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Editor's note

Welcome to the 28th issue of the *Women in Fisheries Bulletin*, which highlights gender roles in coastal fisheries and development, and women's fishing activities in urban and rural communities.

The first article in this edition is by Alyssa S. Thomas and co-authors on the 'Impact of Tropical Cyclone Winston on mud crab fishers in Fiji'. The authors assessed the social and economic impact of Cyclone Winston on the mud crab fishers in Bua Province in Fiji two to three months after the cyclone. The results of the study showed that the Category 5 cyclone had a wide impact on fishers' communities in Fiji and there were notable differences between men and women and on their investment in the mud crab fishery. In particular, there were changes in fishing effort, catch volume and price. Women were highly vulnerable to the impacts of the cyclone because of inequalities in resource access, opportunities and capabilities. Because the women were unable to collect mud crabs after the cyclone, there were negative consequences for the women fishers' sense of independence.

In the second article, on 'Conserving womangroves: Assessing the impacts of improved cooking stoves on resource management in Langalanga Lagoon, Solomon Islands', Helen Macfasia Teioli and her co-authors describe the impacts of improved cooking stoves on mangrove conservation and on women in Langalanga Lagoon, Malaita Province. Most women in rural households in the area depend on mangrove ecosystems for food and firewood. The researchers found that an improved cooking stove, the kiko stove, is not more efficient than cooking on an open fire in terms of cooking time and wood consumption; however women who use the kiko stoves perceive a number of benefits and think the stoves reduce mangrove degradation. The paper concludes that promoting improved cooking stoves can transform gender norms that inhibit community-based resource management.

'Quantifying and valuing the critical role women play in Fiji's inshore fisheries sector' by Alyssa S. Thomas and co-authors is the third article in this edition. The national study in Fiji was undertaken over seven months between October 2017 and April 2018. About 1238 women were interviewed across 11 of the 14 Fiji provinces. The women were from 47 districts and 110 villages. Survey findings showed that women fished in all habitats from freshwater streams to intertidal areas and open oceans. Women fish for subsistence and also sell portions of their catch to support household income. The findings will help government and non-government stakeholders to give recognition to women's contribution to food security and to the national economy.

The fourth article, 'Fiji's Northern Division hosts its first Women in Fisheries Forum', was written by Sangeeta Mangubhai and co-authors. The article describes the Women in Fisheries Forum that was co-hosted by the Fiji Ministry of Fisheries, the Wildlife Conservation Society, the Fiji Locally-Managed Marine Areas Network (FLMMA) and the Women in Fisheries Network-Fiji. The Women in Fisheries Forum took place in Labasa, Fiji on 15 May 2018. There were 18 women who participated from 16 districts of the provinces of Bua, Cakaudrove and Macuata on the island of Vanua Levu. The forum was the first of its kind in Fiji and gave an opportunity for women in the Northern Division to meet, discuss, network and find ways to increase recognition of the roles they play in coastal fisheries in Fiji. The forum also empowered women to speak and to ensure that women's contribution to food security, livelihood and the national economy is recognised in the long term.



In the fifth article, 'Establishment of the first private tilapia hatchery in Fiji by a woman after Tropical Cyclone Winston - A case study', Veikila Vuki presents a case study on a project funded by the European Union (EU) and implemented by the Pacific Community (SPC) in Fiji. The article describes how the support provided by the EU resulted in the establishment of the first private hatchery by a woman tilapia farmer in Fiji, and acknowledges the provision of training (transfer of knowledge and technology) and materials for the hatchery as key factors in the establishment of the hatchery for recovery after the cyclone.

In the sixth article, 'Samoa women at the helm of inland fishing', Joanne Kunatuba writes about an interview with Epifalia, a tilapia farmer, and her son-in-law, Talalelei. They were among the 85 key informants interviewed for a gender assessment of the aquaculture sector in Samoa in December 2017. The paper describes how Epifalia has gained a sense of empowerment and a better involvement in decision-making thanks to her knowledge of tilapia farming. She reports on how it has also allowed her to be more involved in village activities and has given her increased visibility within the village community.

In the seventh article, Jimaima Lako and her co-authors present a paper on 'Consumer preference for Nile tilapia (*Oreochromis niloticus*) value-added products in Samoa'. The authors have investigated the possibility of better utilising tilapia by developing four value-added products: smoked fish in different brine concentrations, cured-smoked, surimi and fish paste. These products were evaluated through a consumer preference test in Samoa. Results showed that fish paste was consumers' preferred product, followed by brined-smoked, surimi and cured-smoked tilapia. Women in Samoa who, like elsewhere in the Pacific Islands, are actively involved in fish post-harvest activities should be able to utilise the results of this study to generate income and increase food security. This study can also promote the marketing of cultured tilapia for fish consumption in the Pacific region.

The article 'Trailblazers: Conversations with Pacific women driving scientific advances in fisheries' by Melinda Morris is the eighth article in this edition. Four women were interviewed to celebrate the International Day of Women and Girls on 11 February 2018. Lucy Joy, Esther Leini, Maria Fiasoso Sapatu and Sarah Botaake Teetu tell us what motivates them to work in fisheries science and what advice they would give to young women and girls considering a career in this field.

The ninth and tenth articles are reproduced from *Yemaya* with permission. The ninth article, 'Women in Fisheries in Asia: 1978–2016' by Meryl Williams and her co-authors, summarises fisherwomen's struggles in Asia and the Pacific. The article describes the milestones achieved by fisherwomen based on existing literature and contributions from the authors from various Asia-Pacific countries. The milestones described reflect fisherwomen's struggles against unfair taxation, the difficulties they face in organising global programmes, and the lack of recognition of their contribution to the economy in the Asia-Pacific region.

The tenth article, 'Women in Fisheries Network', was written by Loata Leweniqila. The article summarises the current activities of the Fiji-based Women in Fisheries Network on needs training assessments, capacity building and helping women to add value to their activities within the fisheries sector. The Women in Fisheries Network Strategic Plan was designed to support fisherwomen by engaging them in training and capacity-building activities that will reinforce their participation and the added value they bring to the fisheries sector.

I have been the coordinator of this bulletin since issue number 17, published in December 2007 – more than 10 years ago. My role of coordinator will end with this issue and I will pass the baton to Sangeeta Mangubhai, who has accepted to become the new editor, starting with the next issue. Sangeeta has been involved in many projects related to women in fisheries and has good experience working with Pacific Island communities. I am giving her my support for the coordination of the bulletin and will remain an attentive reader of and an active contributor to the bulletin.

Don't hesitate to send us any feedback on these articles, and I also encourage you to submit articles on gender and fisheries issues from your country or region.

Veikila Curu Vuki

Message from Moses Amos, Director of SPC's Fisheries, Aquaculture and Marine Ecosystems Division

The Women in Fisheries Information Bulletin was first published in October 1997 – following recommendation 10 of the 26th Regional Technical Meeting on Fisheries – to provide a channel to exchange ideas, knowledge and experience about all issues related to women involved in fisheries activities. Twenty years later, the bulletin is still relevant with good interest, as shown with the present issue, and this is largely due to the hard work and dedication of four women who volunteered to be the successive coordinators of the bulletin: Aliti Vunisea (1997–1998 and 2004–2007), Lyn Lambeth (1998–2001), Kim DesRochers (2002–2003) and Veikila Vuki (2007–2018).

Veikila will, as she says in her editorial above, 'pass the baton' to Sangeeta Mangubhai as the new coordinator for the next issue. I would like to use this opportunity to deeply thank Veikila for over eleven years of hard and dedicated work in maintaining the network and keeping it active, sourcing the articles for the bulletin, advising authors – including young authors from the Pacific Islands region – on how best to convey their message, and the many other tasks associated with putting together an issue of the bulletin. The coordinator's job is done on a voluntary basis. I think everybody will understand that Veikila's eleven-year dedication to the bulletin was mainly driven by her passion. Passion is often a very efficient tool for progressing things. Thank you Veikila for allowing us to benefit from your passion.

Moses Amos

To compare the pre- and post-cyclone responses of fishers, the majority of the questions asked were identical or complementary to those in the earlier VCA. The questionnaire used a quantitative approach designed to obtain information on mud crab dependency and how mud crab fishing activities, such as site, catch and use of mud crabs, had changed since the cyclone.

Results and discussion

Changes to harvesting patterns

Two to three months following Cyclone Winston, 52% of the fishers interviewed in Bua Province had stopped collecting mud crabs, with notable differences between districts. For example, in Kubulau District all fishers had stopped collecting mud crabs, compared to Lekutu where only 30% of fishers had stopped. These differences corresponded with the extent of damage from Cyclone Winston across the districts. Fallen trees and/or debris preventing clear access to mangroves and crab holes were given as the primary reasons fishers stopped collecting (Figure 2). Other reasons included bad weather, the presence of a mangrove *tabu* area, illness, or being busy with village repairs following the cyclone.

For the 48% of fishers who continued collecting mud crabs, only three fishers reported that their harvesting sites had changed. The travel time to the sites had not significantly changed from pre- to post-cyclone. The majority of fishers (77%) travelled less than one hour, and none reported travelling more than two hours to the site. This suggests that despite the cyclone prompting or forcing some fishers to choose new sites in the two to three months following the cyclone, these were not necessarily further away. The primary methods of crab collection were also unchanged from 2015

– hand collection was the most common method (68%) and hand net (27%) the second most common. Only two fishers, both male, used spears.

Over half of the fishers (68%) noticed a change in the number of crabs caught post-cyclone. Whilst the majority of these fishers noted that they were catching both fewer and smaller mud crabs after the cyclone, 25% of fishers (from just three districts) actually noted an increase in the number of mud crabs caught. Post-cyclone, the average number of crabs caught per trip averaged 5.60, ranging from 1 to 30. The majority (88%) of fishers caught 10 or fewer mud crabs per trip. Forty-two per cent of fishers also reported that the frequency of their fishing trips (to collect crabs) had changed. Fishers were also collecting mud crabs less often, with 30% collecting less than once a week, compared with only 7% prior to the cyclone.

Changes to use of harvested mud crabs

Fishers were asked to rank the main use of the mud crabs they collected, and their pre- and post-cyclone responses were compared. Figure 3 shows the most common (rank 1) and the second most common (rank 2) use of mud crabs caught by fishers in Bua Province. Prior to the cyclone, the most frequent use of mud crabs was consumption by the household (25%), closely followed by sale to middlemen (24%) and sale to local markets (23%) (Figure 3a). Middlemen frequently visited even very remote villages to source mud crabs. Post-cyclone, the rankings changed with the most frequent use of mud crabs now sale to middlemen (70%) (Figure 3b).

This shift in rankings might be explained by the decrease in harvesting of mud crabs in cyclone-affected areas where mangroves were extensively damaged, prompting middlemen to

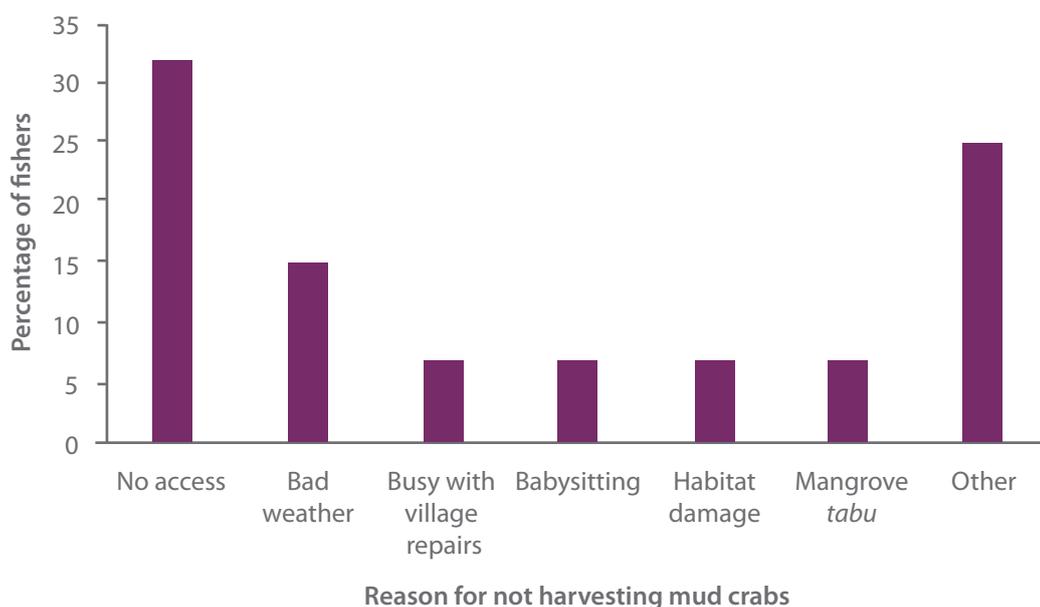


Figure 2. Reasons fishers did not collect mud crabs post-Cyclone Winston. A *tabu* is a periodic harvesting closure. Other reasons included being sick or too old.

