viable financial management plans
Former seaweed project manager CROPSI	Transport, particularly fibreglass boats and outboard engines	Farmers can reach most of their sites with dub-out canoes, however bringing harvest to the agent requires larger motorized boats	The individual loan system against fuel payments is insufficient, more motorized boat transport is needed. Perhaps application of the loan systems as practiced within the former fisheries center project would be a possibility.
Former seaweed project manager CROPSI		Farmers struggle to bring their harvest at times to our buying point	Perhaps community owned motorized boat transport that can be loaned
Seaweed Exporter, Honiara	Not enough farmers	The production volume does not render export of seaweed economically attractive	Increased seaweed production nation-wide

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Annex : Socio-economic questionnaire survey Wagina

FAO – Seaweed Socio-Economic Questionnaire Survey

1. Name: _____ male ☐ female ☐ age:_____
2. Province: _____ Island:_____ Village:_____
3. Number of persons in household (permanent): ☐

Men	age

Women	age

4. What are the income opportunities in your community? Rank by priority as you believe! 1=most important, 2 = 2nd most important, 3 = 3rd most important, etc.

Income source	**Specify:**	Importance (ranked)
Agriculture		
Crops:		
Livestock:		
Wild-caught fisheries		
Finfish		
Beche-de-mer		
Trochus		
Others:		
Aquaculture:		
seaweed		
Others:		
Salaries:		
Public sector:		
Private sector:		
Others:		
Remittances		

Pension		

5. Where does the income in your household come from (list income sources)

Income source	**Specify:**	Contribution in $	Contribution in %
Agriculture			
Crops:			
Livestock:			
Wild-caught fisheries			
Finfish			
Beche-de-mer			
Trochus			
Others:			
Aquaculture:			
seaweed			
Others:			
Salaries:			
Public sector:			
Private sector:			
Others:			
Remittances			
Pension			

6. How much cash income does your household has on average? (please note time period, i.e. weekly, fortnightly, monthly; also take care and note if there is regular income and seasonal income, specify all;

_____

_____

7. Could you please try to determine the contribution of each to the total income that your household receives *(leave respondent to choose whether in per cent or SI$ amount; if in SI$ amount note time period to match above total income estimate – Input in table no 5.)*

8. Did your household had other income sources before you started seaweed farming?

No others: ☐ Yes, others: ☐

which ones?_____

9. Do you think most household in the community that started seaweed farming have reduced or did not change their sources of cash income but added the seaweed farming?

Reduced: ☐ just added the seaweed farming: ☐

10. What are the major changes that you have perceived since the community got involved in seaweed farming?

Income:	Comments:
- amount	
- regularity of cash income	
- security of earning cash?	
- Reduced finfishing activities (for what, subsistence or cash income?)	
- Reduced invertebrate fisheries (which one, for subsistence or for cash income?)	
Living standard/infrastructure:	
- electricity	
- buildings	
- school	
- transport	
- shops	
- boats (number)	
Employment?	
Food and nutrition:	
- eat less fish and shellfish caught by the household	
- buy for fish from fisher in the village or markets	
- buy more food in the shops, for example what?	
Support and communication with fisheries services?	
Improvement of skills, training? Who did provide the training?	
Community groups:	
- more reunited, help each other more	
- split into groups	
- jealousy	
Others:	

11. And what do you believe are the major changes for your household?

12. If not included particularly in 9 above, please ask for:

    If you compare the finfishing amd invertebrate fishing in your household before you started with seaweed farming, and now with the seaweed farming, is it now:

    The same ☐ Less ☐ More? ☐

    <u>If less,</u> how many people in your household have stopped going:

    (a) finfishing: Women:_____ (no) men: _____(no)

    (b) invertebrates gleaning: Women:_____ (no) men: _____(no)

    (c) beche-de-mer: Women:_____ (no) men: _____(no)

    (d) others, specify:_____ Women:_____ (no) men: _____(no)

How much would you think did you (your household in total) reduce your:

(a) Finfishing: half ☐ quarter ☐ all ☐

(b) Invertebrate gleaning: half ☐ quarter ☐ all ☐

(c) Beche-de-mer: half ☐ quarter ☐ all ☐

☐ ☐ ☐

(d) Others, specify:_____ half quarter all

13. What are the different activities/works that you and anybody else are doing to produce and earn from seaweed farming?

Activities/Works	Household	External to household (who? And where)

14. All the activities that are taken care of by somebody in your household, who of the adults and children is responsible for doing what? (copy activities from above (11) and complete if necessary:

Activities/Works	Women and girls in household (age)	Men and boys in household by age	How often per day or week?	How many hours each time (day/week?)

15. With the new activities of the women (and girls) and men (and boys) in your household for seaweed farming, did they change any of their former contributions to the household life, others as for the fishing that we already talked about?

Women (girls): ☐ no other changes ☐ changes

which ones?_____

Men (boys): ☐ no other changes ☐ changes

which ones?_____

16. Who in your household gets the money from seaweed farming, and how do your members benefit from these money?

    _____ receives the money from sales

    _____ gets paid (how much/month/sale?)

    _____ used to cover household expenditures (about what proportion?)
    _____ used to cover seaweed farming costs (about what proportion?)
    _____ others (specify)?

17. Are there any effects of seasons for fishing, say when a fishery such as beche-de-mer or trochus opens, or taboos are lifted that conflict with the seaweed production?

    no ☐ yes ☐ if yes, what?_____

18. Any effects of agricultural peak seasons, say harvesting for example, when you have not enough time for seaweed farming?

    No ☐ Yes ☐ if yes, what?_____

19. Since when did your household start to farm seaweed?

    Since: _____

20. How did you start and how do you operate and sell?

Operational steps	On my own	Technical help from	Financial help from
Information how and why, get convinced			
Training			
Investment			
Setting up of the farm			
Organization of the work			
Maintenance, getting materials			
Harvesting			
Processing			

Transport to agents			
Selling (marketing)			

21. Did your household ever stopped seaweed production because the price dropped too much?

    No ☐ Yes ☐ if yes, when?_____ price dropped to:_____

    if yes, when?_____ price dropped to:_____

22. Anybody in your community dropped out of seaweed farming?

    No ☐ Yes ☐ if yes, why? _____

23. What do you think about seaweed farming concerning your own household?

24. And what do you think concerning your community?

25. Are there any problems or difficulties that you see with the seaweed production?

Problem/difficulty	For the:	
	Household	Community

26. What do you think should be done to solve these problems/difficulties?

THANK YOU!

FAO-Seaweed Questionnaire Survey Solomon Islands

Challenges – Recommendations – Recent Trends

Governmental staff-Agents-Processors-Exporters

Name of Respondent: _____

Position: _____

Address: _____

Date: _____ Location: _____

1. In your opinion, what are the main problems currently faced by the seaweed production in the Solomon Islands?

Problem	Description	Solution

2. Instability of prices has stopped production of seaweed as shown in the past. In your opinion which are the major factors leading to price instability?

Price instability at levels:	Factors	Solutions?
International/world market		
Domestic/Solomon islands		

3. Are you aware of any innovations in the SI concerning:

Production methods	
Added value	
Seaweed commercialization	
Regulations and other governmental support	

4. What measure would you recommend for overcoming problems and challenges faced by the seaweed industry and for strengthening its benefits to coastal populations?

- **THANK YOU -**