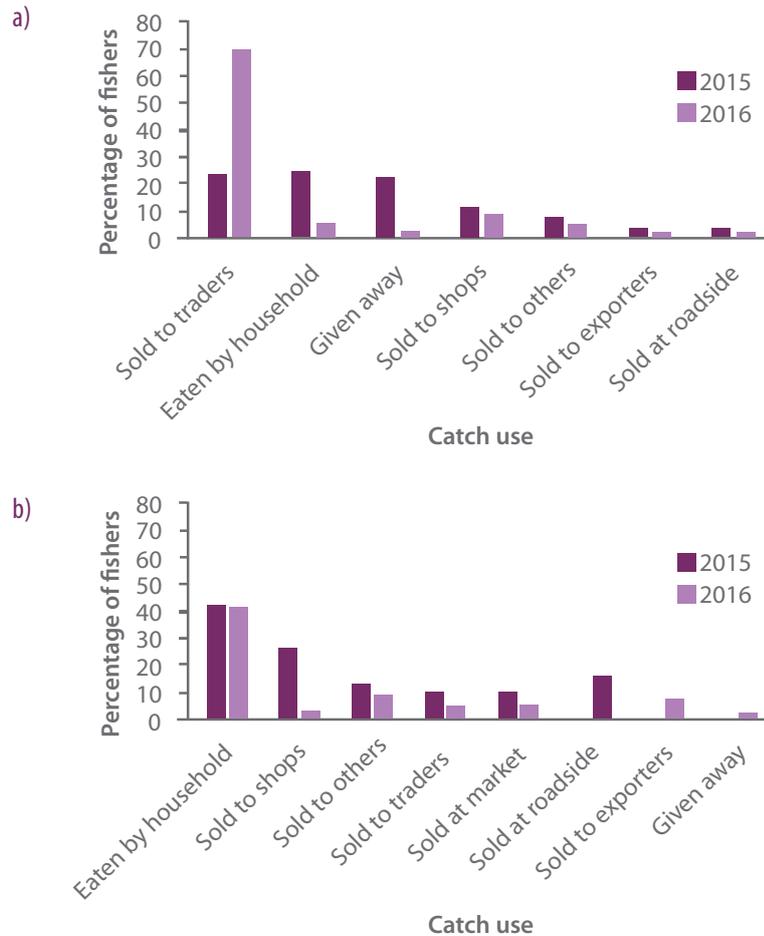


Figure 3. The number one (a) and number two (b) use of mud crabs pre- and post-Cyclone Winston.

actively source mud crabs from other districts (M. Fox pers. comm.). Alternatively, fishers may have preferentially chosen to sell their crabs rather than consume them to generate much needed income to rebuild their homes and lives post-Cyclone Winston (S. Mangubhai pers. comm.). Both pre- and post-cyclone, the second most common use of mud crabs was household consumption (Figure 3).

Changes to sales

Of the fishers interviewed, 21% stated that the cyclone had impacted their ability to sell mud crabs. This was largely caused by road access being blocked (46%), access to markets being only by boat (23%), or a perceived decrease in mud crab stocks (15%). A significant percentage of these fishers (29%) also reported that the cyclone had affected the sale price of mud crabs. The majority (81%) noted the price of mud crabs had increased, without attributing the increase to the cyclone; and the others (19%) reported they could now sell their mud crabs at a higher price because of the cyclone.

Fishers also reported an increase in the sale frequency of the crabs they had caught. Prior to the cyclone, crabs were mostly sold once a month (39%) or once a week (27%). The frequencies were reversed after the cyclone; the majority of fishers (76%) now sold crabs on a weekly basis with a smaller percentage (21%) selling on a monthly basis. The price of

sold mud crabs averaged FJD 14.28/kg and ranged from FJD 8/ kg to FJD 18/kg post-cyclone, with 50% of the fishers getting FJD 14/kg or less. This was a 36% increase from pre-cyclone prices, which had averaged FJD 10.46/kg.

Changes to alternative livelihoods

With changes in the availability of mud crabs, interviewers asked fishers if they had opted to harvest other seafood to compensate for a loss in income when they were unable to harvest and/or sell crabs. Sixty-four per cent of respondents did not sell any other type of seafood, up from 29% pre-cyclone. The other two main seafood species sold were sea cucumber (70%) and fish (55%); these figures were similar to those from before the cyclone.

Respondents were also asked if they had any other source of income, unrelated to fishing, and 57% answered 'yes'. Post-cyclone, fishers were less likely to have non-fisheries sources of income, despite reporting that they needed to earn money and had seen their income from mud crabs decrease. Weaving and/or sewing mats was the most common source of other income, closely followed by sales of kava (*yaqona*, *Piper methysticum*) and coconut (Figure 4). The main sources of non-fisheries income did not vary significantly from 2015.

Rural women are often the most affected by changes to natural resources because of their high dependency on these

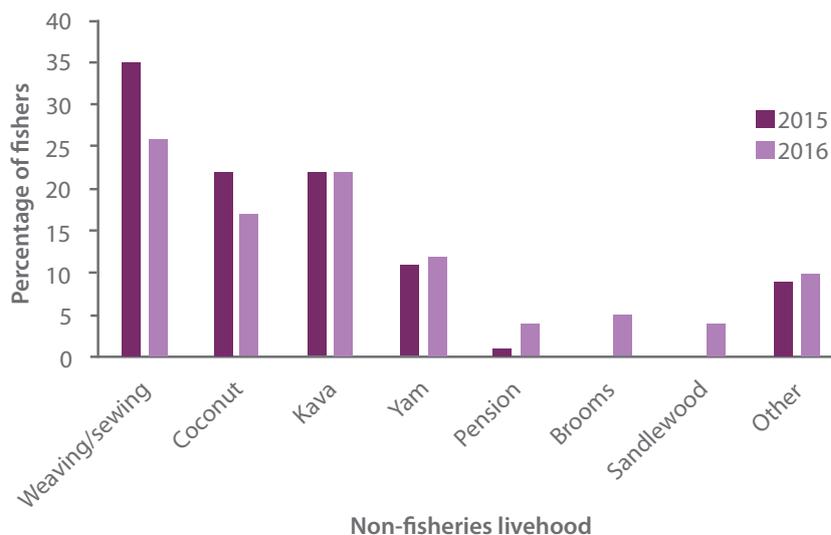


Figure 4. Comparison of pre-and post-cyclone non-fisheries income sources. Kava (*yaqona*) is a traditional drink in Fiji. 'Brooms' are traditional Fijian brooms (*sasa*) made out of the vein of coconut leaves.

resources and fewer opportunities for income diversification; and climatic changes leave them more vulnerable (Denton 2002; Siagian et al. 2014; FAO and Biswas 2017). Post-cyclone, fishers with other livelihoods were also more likely to report that these other livelihoods provided a better source of income than fisheries. Extreme weather events further reduce opportunities for women to earn a livelihood (FAO and Biswas 2017). For example, coconut was the second most common non-fisheries livelihood before the cyclone (22%); but the cyclone damaged many of the trees and made this alternative a less viable source of income.

During the survey, communities specifically requested government assistance with: (i) repairing/replacing fishing gear; (ii) standardising market prices for crabs so that they can earn enough money to pay for the damage suffered during the cyclone; (iii) creating a mud crab nursery to help restock populations in the mangroves; and (iv) finding new markets that will buy mud crabs at higher prices from fishers (Figure 5).

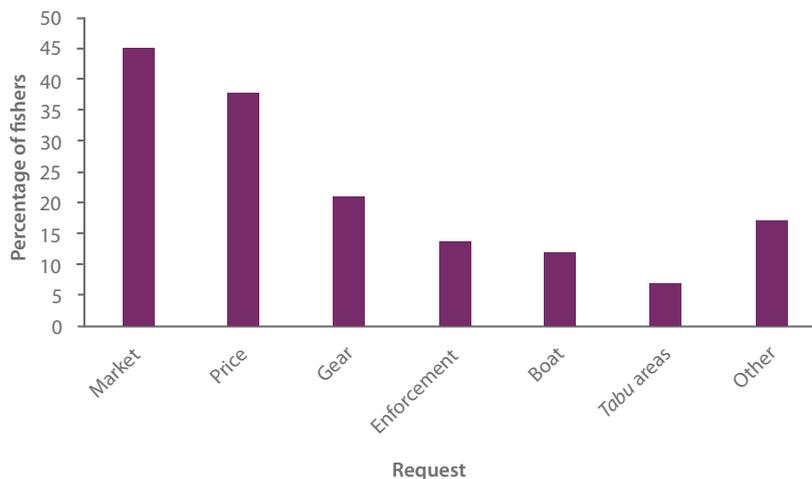


Figure 5. Fishers' requests to the government concerning mud crab fisheries. 'Market' included access to new markets and more stable markets. Price-related requests from fishers were both higher and/or standard prices for the mud crabs they sold. Gear requested by the fishers included traps, nets and reef shoes. A *tabu* is a periodic harvesting closure.

Conclusions

Cyclone Winston caused wide-scale impacts to fisheries-dependent communities across the impact zone in Fiji, with notable differences between men and women depending on their investment in coastal fisheries (Chaston Radway et al. 2016). This study enabled a detailed analysis of the impact of Cyclone Winston on the mud crab fishery, including changes in fishing effort, catch volume and price.

Inequalities in access to resources, capabilities and opportunities (UN Women 2015; Mersha and Van Laerhoven 2016; Afriyie et al. 2017) meant the mud crab fishers, who were mainly women, were highly vulnerable to the cyclone and its impacts. Women gain an added sense of security and respect through income generation (Fay-Sauni et al. 2008). This suggests that being unable to collect mud crabs, as well as a lack of alternative livelihoods, had negative repercussions for the women fishers' sense of independence.

The following recommendations are made from this study:

- Ensure government support to fishing communities is gender sensitive and takes into consideration the losses and damages incurred by women fishers.
- Provide up to date information to women fishers on pricing to ensure they get a fair price for their mud crabs.
- Encourage villages and districts to establish regulations or guidelines for the mud crab fishery which promotes the resilience of the fishery to cyclone events.
- Ensure districts with damaged mangrove tabu areas remain closed to help promote recovery.
- Continue monitoring the mud crab fishery to gauge the recovery of the fishery, and the impact to subsistence and livelihoods in Bua Province.

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References

- Afriyie K., Ganle J.K. and Santos E. 2017. 'The floods came and we lost everything': weather extremes and households' asset vulnerability and adaptation in rural Ghana. *Climate and Development* 10(3):1–16. [<http://doi.org/10.1080/17565529.2017.1291403>]
- Chaston Radway K., Manley M., Mangubhai S., Sokowaqanilotu E., Lalavanua W., Bogiva A., Caginitoba A., Delai T., Draniatu M., Duluaqio S., Fox M., Koroiwaqa I., Naisilisili W., Rabukawaqa A., Ravonoloa K. and Veibi, T. 2016. Impact of Tropical Cyclone Winston on fisheries-dependent communities in Fiji (No. 03/16). Suva, Fiji. 74 p.
- Dalzell P., Adams T.J.H. and Polunin, N.V.C. 1996. Coastal fisheries in the Pacific Islands. *Oceanography and Marine Biology: An Annual Review* 34:395–531. Retrieved from [https://www.engineeringvillage.com/blog/document.url?mid=geo_1630ab910af2e-26c042e1720613774210&database=geo]
- Davis M., Newell P. and Quinn, N. 1998. An urban women's subsistence fishery off Suva Peninsula, Fiji: Potential threats and public health considerations. Pp. 35–43 in J. Seeto and N. Bulai (eds), Papers presented at Symposium 8th Pacific Science Inter-Congress. Suva, Fiji.
- Denton F. 2002. Climate change vulnerability, impacts, adaptation: Why does gender matter? *Gender and Development* 10(2):10–20.
- FAO and Biswas N. 2017. Handbook: Towards gender-equitable small-scale fisheries governance and development. Rome, Italy. 154 p. Retrieved from [<http://www.fao.org/3/a-i7419e.pdf>]
- Fay-Sauni L., Vuki V., Paul S. and Rokosawa M. 2008. Women's subsistence fishing supports rural households in Fiji: A case study of Nadoria, Viti Levu, Fiji. *SPC Women in Fisheries Information Bulletin* 18:26–29. Retrieved from [http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/WIF/18/WIF18_26_Fay.pdf]
- Government of Fiji 2016. Fiji post-disaster needs assessment. Tropical Cyclone Winston, February 20, 2016. Suva, Fiji: Government of Fiji. 153 p.
- Lal P.N., Singh R. and Holland P. 2009. Relationship between natural disasters and poverty: A Fiji case study. 82 p. Retrieved from [http://www.preventionweb.net/files/11851_11851R25PovertyAFijiCaseStudyLowres.pdf]
- Le Vay L. 2001. Ecology and management of mud crab *Scylla* spp. *Asian Fisheries Science* 14:101–111.
- Mangubhai S., Fox M. and Nand Y. 2017. Value chain analysis of the wild caught mud crab fishery in Fiji. No. 02/17. Suva, Fiji: Wildlife Conservation Society. 20 p.
- Mersha A.A. and Van Laerhoven F. 2016. A gender approach to understanding the differentiated impact of barriers to adaptation: responses to climate change in rural Ethiopia. *Regional Environmental Change* 16(6):1701–1713. [<http://doi.org/10.1007/s10113-015-0921-z>]
- Siagian T.H., Purnadi P., Suhartono S. and Ritonga H. 2014. Social vulnerability to natural hazards in Indonesia: Driving factors and policy implications. *Natural Hazards* 70(2):1603–1617. [<http://doi.org/10.1007/s11069-013-0888-3>]
- UN Women 2015. Gender, climate change and disaster risk reduction and recovery strategy: 2015-2018. New York: United Nations.



Conserving womangroves: Assessing the impacts of improved cooking stoves on resource management in Langalanga Lagoon, Solomon Islands

Helen Maefasia Teioli¹, Jan van der Ploeg¹, Anne-Maree Schwarz², Meshach Sukulu¹ and Hampus Eriksson^{1,2}

Abstract

Firewood harvesting is a major threat to mangrove ecosystems in Solomon Islands. Improved cooking stoves could reduce firewood use and thereby ease pressure on mangroves. We conducted a field-based experiment in Langalanga Lagoon to evaluate this theory of change. Our results suggest that the so-called 'kiko stove', an improved cooking stove that is widely promoted in Solomon Islands, is not more efficient than cooking on an open fire in terms of cooking time and wood consumption. Yet, women who use the kiko stoves perceive a number of benefits and think the stoves reduce mangrove degradation. Promoting kiko stoves can transform gender norms that inhibit community-based resource management, and thereby provide a starting point for the conservation and rehabilitation of mangroves.

Keywords: gender transformative approach, improved cooking stove, mangrove

Introduction

Mangrove ecosystems have great economic and ecological value for coastal communities (McLeod and Salm 2006). In Solomon Islands, mangroves cover about 65,000 hectares (Warren-Rhodes et al. 2011). Mangroves are of critical importance for the food security of many coastal communities in the archipelago, directly through harvesting

marine invertebrates, and indirectly by sustaining coastal fisheries. Women especially make intensive use of mangrove forests, collecting a range of shells and crabs for food and to sell in local markets. The country's mangrove forests remain generally intact (Green et al. 2006). The main threats are land clearance for log ponds, timber harvesting and firewood gathering (Warren-Rhodes et al. 2011). In relatively densely populated areas such as the Langalanga Lagoon on Malaita (Figure 1) firewood gathering is an important driver of mangrove forest degradation (Goto 1996; MECM 2008; Albert and Schwarz 2013). Almost all rural households in the country rely on firewood as their main energy source for cooking (SINSO 2009; ADB 2015).

Since 2012 WorldFish has engaged with communities in Langalanga Lagoon to improve community-based resource management (Schwarz et al. 2013; van der Ploeg et al. 2016; Sukulu et al. 2016). People identify the ongoing degradation of mangroves as a major concern, and highlight the need for alternative energy sources (Albert and Schwarz 2013). Therefore, WorldFish facilitated a practical training on building improved cooking stoves in four communities in Langalanga Lagoon in 2015 in collaboration with Kastom Gaden Association (KGA; Figure 2). KGA is a Solomon Islands non-government organisation that is promoting the so-called 'kiko stove' (Kabu 2011a, b). The stove, made of clay and sand, wood ash and coconut husks, was designed by

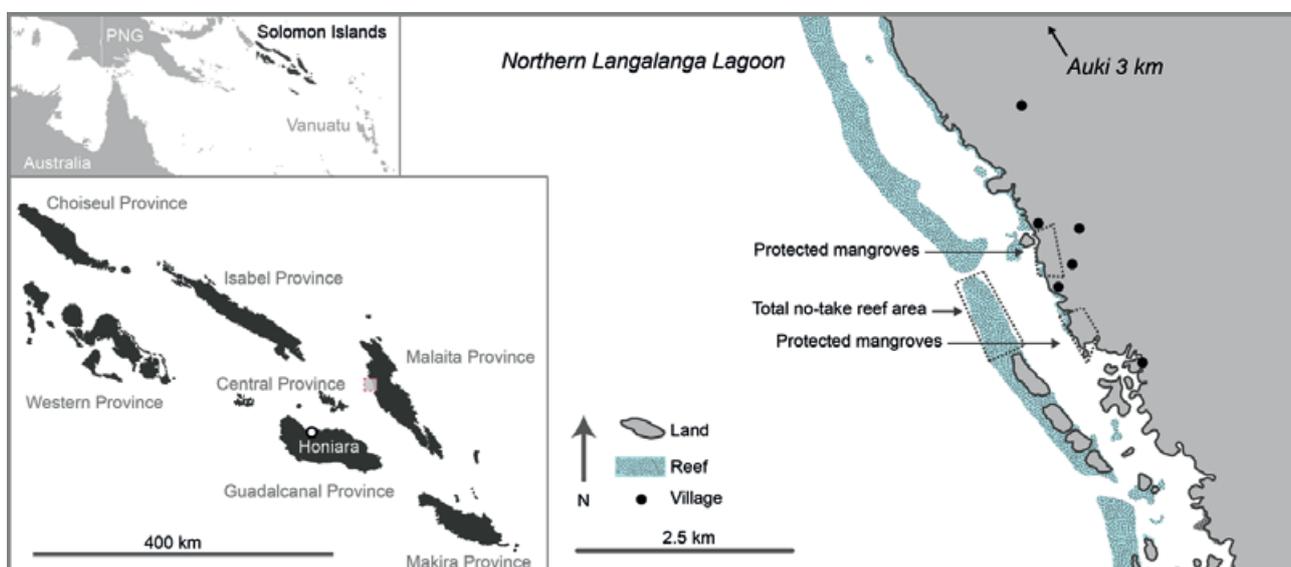


Figure 1. The Rarata locally managed marine area in Langalanga Lagoon.

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² Australian National Centre for Ocean Resources and Security (ANCORS), University of Wollongong, Australia.

a Japanese volunteer, Yukiko Kasuya; hence the name 'kiko stove' (R. Kabu pers. comm. 2017). The theory of change behind the training workshops was that the introduction of fuel-efficient stoves would reduce firewood collection and thereby reduce mangrove degradation in the lagoon (Sulu et al. 2015a: 17–18).

Improved cooking stoves are widely promoted in developing countries to address the 'global fuelwood crisis' (Manibog 1984: 199). In sub-Saharan Africa, where firewood and charcoal contribute over 90% of total energy demand, considerable resources are invested by national governments and NGOs to encourage households to use more efficient cooking stoves in order to reduce fuelwood demand and thereby counter deforestation (see for example Lasisi et al. 2015 on Nigeria; Malakini and Maganga 2011 on Malawi). Also in Asia and Latin America, improved cooking stoves are actively promoted to halt forest degradation (see for example Adiranzén 2013 on Peru; Granderson et al. 2009 on Guatemala; Hanbar and Karve 2002 on India).

The National Development Strategy 2016–2035, the strategic framework that guides all development policies and programmes of the Solomon Islands Government, aims to reduce the proportion of households for whom firewood is the primary source of energy for cooking from 97% to 80% by 2020, in order to prevent deforestation and restore degraded forests (SIG 2016). There is however very little information available on firewood use, cooking practices, or the views of people on alternative cooking methods. This paper explores the impact of improved cooking stoves in Langalanga Lagoon, and asks the question: does the kiko stove reduce the degradation of mangroves? In the next paragraph we describe the research methodology. We then summarise and discuss the results. We conclude that the causal links between kiko stoves, a decrease in firewood use, and reduced pressure on mangroves are tenuous. However, our experiences in Langalanga Lagoon suggest that the promotion of improved cooking stoves can contribute to mangrove rehabilitation: by recognising women as principal users of mangroves, highlighting women's domestic workload, and offering women an opportunity to learn new skills, the kiko stoves transformed gender norms that inhibit community-based resource management and provided a starting point for mangrove conservation.

Methods

Research area

The kiko stove training workshops were conducted from 2 to 10 November 2015 in four villages on Langalanga Lagoon: Radefasu, Oibola, Sita and Oneoneabu. The workshops were facilitated by two trainers from KGA with support from WorldFish and the community-based organisation OKRONUS (see Sukulu et al. 2016 for a detailed description of OKRONUS). Two hundred and twenty-six people attended these trainings: 137 women and 89 men. During the two-day workshops the participants constructed their own kiko stove: a total of 120 stoves were built. The total costs of the workshops amounted to SBD 14,614 (USD 1,850). This study concentrated on two villages: Radefasu and Oibola. Two ethnic groups inhabit the lagoon area: the bus pipol



Figure 2. (a) Collecting firewood in Langalanga Lagoon; (b) cutting firewood; (c) kiko stove; (d) kiko stove training workshop. Photos : Helen Maefasia Teioli

[bush people] from Kwara'ae and the solwata pipol [saltwater people] from Langalanga (Sulu et al. 2015b; Sukulu et al. 2016). Traditionally, the Kwara'ae inhabited the hills and the Langalanga lived on artificial islands constructed on the reefs and in the mangroves, but nowadays both groups reside in villages along the coastal road, such as Radefasu and Oibola. Women in the lagoon area depend heavily on the mangroves as a source of firewood, food and cash.

Data collection

Data were collected using two different methods. First, we conducted face-to-face interviews with 30 women: 15 women who after the training started to use a kiko stove (the adopters) and 15 women who did not (the non-adopters). The interview focused on household livelihood strategies, cooking practices and wood consumption. We used Likert scales to assess the attitudes, views and perceptions of women on the kiko stove. Second, we conducted a field experiment in which we asked the adopters to boil one litre of water using a small kettle on a kiko stove, and the non-adopters on an open fire. We measured the initial water temperature with a thermometer and recorded the time it took to boil the water in minutes. The weight of the firewood was recorded (before and after cooking) using a digital scale.

All data were encoded into a Microsoft Excel spreadsheet. To compare the results of the field experiment we conducted an independent t-test using R software for statistical computing.

Results

Household size and literacy

Average household size in the two communities is six people (range 2–14). Fifty-seven per cent of the respondents said that their house accommodates five people or less. Fourteen per cent of the households are composed of more than 10 people. Seventy-three per cent of the respondents said that they could read and write. Twenty-seven per cent of the respondents did not attend school. Forty per cent of the respondents stopped going to school after finishing primary school (grade 6).

Livelihoods

Gardening, fishing and livestock keeping (poultry and pigs) are key sources of income and food for the women in Radefasu and Oibola. All but one respondent cultivate their own gardens. Thirty-three per cent of the respondents fish on a regular basis. Twelve per cent are keeping pigs or chicken, mainly to earn cash for school fees. In Oibola most women earn cash by making shell jewellery. Only 13% of the respondents regularly travel to the market in Auki to sell products, such as shell jewellery, garden produce, home-baked buns or cooked fish. Only one woman had a regular income: she is a teacher.

Firewood

Women use different mangrove species as firewood: dinale (*Lumnitzera littorea*) and kobleo (*Rhizophora stylosa*) are the most common. Other tree species include fata (*Vitex cofasus*), akwa (*Pometia pinnata*), kwa'u (*Bremna corimbosa*), dafa (*Terminalia brassii*) and ngali nut (*Canarium indicum*).

Coconut husk and sago palm stalks are also often used to make fire. Interestingly, most women (63%) collect firewood in the 'bush', i.e. secondary forests on the hills, and only 27% in the mangroves (Figure 3). The respondents in the two villages spend on average one hour per week collecting firewood. Typically, firewood gathering is seen as a women's job, but 27% of the respondents said that their husband helps with this task. In more than half of the cases firewood is collected by children (mainly girls). Twenty-six per cent of the respondents said that they have to ask permission from the landowners before they can collect firewood. Twenty per cent of the respondents regularly buy firewood from other people in the village. The type of firewood seems to affect the taste of the food: most women say that they prefer the taste of food prepared on mangrove firewood.

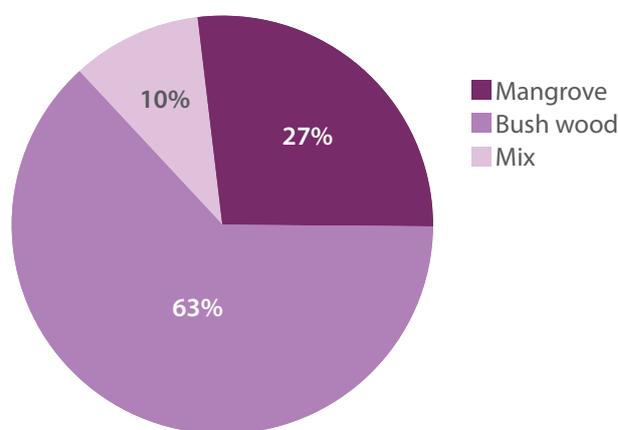


Figure 3. Source of firewood used by women in Radefasu and Oibola.

Cooking

Women use a variety of cooking methods: open fire, hot stones, gas, charcoal and kerosene (Figure 4). All respondents say they cook on an open fire. Sixty per cent of the respondents also use the traditional Melanesian stone oven, motu, in which food is covered with hot stones and sealed with leaves. Most women regard the kiko stoves as a supplementary cooking method, not necessarily as a substitution for using an open fire. Women use an average of 5.26 pieces of split firewood, so-called 'sticks', per day (range 3–8). A stick is generally 50 cm long and 5 cm in diameter. Figure 4. Sources of energy for cooking used by women in Langalanga.

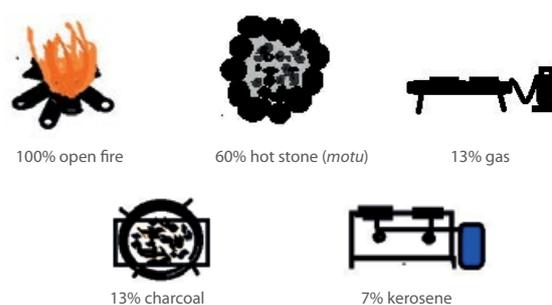


Figure 4. Sources of energy for cooking used by women in Langalanga.

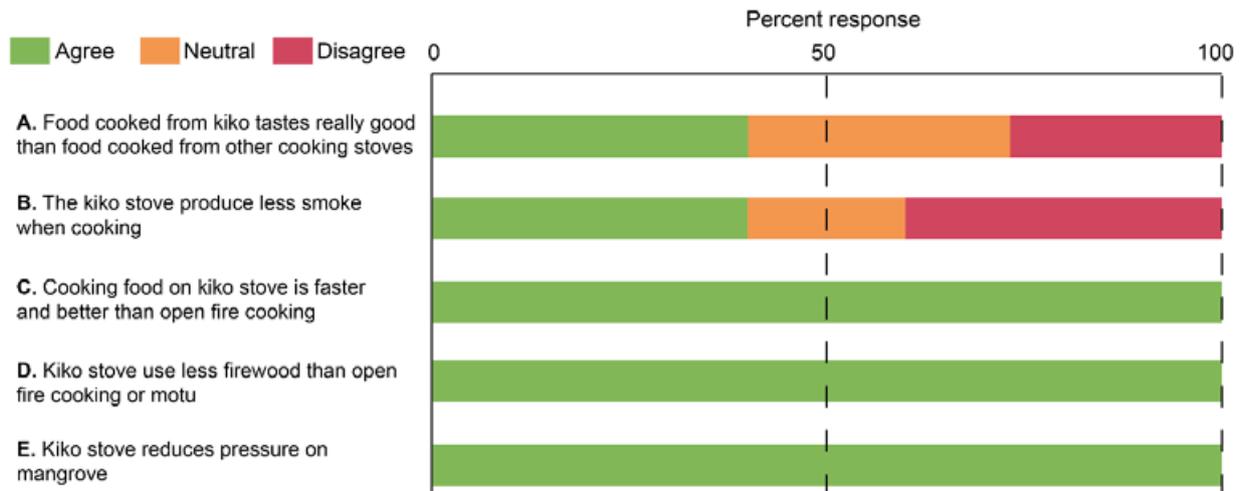


Figure 5. Women's perceptions of the kiko stove.

The kiko stove

The women who adopted the kiko stove said that the stove reduces the burden to collect firewood ($n = 15$). They also said that the stove reduces the time needed for cooking. Most of the women claimed that the stove enables them to cook more food using the same quantity of firewood (86.6%). Eighty per cent of the respondents said that the kiko stove improves the cleanliness of the cooking area, particularly because it produces less ash: "kiko no mekem mess" [a kiko stove doesn't make a mess]. We asked the respondents ($n = 15$) if they agreed or disagreed with statements on: (1) the taste of food prepared on a kiko stove; (2) the amount of smoke produced by a kiko stove; (3) the efficiency of cooking on a kiko stove; (4) the amount of firewood needed; and (5) the impacts on mangroves (Figure 5). Opinions varied whether food prepared on a kiko stove tastes better than food prepared on other stoves: only 40% of the women agreed. The kiko stove seems particularly suitable for cooking rice: "kiko makes food taste really good. There is no smell. The rice dries up nicely." Only 40% of the women agreed with the statement that the kiko stoves produce less smoke. This is remarkable because an important additional reason to promote fuel-efficient stoves is to minimise indoor air pollution (WHO 2006; Clementh 2011). All women agreed with the statement that 'cooking food on kiko stove is faster and better than open fire cooking'. The women explained that the clay stove transfers heat slowly, enabling them to cook more than one pot: "the heat trapped in the kiko makes water boil faster". Similarly, all women agreed that the stove reduces the amount of firewood needed: "fo kiko iu no nidim staka faewud [for a kiko stove you don't need a lot of firewood]". "Kiko is easy: you don't have to cut firewood all the time" commented one woman from Radefasu. And all respondents agreed that the kiko stoves reduce pressure on mangroves.

Cooking time and wood consumption

During the field experiments it took on average two minutes longer to boil the same amount of water on a kiko stove than on an open fire ($t = 2.33$, $df = 24.55$, $p = 0.03$) (Figure 6).

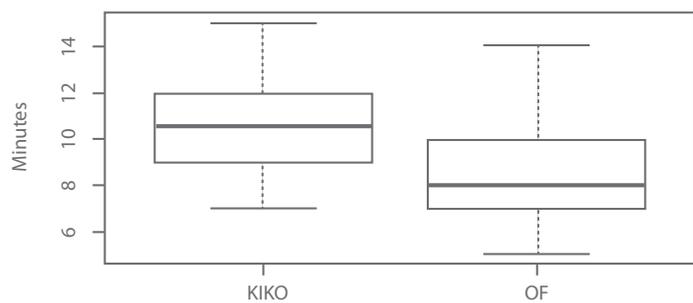


Figure 6. Time to boil one litre of water (kiko versus open fire, $n = 30$).

Figure 7 shows that there was no significant difference between the amount of wood used by women to boil one litre of water on a kiko stove and on an open fire ($t = -1.56$, $df = 17.41$, $p = 0.14$).

As women constructed their own stove there was considerable variation in the size and height of the stoves. It seems that kiko stoves that are higher use more firewood to boil the same amount of water than lower stoves ($F(1, 12) = 5.13$, $p = 0.04$). However, there was no significant relationship found between time to boil and height of kiko stove ($F(1, 12) = 0.69$, $p = 0.42$).

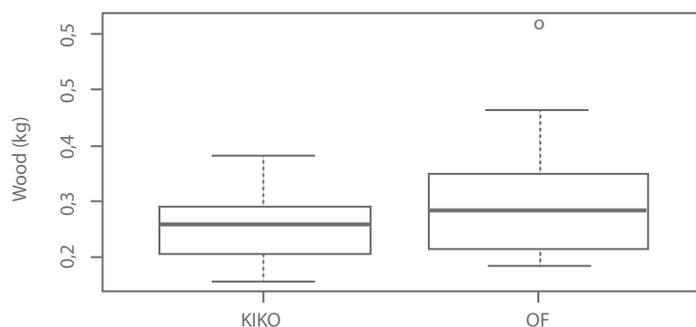


Figure 7. Wood (kg) needed to boil one litre of water (kiko stove versus open fire, $n = 30$).

Discussion: Conserving 'womangroves'

Women in Langalanga Lagoon, who after the training workshop started to cook on a kiko stove, say that they use less firewood and that this in turn leads to less pressure on mangroves. This seems to confirm the theory of change that the improved cooking stoves reduce the amount of firewood and thereby ease pressure on mangroves (Figure 8). However, we could not find evidence that cooking on a kiko stove is more efficient than cooking on an open fire. Clearly, the sample size of our field experiment is small, and the variation in height and width of the clay stoves could have influenced the measurements. But the proposition that a kiko stove reduces the amount of firewood used seems tenuous. Moreover, the insight that most women collect firewood in the bush and not in the mangroves further complicates the causal model linking improved cooking stoves to reduced mangrove degradation (Figure 8). Promoting kiko stoves therefore does not seem to be an effective strategy for mangrove conservation.

However, our experiences suggest that the kiko stoves did function as a catalyst for change in Langalanga Lagoon – but not in a way we anticipated. The kiko training workshops in the four villages underlined that mangroves are principally the domain of women. Whereas men fish on the reefs and at sea, women collect shells, crabs, mangrove propagules and firewood in the mangroves (SPC 2018; Kruijssen et al. 2013). In that sense, the word 'womangroves' perhaps better captures the gendered division of labour in the seascapes of Solomon Islands (Bosold 2012). Decisions about mangrove tenure and management are however typically made by men (Albert and Schwarz 2013). Externally supported initiatives often ignore and may unintentionally reinforce such power inequalities. For example, community consultations to discuss resource management often only involve men. Similarly, few women attend training workshops simply because the invitations are sent to 'community leaders' or 'heads of households', almost

always men; or because the workshops are held in locations or at times when women cannot attend because of their household chores (Lawless et al. 2017). Clearly, this gender bias can undermine community-based resource management efforts, and may make the life of women harder (Schwarz et al. 2014; Blum and Herr 2017).

Our efforts to facilitate community-based resource management in Langalanga Lagoon were not an exception to this general pattern. OKRONUS, the community-based organisation that is spearheading efforts to conserve and rehabilitate mangroves in the lagoon, is led exclusively by men. Women attend meetings, but their participation is often cosmetic. In 2015 OKRONUS proposed a management plan for the mangrove areas around Radefasu, Oibola, Oneoneabu and Sita, which completely banned harvesting of firewood in the mangroves (Sukulu et al. 2016). The plan was met with scepticism during community consultations, and most women ignored the rule. The kiko stove changed this in two ways. First, the training workshops changed the attitudes of men. The OKRONUS leaders realised that women use and value mangroves in different ways, that mangrove management is primarily about and for women, and that without the support of women their plans to rehabilitate the mangroves were doomed to fail. They subsequently redesigned the management plan: the proposed locally managed marine area now covers a much smaller area and only bans the felling of live mangrove trees (Figure 9). Second, the workshops changed the attitudes of women. By specifically targeting women, recognising women's workloads and building the practical skills of women, the workshops generated much goodwill and support for the activities of OKRONUS among women. During the new round of consultations on the OKRONUS management plan in November 2017, many women in the four villages actively participated in the discussions about mangrove rehabilitation.

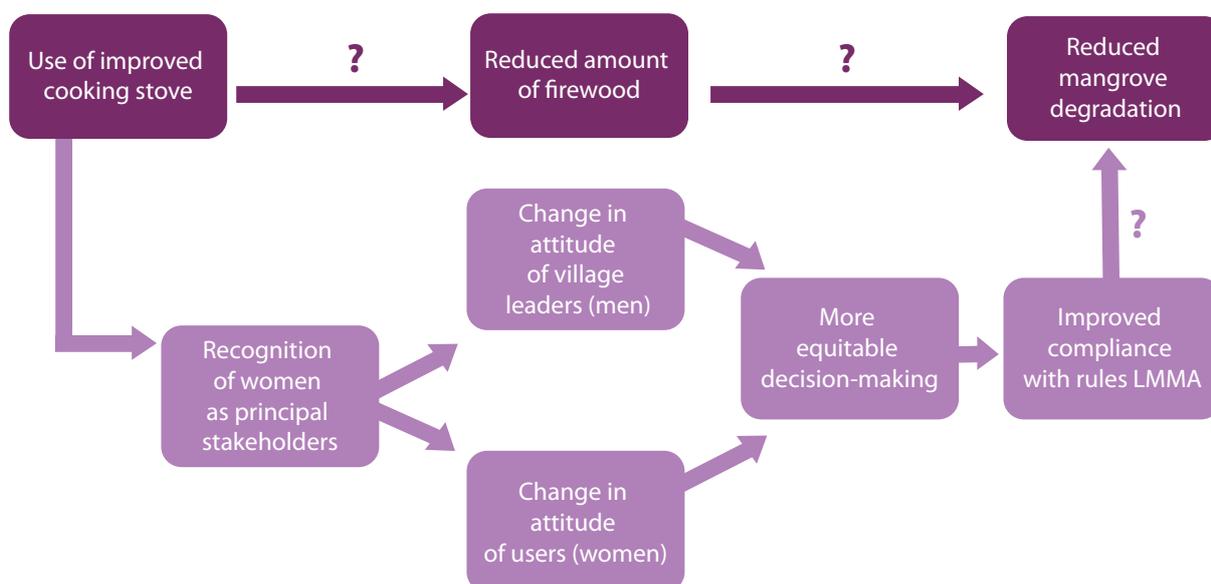


Figure 8. A theory of change logically links an activity to outcomes and impacts, usually in the form of a graphic model in which arrows posit causality. The kiko stove theory of change is shown in dark purple. An alternative pathway how improved cooking stoves could reduce mangrove degradation is highlighted in light purple.

As such, the kiko stove could reduce the degradation of mangroves in Langalanga, although in a more indirect way than was originally envisioned. Promoting improved cooking stoves can transform gender-biased decision-making processes that inhibit community-based resource management. Clearly, this is a small step in a much longer, non-linear journey (Cohen et al. 2014; Abernethy et al. 2014; Sukulu et al. 2016). It is unrealistic to expect that four training workshops will lead to significant changes in resource management in Langalanga Lagoon, nonetheless promoting a clay stove can be an effective first step to challenge deep-rooted ideas of men and women about how to conserve their womangroves.

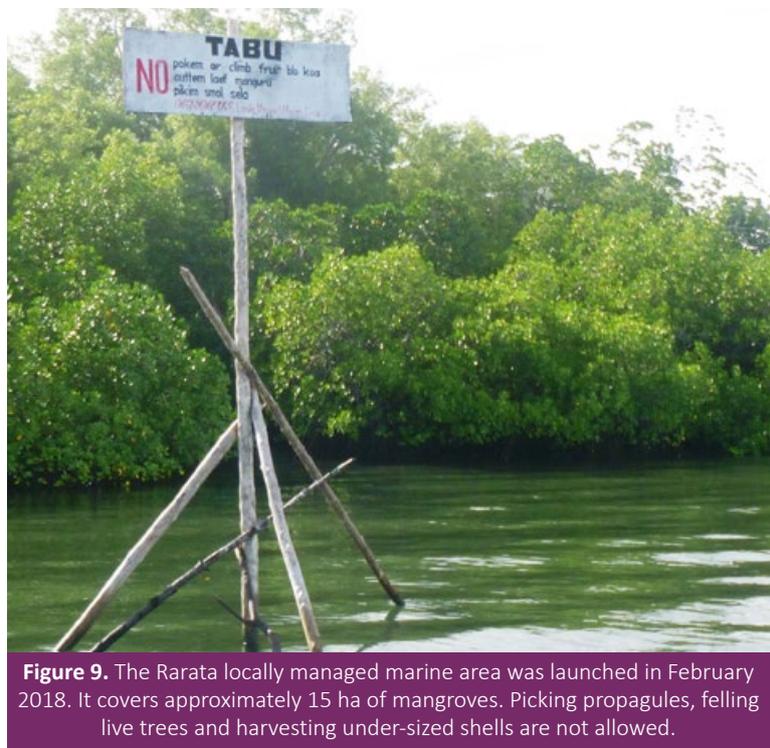


Figure 9. The Rarata locally managed marine area was launched in February 2018. It covers approximately 15 ha of mangroves. Picking propagules, felling live trees and harvesting under-sized shells are not allowed.

Acknowledgements

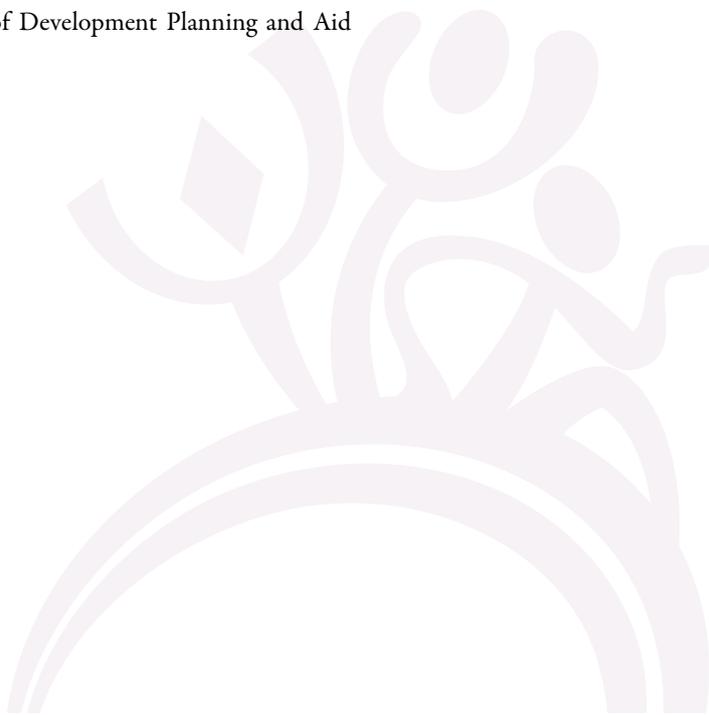
All authors planned the study together. Helen Teioli collected and analysed the data and wrote the manuscript. Johan van der Ploeg analysed the data and wrote the manuscript. Anne-Maree Schwarz initiated the mangrove work in Langalanga and reviewed the paper. Meshach Sukulu organised the training workshops and collected the data. Hampus Erikson analysed data, made the figures and reviewed the paper. The activities of WorldFish in Langalanga Lagoon were undertaken as part of the CGIAR Research Program on Fish Agri-Food Systems (FISH) and were funded by the ‘Strengthening community-based natural resource management to safeguard food security in Malaita Province’ project (ADB-SOL-7753) and the ‘Enhancing rural livelihoods while governing marine resources in Pacific Island countries’ project (SwedBio, a programme at Stockholm Resilience Centre).

References

- Abernethy K.E., Bodin Ö., Olsson P., Hilly Z. and Schwarz A.M. 2014. Two steps forward, two steps back: the role of innovation in transforming towards community-based marine resource management in Solomon Islands. *Global Environmental Change* 28:309–321.
- ADB (Asian Development Bank) 2015. Solomon Islands country gender assessment. Mandaluyong: ADB.
- Adrianzén M.A. 2013. Improved cooking stoves and firewood consumption: Quasi-experimental evidence from the Northern Peruvian Andes. *Ecological Economics* 89:135–143.
- Albert J.A. and Schwarz A.M. 2013. Mangrove management in Solomon Islands: case studies from Malaita Province. Penang: WorldFish. 7 p.
- Blum J. and Herr D. 2017. Gender equity is key to mangrove restoration. [www.iucn.org/fr/node/28839]. Accessed on 26/06/18.
- Bosold A.L. 2012. Challenging the “man” in mangroves: the missing role of women in mangrove conservation. Gettysburg College Student Publication 14.
- Clementh. 2011. Kiko cooking stove and baking oven reduces kitchen smoke. Kastom Gaden Association. [www.kastomgaden.org/2011/03/14/kiko-cooking-stove-baking-oven-reduces-kitchen-smoke/]
- Cohen P., Schwarz A.M., Boso D. and Hilly Z. 2014. Lessons from implementing, adapting and sustaining community-based adaptive marine resource management. Penang: WorldFish.
- Goto A. 1996. Lagoon life among the Langalanga, Malaita, Solomon Islands. *Senri Ethnological Studies* 42.
- Granderson J., Sandhu J.S., Vasquez D., Ramirez E. and Smith K.R. 2009. Fuel use and design analysis of improved woodburning cookstoves in the Guatemalan Highlands. *Biomass and Bioenergy* 33:306–315.
- Green A., Lokani P., Atu W., Ramohia P., Thomas P. and Almany J. (eds) 2006. Solomon Islands marine assessment. Honiara: TNC Pacific Island Countries Report No. 1/06.
- Hanbar R.D. and Karve P. 2002. National Programme on Improved Chulha (NPIC) of the Government of India: an overview. *Energy for Sustainable Development* 6(2):49–55.
- Kabu R. 2011a. KGA lead trainer continues training more women in kiko stove making. [www.kastomgaden.org/2011/06/29/trainer-trained-woman-in-kiko-stove-making/]
- Kabu R. 2011b. Kiko stove training at OISCA training center, Japan. [www.kastomgaden.org/2011/07/20/kiko-stove-training-at-oisca-training-centre-japan/]



- Kruijssen F., Albert J., Morgan M., Boso D., Siota F., Sibiti S. and Schwarz A.M. 2013. Livelihoods, markets, and gender roles in Solomon Islands: case studies from Western and Isabel Provinces. Penang: WorldFish. 13 p.
- Lasisi R., Alfred S.E. and Collinus S.I. 2015. Looking towards the forest: women's firewood consumption and environmental degradation in Bayelsa State Nigeria. *Advances in Social Sciences Research Journal* 2(10):224–249.
- Lawless S., Doyle K., Cohen P., Eriksson H., Schwarz A.M., Teioli H., Vavekaramui A., Wickham E., Masu R., Panda R. and McDougall C. 2017. Considering gender: Practical guidance for rural development initiatives in Solomon Islands. Penang: WorldFish. 23 p.
- Malakini M. and Maganga A. 2011. Does cooking technology matter? Fuelwood use and efficiency of different cooking technologies in Lilongwe District, Malawi. MPRA Paper No. 33866. [<https://mpra.ub.uni-muenchen.de/id/eprint/33866>]
- Manibog F.R. 1984. Improved cooking stoves in developing countries: problems and opportunities. *Annual Review Energy* 9:199–227.
- McLeod E. and Salm R.V. 2006. Managing mangroves for resilience to climate change. Gland: IUCN. 63 p.
- MECM (Ministry of Environment Conservation and Meteorology) 2008. Solomon Islands State of Environment Report 2008. Honiara: MECM.
- Schwarz A.M., Andrew N., Govan H., Harohau D. and Oeta J. 2013. Solomon Islands Malaita hub scoping report. CGIAR Research Program on Aquatic Agricultural Systems. Penang: WorldFish.
- Schwarz A., James R., Teioli H.M., Cohen P. and Morgan M. 2014. Engaging women and men in community-based resource management processes in Solomon Islands. Penang: WorldFish. 11 p.
- SIG (Solomon Islands Government) 2016. National Development Strategy 2016 to 2035: improving the social and economic livelihoods of all Solomon Islanders. Honiara: Ministry of Development Planning and Aid Coordination.
- SINSO (Solomon Islands National Statistics Office) 2009. 2009 Population and housing census. Honiara: Ministry of Finance and Treasury.
- SPC (Pacific Community) 2018. Gender analysis of the fisheries sector – Solomon Islands. Noumea, New Caledonia: Pacific Community. 65 p.
- Sukulu M., Orirana G., Oduagalo D., Waleilia B., Sulu R., Schwarz A.M., van der Ploeg J. and Eriksson H. 2016. 'Management over ownership': towards community-based natural resource management in Langalanga Lagoon, Solomon Islands. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 37:13–21.
- Sulu R., Orirana G., Sukulu M. and Schwarz A.M. 2015a. Ecosystem approach to fisheries management (EAFM) in tropical fisheries; findings from a European Commission funded study in Langalanga Lagoon, Solomon Islands 2012–2014: a report prepared for national stakeholders. Honiara: WorldFish.
- Sulu R., Eriksson H., Schwarz A.M., Andrew N., Orirana G., Sukulu M., Oeta J., Harohau D., Sibiti S., Toritela A. and Beare D. 2015b. Livelihoods and fisheries governance in a contemporary Pacific Island setting. *PLOS One* 10(11):e0143516.
- van der Ploeg J. et al. 2016. Learning from the lagoon: Research in development in Solomon Islands. CGIAR Research Program on Aquatic Agricultural Systems. Penang: WorldFish. 43 p.
- Warren-Rhodes K. et al. 2011. Mangrove ecosystem services and the potential for carbon revenue programmes in Solomon Islands. *Environmental Conservation* 38(4):485–496.
- WHO (World Health Organization) 2006. Fuel for life: household energy and health. Geneva: WHO.



Quantifying and valuing the critical role women play in Fiji's inshore fisheries sector

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Background

Coastal fisheries contribute to household nutritional security and local livelihoods, particularly in developing countries. In the Pacific, fisheries contribute substantially to food and income, with women providing a disproportionate contribution to household and village protein requirements – around 80% (Chapman 1987; Kronen and Vunisea 2009). This is explained by two factors: (1) fisheries catches by women normally go to feeding their family, whereas catches by men go mostly to markets; and (2) contributions from women's fishing activities are usually more regular and frequent than the irregular contributions from men. In terms of non-subsistence fishing, women contribute 25–50% of the small-scale fisheries catch globally (Harper et al. 2013; Kleiber et al. 2014). However, their contributions, to household food and income, are often overlooked, underestimated, and/or undervalued (Chapman 1987; FAO 2017; Harper et al. 2017). This is largely because the majority of the seafood women catch is for food for their families, and therefore harder to track and quantify, especially where communities are widely dispersed and far from the market.

It is important to note that women's contribution to the fisheries sector is not just through gleaning and fishing. In many communities, women are also involved in post-harvest processing (such as gutting, cleaning, salting or drying) of seafood caught by themselves or other family members, such as their husbands and children (e.g. Mangubhai et al. 2016). And in Fiji for example, women also play an important role in the sale of seafood, especially invertebrates, along the roadside or at municipal markets on the islands of Viti Levu and Vanua Levu (Mangubhai et al. 2016, 2017). However, there is little current information on the role of women in small-scale fisheries in Fiji. Most of the publications on women in the fisheries sector from Fiji are from the 1980s and 1990s, and most fisheries profiles fail to gender disaggregate data (Lee et al. 2018). This lack of information has meant that technical and funding support tends to be focused on or biased towards male fishers who are considered a higher priority. Although women are heavily involved in both subsistence and commercial fisheries, they are either absent or very poorly represented in fisheries planning and management decision-making (Mangubhai et al. 2018).

Gender inclusion in fisheries management is increasingly becoming a priority for Fiji and other countries globally. It is also being made a requirement by development agencies. To date, Fiji has not conducted any national studies to quantify the role women play in food security, household nutrition, local livelihoods and the national economy, which can then guide decision-makers. In late 2017, a number of organisations came together to advance the recognition of the role women play in the coastal fisheries sector in Fiji and address this knowledge gap.

National study

The Wildlife Conservation Society (WCS) developed a socio-economic questionnaire in consultation with gender experts from the Pacific Community (SPC) and United Nations Women (UN Women). Both household and focal group surveys were developed and approved by WCS's Institutional Review Board. Questions were asked on a wide range of fishing-related topics to adequately document the diversity of fisheries women are involved in, and to establish a detailed baseline for future applied research and management action. The survey aimed to cover a wide range of habitats including rivers, mangroves, seagrass, coral reefs and deeper pelagic waters. Due to financial and time constraints, only women were interviewed.

Examples of questions the surveys aimed to answer include:

- a) Which habitats do the women fish and how often?
- b) Are they using their catch for food or selling it?
- c) What types of seafood (e.g. finfish, crabs, shellfish) are they catching?
- d) How long do they spend fishing at different sites?
- e) What barriers do they face in their fishing, in terms of both catching and selling the seafood?
- f) How much do the households depend on seafood for consumption, income and livelihoods?

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- g) What are the fishing strategies (e.g. what gear, boat use, time of day fished, what habitats targeted, duration and frequency of fishing trips) employed by the women?
- h) What methods of preservation, if any, do the women use for their seafood?
- i) Where do they sell the seafood and at what price?

To enable a wide coverage of Fiji, WCS collaborated with the Fiji Locally-Managed Marine Area (FLMMA) network, Conservation International, the Ministry of Fisheries, Women in Fisheries Network-Fiji, World Wide Fund for Nature, the University of the South Pacific, and the Vatuvara Foundation to implement the surveys. Surveys were targeted at rural indigenous Fijian (*iTaukei*) women fishers and were conducted in the *iTaukei* language by trained interviewers. Surveys were conducted over 7 months between October 2017 and April 2018.

To date, a total of 1238 women have been interviewed across 11 of the 14 provinces in Fiji, including 47 districts and 110 villages. Preliminary findings show that women fish in all habitats in their areas, ranging from freshwater streams to the intertidal area and the open ocean. Some of the women fish just for subsistence, but many of them sell at least a portion of their catch to support their household income. All women were willing to participate in the study and share their fishing practices and stories. The data are currently being analysed and a full report will be published later this year.

The information gathered from the surveys will assist stakeholders (government and non-government) to better recognise the valuable contribution women fishers make to food security and to the national economy. What is clear from this work is that fisherwomen are a critical backbone for their families, and to our society. However, it is not enough just to recognise the substantial role these women play. Ultimately, fisherwomen need to be provided the same opportunities as fishermen. This includes participation in fisheries planning and management, receiving training and support, and accessing projects and funding to improve their fisheries.

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References

- Chapman M.D. 1987. Women's fishing in Oceania. *Human Ecology* 15(3):267–288.
- FAO (Food and Agriculture Organization of the UN) 2017. Towards gender-equitable small-scale fisheries governance and development – a handbook. Italy: FAO. 174 p.
- Harper S., Grubb C., Stiles M. and Sumaila U.R. 2017. Contributions by women to fisheries economies: Insights from five maritime countries. *Coastal Management* 45(2):91–106.
- Harper S., Zeller D., Hauzer M., Pauly D. and Rashid U. 2013. Women and fisheries: Contribution to food security and local economies. *Marine Policy* 39:56–63.
- Kleiber D., Harris L.M., Vincent A.C.J. and Rochet M.-J. 2014. Improving fisheries estimates by including women's catch in the Central Philippines. *Canadian Journal of Fisheries and Aquatic Sciences* 71(5): 656–664.
- Kronen M. and Vunisea A. 2009. Fishing impact and food security – Gender differences in finfisheries across Pacific Island countries and cultural groups. *SPC Women in Fisheries Information Bulletin* 19:3–10.
- Lee S., Lewis A., Gillett R., Fox M., Tuqiri N., Sadovy Y., Batibasaga A., Lalavanua W. and Lovell E. 2018. Fiji fishery resource profiles. Information for management on 44 of the most important species groups. Fiji: Gillett Preston and Associates and the Wildlife Conservation Society. 253 p.
- Mangubhai S., Nand Y., Ravinesh R. and Fox M. 2016. Value chain analysis of the wild caught sea cucumber fishery in Fiji. Report No. 02/16. Fiji: Wildlife Conservation Society and Department of Fisheries. 58 p.
- Mangubhai S., Fox M. and Nand Y. 2017. Value chain analysis of the wild caught mud crab fishery in Fiji. Report No. 03/17. Fiji: Wildlife Conservation Society. 100 p.
- Mangubhai S., Tabunakawai-Vakalalabure M., Fox M., Leweniqila L., Meo I., Naleba M. and Thomas A. 2018. Fiji's Northern Division hosts its first "Women in Fisheries Forum". *SPC Women in Fisheries Information Bulletin* 28 (this issue).

Fiji's Northern Division hosts its first Women in Fisheries Forum

Sangeeta Mangubhai¹, Margaret Tabunakawai-Vakalalabure², Margaret Fox¹, Loata Leweniqila³, Iva Meo⁴, Mosese Naleba¹ and Alyssa Thomas¹

The first Women in Fisheries Forum for the Northern Division took place in Labasa, Fiji, on 15 May 2018. It was hosted by the Ministry of Fisheries, the Wildlife Conservation Society, the Fiji Locally-Managed Marine Area Network (FLMMA), and the Women in Fisheries Network–Fiji. The Forum was chaired by Margaret Tabunakawai-Vakalalabure, FLMMA Coordinator.

Background

Women play an important but poorly acknowledged role in coastal fisheries in Fiji, contributing to food security and local livelihoods (Vunisea 2016). In addition to being fishers, women are involved in freshwater and marine aquaculture, and play important roles as middle sellers, processors and market sellers, and in small and medium enterprises including post-harvest value adding. Women engage in a wider diversity of fisheries than men, and therefore can be disproportionately impacted if the habitats they access are damaged (Chaston Radway et al. 2016).

Despite their level of involvement in the coastal fisheries sector, women are largely undervalued, overlooked and receive little direct support from government or non-government organisations. They are often missing from important discussions about local priorities and natural resource management strategies due to childcare, household obligations, and traditional roles within their community. Women also have poor access to information and financial resources, and receive little training to build their capacity to manage their fisheries for food and/or livelihoods.

Fiji's National Gender Policy emphasises that gender must be mainstreamed into all sectors, including fisheries. This requires concerted efforts and collaboration with various agencies and partners, with due consideration to national, regional and international policies, agreements and commitments. Whilst gender mainstreaming has already begun at various levels of ministries, challenges remain in terms of the allocation of adequate resources (e.g. funding, human) towards women in the fisheries sector. For example, despite the large, diverse and growing role women play in the fisheries sector, the Ministry of Women, Children and Poverty Alleviation does not have any fisheries programmes to support their needs.

The 'Northern Division Women in Fisheries Forum', hosted by the Ministry of Fisheries in partnership with the Wildlife

Conservation Society (WCS), the Fiji Locally-Managed Marine Area Network (FLMMA) and the Women in Fisheries Network–Fiji, held in Labasa on 15 May 2018, brought together 18 women from 16 districts across the provinces of Bua, Cakaudrove and Macuata on the island of Vanua Levu.

The forum, the first for the Northern Division, provided an opportunity for women fishers to meet to discuss, network and identify ways to increase the recognition of the important role they play in Fiji's coastal fisheries sector. The forum explored pathways or approaches to assist and empower women in the fisheries sector, to ensure their long-term contribution to food security, livelihoods and the national economy.

Challenges and opportunities for women in the fisheries sector

During the forum a number of challenges or barriers that are faced by women in the coastal fisheries sector in Fiji were identified:

- Poor understanding around fair pricing of seafood products makes it difficult for women to negotiate prices with middlemen. As a result, many women are still selling at the same price as 10–15 years ago, with the result that earnings remain low.
- Lack of awareness on post-harvest and food handling techniques to ensure a high level of food hygiene. Many women were interested in receiving training to improve the way they processed and handled seafood, but there were few opportunities to improve their knowledge and skills.
- Lack of access to a wide diversity of markets, to ice and to proper market facilities for selling their seafood. For example, when the women go to the ice plant they often find there is no ice left, as the middlemen have arrived earlier and purchased all the ice to ship their fish to Suva. Some women, especially those in more remote areas, also lack easy access to shops selling fishing gear.
- Strong views were expressed on the lack of respect for the unique viewpoints and inputs from women during village, district or provincial meetings. Many women felt their views were taken lightly at village meetings (*Bose Vakoro*) and rarely given importance or

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priority at traditional meetings (*Bose Vanua*). The *Bose Vanua* is considered the highest forum in the *iTaukei* governance system. The women noted that some district resource management committees did not have women represented, such as in Kubulau and Vuya.

- There were concerns that women were not able to protect marine resources during spawning seasons. The women are aware of the spawning grounds and seasons and a greater involvement in management decisions would help them protect these areas. For some, there was a scarcity of fishing grounds for women to utilise, or fishing grounds were too far away from the village.
- Many women highlighted that poor land practices – such as inadequate waste management, run-off from nearby farms, the overuse of weedicides and improper disposal of rubbish – were impacting the habitats where women fish and glean. Some raised concerns about the impact of climate change on fisheries, and the habitats where they fish.
- Lastly, some women stated their husbands did not advocate for the involvement of women and many consider or treat women as subordinate. There is the pervasive cultural norm that women ‘belong to the kitchen’, and the chores and responsibilities of a household are placed on their shoulders, preventing them from branching out and getting involved in crucial meetings on decisions relating to natural resources. Women felt that there was a ‘yolk’ or ‘veil’ that should be removed from wider society to enable them to be equally engaged and involved in decisions around natural resource management. Some women expressed the view that if this was not resolved in the near future, and with increasingly numbers of educated women, women would start exercising the provisions of the constitution regarding gender equality.

The women participants highlighted a number of approaches that might help improve the inclusion of women in the planning and management of coastal fisheries, some of which have been successfully tested. Three examples were provided:

- A number of women were involved in established committees and used the opportunity to raise issues important to themselves and other women. There were positive examples of their concerns being heard at village meetings (*Bose Vakoro*), when elders gave the women a chance to speak.
- An example of high-level leadership by a woman. In one of the villages in Lekutu District, a woman is the paramount chief and as a result other women in the village were bolder in voicing their concerns.
- There were some examples of more well-educated women providing advice at village meetings, particularly in terms of establishing small businesses.

New ideas that women highlighted that might be worth testing in the future included:

- Formation of women fishers’ associations to give women a stronger collective voice on natural resource management and for negotiating with middlemen for fair pricing.
- Making low-tech fishing gear used by women (e.g. handlines and hand nets) available in smaller shops and/or canteens in the villages.
- Improving communication between women in a village, and teaching them new techniques on how to voice their opinions in ways that are more likely to be heard and respected.
- Investing more in ensuring equal involvement of marginalised women in established committees and in other village social activities. Existing or established groups in the village should have at least one or two women in the group who will hear the women’s perspective, with women being encouraged to take up more executive positions within the group.
- Advocate for more funding mechanisms that target the involvement of women, so that it becomes a core part of the design and implementation of fisheries projects.
- Raising awareness for men so they are more informed of national laws that promote and support equal opportunity for women, and therefore the involvement of women at every level within organisations.

References

Chaston Radway K., Manley M., Mangubhai S., Sokowaqanilotu E., Lalavanua W., Bogiva A., Caginitoba A., Delai T., Draniatu M., Dulunaqio S., Fox M., Koroivaqa I, Naisilisili W., Rabukawaqa A., Ravonoloa K. and Veibi T. 2016. Impact of Tropical Cyclone Winston on fisheries-dependent communities in Fiji (No. 03/16). Suva, Fiji. 74 p.

Vunisea A. 2016. The participation of women in fishing activities in Fiji. SPC Women in Fisheries Information Bulletin 27:19–28.

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Establishment of the first private tilapia hatchery in Fiji by a woman after Tropical Cyclone Winston – A case study

Veikila Vuki¹

Introduction

The Increasing Agriculture Commodity Trade project (IACT) Phase I started in June 2011. It was funded by the European Union (EU) and implemented by the Pacific Community (SPC). It focused on increasing and strengthening export trade within the agriculture, forestry and aquaculture sectors in 15 Pacific countries belonging to the African, Caribbean and Pacific Group of States. The EU provided a total of EUR 8 million for the project, which ended on 14 March 2017.

On 20 February 2016, the Category 5 tropical cyclone (TC) Winston struck Fiji. It was one of the strongest cyclones ever experienced by Fiji, and caused massive and destructive damage on many Fijian islands, killing 44 people. It also directly affected many beneficiaries of IACT Phase I, who were involved in agriculture, forestry or aquaculture activities.

Following a post-disaster needs assessment, the EU delegation to Fiji decided to reallocate the remaining funds of EUR 2.2 million from IACT Phase I to support emergency assistance to the agriculture and fisheries sectors. The IACT TC Winston Recovery Action Project was then established within IACT to use these funds.

The aquaculture sector was one of the beneficiaries of the IACT TC Winston Recovery Action Project. The project assisted tilapia, pearl, crab and prawn farmers. This case study highlights the support provided to and results obtained by one of the tilapia farmers, Katarina Baleisuva.

A key achievement of the project was the establishment of the first private tilapia hatchery in Fiji by Katarina. After over 40 years of research and tilapia farming by the Ministry of Fisheries, the establishment of a private hatchery by a female tilapia farmer is a highlight for the Fiji aquaculture sector, and for the IACT TC Winston Recovery Action Project.

Data collection

The case study is based on data collected during an interview (Figure 1), from questionnaires answered by the beneficiary, from project documents, from the project database and also from other sources such as the final narrative report for the IACT TC Winston Recovery Action Project.

Generally, the case study included the collection of information on:

- the beneficiary's situation prior to TC Winston (size of business, type of trade, and benefits to suppliers or harvesters);
- the impact of TC Winston on the business (impact on the supply chain and impact on trade);
- solutions envisaged (how equipment and services provided by the project could assist in solving problems);
- the overall impact of the project;
- the negative and unforeseen impacts of the project; and
- planned investments by the beneficiary.

Tropical Cyclone Winston – before and after

Prior to TC Winston, the Ministry of Fisheries hatcheries in Navua and Naduruloulou had the capacity to supply tilapia fry and fingerlings to tilapia farmers to meet their demand. This capacity was lost with the destruction of both hatcheries during TC Winston.

Katarina Baleisuva's farm is on a 5-acre lot in Nakasi, just outside of Suva. Prior to TC Winston, Katarina was producing and selling tilapia at local markets. She was also



Figure 1. The author (left) interviewing tilapia farmer Katarina Baleisuva inside her hatchery (under construction).

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producing vegetables (beans, cabbage and local spinach) and tropical fruits (watermelon, passionfruit and pineapples) and selling at local markets. The tilapia ponds and the vegetable crops were severely damaged during the cyclone. As there was no fry or fingerlings available to restock ponds after TC Winston, the farm had to stop producing tilapia.

Solutions

The solutions identified for recovery after TC Winston included addressing the need for hatcheries in the aquaculture sector. Five tilapia farmers whose farms had been damaged by TC Winston were supported by the project to attend a two-week training course at the Asian Institute of Technology Aquaculture Center in Thailand. The course provided training to enable the farmers to establish private tilapia hatcheries in Fiji to complement the work of the Ministry of Fisheries hatchery rehabilitation.

The main objective of the training was to help tilapia farmers acquire the skills to breed and manage tilapia fry and fingerlings in a commercial hatchery. They were also taught how to manipulate the sex of the fry to produce all male fish (which are preferred for culture because they grow faster than females), and good management of a tilapia hatchery operation. Katarina Baleisuva was the only female participant on the course.

Further training was delivered by the Asian Institute of Technology Aquaculture Centre in Fiji, on the management of tilapia broodstock. The IACT TC Winston Recovery Action Project funded this training, for Ministry of Fisheries hatchery staff and the future private hatchery operators. The participants also learned how to maintain the genetic

quality of the broodstock. Tilapia eggs were sourced from the Ministry of Fisheries to ensure the highest possible genetic quality.

Equipment provided and additional investment

The project supplied aquaculture equipment and building materials to Katarina's farm so she could establish a private tilapia hatchery. Katarina provided the labour to build the hatchery (Figure 2). The equipment was imported from Thailand and the building materials were sourced locally in Fiji. The project also provided fish feed, and 'hapa' nets (Figure 3) to contain the juvenile tilapia fish and reduce feed waste.

Katarina borrowed money to dig additional ponds and build raceways for the raising of tilapia fry and fingerlings. With the additional ponds, Katarina's production of tilapia doubled. Katarina also borrowed money to improve the drainage and quality of the ponds to prevent future flooding damage.

Additional water tanks were bought by the project and were installed by Katarina to improve water management on the farm, including during drought periods. The new raceways will be built when the hatchery is completed, and the additional tilapia fry and fingerlings will be used by Katarina's farm, and will also be sold to other farmers to provide additional income for the farm.

Impacts of the project

Without assistance and funding from the project, the hatchery would not have been established. The training provided improved farmer knowledge on tilapia farming management techniques, especially tilapia breeding techniques. The farm has been greatly improved, and this should have an impact on the business and the tilapia aquaculture sector in general. Tilapia production has doubled at Katarina's farm as a result of the new ponds and the improved quality of the ponds.

Recovery from TC Winston would have been extremely difficult without assistance from the project. Without support, Katarina would have had to replant vegetables and fruit trees and then wait for them to mature before she could sell them in order to have money to repair the tilapia ponds. This would have taken many months. The assistance provided by the project enabled quick recovery after the cyclone. Investments in training and the establishment of the hatchery have also benefitted Katarina and other tilapia farmers in the supply chain. The private hatchery establishment will lessen the reliance of tilapia farmers on government-run hatcheries.



Figure 2. Tilapia hatchery under construction at Katarina's farm.



Figure 3. Hapa net installed in a tilapia pond in Katarina's farm.

Recommendations

One recommendation would be to continue establishing private hatcheries in different parts of Fiji as an extra source of income for farmers. This would also mean that the increasing number of tilapia farmers would not have to totally depend on government hatcheries for supplies after a major disaster.

Improving the quality of ponds to prevent damage from flooding is critical for tilapia farmers. This generally involves making sure that proper drainage is planned and developed for the farm. Flooding is common in Fiji because of heavy rainfall during the wet season and cyclones, and usually causes an extensive loss of tilapia.

Another key factor in tilapia farming is ensuring that the farm is able to survive with additional income from alternative sources. Some tilapia farmers in Fiji undertake mixed farming and produce tilapia, vegetables and/or fruits at the same time.

Tilapia males are preferred for culture because they grow faster than females, according to Katarina Baleisuva. Females use more energy in reproduction and do not eat when incubating eggs so their growth is slower than that of males.

Therefore, by increasing the proportion of male fingerlings in their production, tilapia farms will become more productive, according to Katarina.

A good source of water is important for tilapia farms, and for Katarina's farm the additional water tanks will provide extra water during drought. A further recommendation is to help tilapia farmers dig boreholes to supply additional water, and to mitigate against flooding and natural disasters. The water can also be used for irrigation systems for crops within a mixed farming system, to increase production and provide other sources of income for the farm.

The strategic partnership between the SPC Aquaculture Section, the SPC IACT TC Winston Recovery Action Project, the Asian Institute of Technology Aquaculture Centre, the Fiji Ministry of Fisheries and the tilapia farmers was very important to the recovery effort.

It would be beneficial for tilapia farmers to set up a Tilapia Farming Association to strengthen the sector and to facilitate training, exchange of information, technology transfer and delivery of assistance during major disasters.



Samoan women at the helm of inland fishing

Joanne Kunatuba¹

‘Since we built the fish pond, I’ve been trained in tilapia farm management, maintenance and feed formulation and when the Fisheries Division come here, they come to see me. I’ve also taught my husband and son-in-law as they help me with the tilapia project. Now, other women are also interested in this venture’, says Epifalia Muliaga, a farmer and mother of two girls. Epifalia’s farm is one of several tilapia farms undergoing testing for intensive culture. Her tilapia tank was established under a project run by the Pacific Community (SPC), alongside five other families. Epifalia and her son-in-law Talalelei were among 85 key informants interviewed for a gender assessment of the aquaculture sector in Samoa in December 2017.

According to Epifalia, the farm and her knowledge of tilapia farming have given her a sense of empowerment. Family members look up to her and her family, as they share the fish harvest with extended family members. Food (tilapia) is always readily available when extra food is required urgently, and this has aroused the interest of other members of the community, as they see this as a great alternative food source. Epifalia is part of the *auluma*², which comprises at least 60 untitled women. She is also a Sunday school teacher and her husband is an assistant pastor in the Assembly of God denomination. The *auluma* meet on the first Monday of every month and Epifalia uses the opportunity to share her knowledge of tilapia farming and the importance of an alternative source of protein in their community. ‘I feel good when there is a need in the village and I am able to support immediately. Like when we need to organise food for the pastor, I am able to say, we can contribute the fish’, says Epifalia.

Epifalia’s husband works in Apia, so the management of the tilapia farm, livestock (chicken and pigs) and rootcrops plantation is left to her. According to son-in-law Talalelei, Epifalia will discuss chores for the day with him, which usually involves feeding the livestock and working in the plantation, as well as what food is required for the household and other community obligations. ‘I am married to the youngest daughter and so, whatever my mother-in-law and

father-in-law tell me, I will do it. There is plenty food but we have to work hard. The tilapia is very good because the fish habitat is overfished but also the waters of this village are very rough’, says Talalelei.

Like other women involved in tilapia farming, Epifalia has experienced increased decision-making opportunities leading to a greater sense of empowerment, greater involvement in village activities and increased visibility in the community. ‘At the moment, a Chinese businessman wants to buy our tilapia for five tala each but I decided not to sell it yet and I discussed this with my husband and he agreed’, she said.

Epifalia says that almost all major farming decisions are made in consultation with her husband, even though she manages the day-to-day running of the farm. This is a reflection of the strong gendered roles of men and women, with men leading decision-making, but nevertheless Epifalia believes she has more to contribute to decision-making because she is the one managing the farm activities. ‘For me, I really enjoy this work because there is a lot I can talk to my husband about and we both can see the rewards it will bring us in the future. It is not only about making money, but we know there is food always available and we always have something to contribute for our community obligations’, said Epifalia.

When asked about how easy it was to start a tilapia venture in her community, Epifalia said it was relatively easy for her and her husband because she is an *auluma* of the village and her husband is also from the village. Although women married into a village would still have access to land through their husbands, the gender assessment of the aquaculture sector in Samoa revealed that the *auluma* of a village appeared to have more autonomy when it came to community ventures. ‘Within the *auluma*, there are women who are untitled and of course titled women who can sit in the village council meetings, so our issues can be presented by them in these meetings. However, we are also members of church committees so there are many ways to raise any issues we have’, Epifalia said.

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² Daughters born of the village.

Consumer preferences for Nile tilapia (*Oreochromis niloticus*) value-added products in Samoa

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Abstract

Nile tilapia (*Oreochromis niloticus*) is an introduced low-value freshwater fish available in the Pacific that has limited scope for consumption in its fresh form. With increased fishing activity and climate change posing threats to global food security, utilisation of this cultured fish may aid in alleviating food security issues in the Pacific. This study explores the potential for better utilisation of Nile tilapia by developing four processed forms – salted-cold smoked, cured-cold smoked, surimi and fish paste – and evaluating these forms through consumer preference testing. A list of sensory terminology and a scoring system for fresh and cooked tilapia were developed prior to the testing. The consumer preference testing was conducted in the fish market, Apia, Samoa with a total of 71 consumers. Fish paste was the most preferred product, followed by salted-cold smoked, then surimi while cured-cold smoked tilapia was the least preferred. However, no significant difference ($P \geq 0.05$) was observed between preference of these products, indicating the acceptability of all four products by Samoan consumers. This means that there is the potential for commercialising these products.

Keywords: consumer preference, food security, Nile tilapia, value-added products

Introduction

Fish is a significant contributor to food security, especially in coastal communities, including the Pacific Island nations (Brander 2007). Globally, fish provides more than 1.5 billion people with almost 20% of the average per capita intake of animal protein, and 3.0 billion people with at least 15% of such protein (FAO 2010). Climate change and variability are a threat to fisheries production. However, it is recognised that fish supplies in traditional marine and inland capture fisheries are stagnating (FAO 1997).

Aquaculture is an important and growing production sector for high-protein food, contributing to global tilapia production of 5,576,800 tonnes in 2015 (Fitzsimmons 2016). This confirms that tilapia contributed significantly to global food security. Tilapia is one of the most popular cultured fish in the world, produced in approximately 75 countries, and its production is continuing to increase (Josupeit 2005). It is one of the freshwater species available worldwide that meets the entire requirements for successful low-cost farming, it is hardy, easy to breed and grow, versatile in feeding, and has low-tech farming requirements (Jarding et al. 2000).

Tilapia has reached the top five preferred seafood items in the USA, overtaking salmon in 2009 (SPC 2011). Studies show that in 2000, global consumption of tilapia was worth USD 1.75 billion and in 2005 it reached USD 2.5 billion (FAO 1997). Tilapia flesh is white, and it has been a good substitute for the declining supply of other white fish such as cod. Availability of value-added tilapia products has been increasing

since 2005 (Fitzsimmons 2016). Most edible products from farmed tilapia have been developed and scientifically tested for their shelf stability. These include surimi (Ramirez et al. 1999; Zhou et al. 2005, 2006), burger (Ninan et al. 2010), smoked products (Yanar et al. 2006), sausages (Oliveira Filho et al. 2010) and frozen fillets (Korel et al. 2001; Ou et al. 2002; Da Silva Afonso and Sant'Ana 2008; Odoli 2009; Liu et al. 2010). Different pre-treatments and packaging types, such as modified atmosphere packaging (Reddy et al. 1994, 1995, 1996; Peng et al. 2009), vacuum packing (Martinsdóttir et al. 2009), canning (Akande et al. 1993), liquid smoke (Siskos et al. 2005; Swastawati et al. 2011) and pre-treatments like irradiation (Abu-Tarboush et al. 1996; Al Kahtani et al. 1996) and ozone (Diao et al. 2007), have been developed to ensure food safety. Whole or gutted tilapia are still available but are sold primarily in ethnic markets. Other interesting by-products, including leather goods for clothing and accessories, gelatin from skins for time-released medicines and flower ornaments made from dried and coloured fish scales, have also emerged (FAO 2011).

There are many strains of tilapia. *Oreochromis mossambicus* was introduced to Samoa in 1955 to provide an alternative supply of fish in order to relieve pressure on over-exploited marine fishery resources as well as to provide a means of generating income (Mulipola et al. 1997). However, in 1991, the fisheries division introduced a better performing strain, *Oreochromis niloticus*, for aquaculture through the South Pacific Aquaculture Development Project (SPADP) (South et al. 2011). This is a genetically improved farmed tilapia

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(GIFT) which has been shown to have higher growth performance and salinity tolerance than other Nile tilapia strains.

Currently in Samoa, there are approximately 27 tilapia farmers of whom five are semi-commercial and 22 are subsistence farmers (South et al. 2011). Tilapia is usually sold live and whole directly to consumers; occasionally they are sold gutted and scaled. At harvest and prior to selling, farmers usually purge the fish in brackish water for 30 minutes to one hour. Chinese restaurants in Apia have been reported to be buying fresh tilapia at a cost of WST⁴3.00–5.00 per fish (South et al. 2011). Commercial tilapia farming is still low key in Samoa despite efforts by the government to develop a sustainable industry. Major constraints are financial and technical support for infrastructure development and accessing markets for products. Teri and Pickering (2007) propose developing additional sale outlets for live tilapia and product development to diversify the ways in which tilapia can be sold, which could help generate income, improve national food security and enhance livelihoods.

In Samoa in 1995, two sensory evaluation events were held that assessed the acceptance of tilapia as a food fish, with the tilapia cooked using different traditional methods (Bell et al. 1997). Results showed that tilapia was acceptable as a food fish. However, there have been few studies on the preservation and value adding of tilapia in Pacific Island countries, thus the need for further research in the area. The objective of this study was to facilitate consumer recognition of four tilapia value-added products through consumer preference testing. The testing also aimed to promote investor confidence for potential commercial processing of tilapia in Samoa.

Methods

Post-harvest preparation

A total of 400 fresh medium-sized tilapia with an average length of 23 ± 1.0 cm and weight 200 ± 0.1 g and in rigor condition were obtained from Naduruloulou Research Station in Nausori, Fiji. The fish were transported on ice to the post-harvest laboratory at the University of the South Pacific, Fiji, where they were scaled, gilled and gutted within 4.5 hours of their arrival. About 70% of the fish were treated as whole fish and were then packed in polythene bags in groups of 10; the remaining fish were manually filleted without skin on and were packed as 2 kg bags. All processed fish packed in sealed bags were stored at -24°C until further processing.

Value adding

Required quantities of the frozen tilapia were thawed at 0°C for 24 hours in the chiller prior to further processing into four value-added products. The recipe for each product was selected based on the descriptive assessment, flavour and texture profiling by the trained panelists for each prototype. A list of sensory terminology and a scoring system for fresh untreated and non-brined-smoked and brined-smoked Nile tilapia that were salted at different concentrations were developed by the trained panelists. The final four value-added products that were prepared were: smoked fish brined in 30

ppt salt solution; smoked-fish cured in a mixture of 30 ppt salt and 18 ppt sugar solution; surimi; and fish paste. These products were packed and stored at -24°C awaiting further packaging for transporting to Samoa.

Packing and storage

A day prior to departure for Samoa, all cold-smoked fish were individually wrapped in aluminium foil, steamed for 15 minutes, cooled for 30 minutes at ambient temperature and further cooled at 4°C for 1 hour. They were then packed in groups of three in polythene bags, sealed with a sealer machine and stored at -24°C . On the departure day, all four products were removed from the freezer and packed in ice boxes with gel ice. All the products were placed in the freezer upon arrival in Samoa until the sensory evaluation day.

Sensory evaluation

The consumer preference test was conducted in a central location at the fish market in Apia, Upolu, Samoa. A month prior to the sensory evaluation event, a public invitation for consumer panelists was made through TV, radio and newspaper advertisements. A special invitation was extended to restaurant owners especially seafood restaurant owners, hotel industry stakeholders and tilapia farmers. A total of 71 consumer panelists attended the sensory evaluation event. At the event, consumer panelists were interviewed on their background and fish consumption characteristics, prior to the sensory evaluation of the four products. About eight fisheries officers assisted in the face-to-face interviews, interpretation and filling of ballot papers. Consumers were asked to evaluate the degree of liking for each of the four value-added products based on the sensory attributes: appearance, aroma, flavour, texture/mouth feel and overall acceptance using a 9-point Hedonic scale (1 = like extremely, 5 = neither like nor dislike and 9 = dislike extremely). Consumers were also asked to rank the four products from 1 to 4, where 1 was the highest and 4 the lowest.

All Nile tilapia value-added products were thawed at 0°C overnight and steamed for 5–7 minutes and cooled prior to sensory evaluation. Each panelist was served with the four samples of the products on a plate. Panelists were instructed to rinse their mouth for 4–5 seconds with water provided before tasting each sample. Samples were evaluated in the following sequence: surimi, paste, salted-smoked and then cured-smoked tilapia. Plain breakfast crackers were provided as a carrier for the evaluation of paste samples. Each consumer panelist took approximately 20–30 minutes to evaluate all the samples. The questionnaire was tested and validated by Samoan fisheries officers prior to the sensory evaluation event.

Data analysis

Data were analysed at $\alpha = 0.05$ unless stated otherwise, using version 16.0 of Predictive Analytics Software (PASW), formerly known as SPSS, compatible. The distribution of all data collected was tested for normality using Shapiro–Wilk test. Due to the nature of the data collected, non-parametric

⁴ WST (Samoan Tala) 1.00 = AUD 0.52 in June 2018.

tests were used as described by Lawless and Heymann (1998). Kruskal–Wallis test was used to analyse consumption characteristics of consumers. G-test was used as a post-hoc test wherever required. Friedman test was used for significant difference among the attributes of each product. Post-hoc analysis was carried out with Wilcoxon Signed-Rank tests by applying Bonferroni's correction. Wilcoxon Signed-Rank test was also used to test for significant difference in attributes for the two smoked products. Chi-square test was used to find the relationship between gender and preference, education and preference and age group and preference of tilapia products. Friedman test was also used to test for significant difference between the overall preferences for tilapia value-added products.

Results and discussion

Socio-demographic characteristics of participants

A total of 71 people participated in the sensory evaluation event, however only 65 questionnaires were accepted for data analysis. The rejected questionnaires were rejected due to incompleteness. As shown in Table 1, of the 65 participants 97% were from the island of Upolu, while the remaining 3%

were from Savaii and Manono. In terms of gender, 23% of participants were female. In terms of ethnicity, participants were 74% Samoan, 8% European, 9% mixed ethnicity, 4% Japanese and 5% other. The average age of the participants was 44 years; the most represented group was 21–40 years (43%) followed by 51–60 years (15%). The average length of education was 16 years, and 51% of panellists had 11–20 years of formal education.

It is not surprising that the majority of the people who participated in the sensory evaluation were from Upolu, where the event took place. People from outside Upolu who participated were people who run businesses on Upolu and reside on the island. It is interesting to note that the participation level of females in the current study is in line with the participation in a similar sensory evaluation event that took place in Samoa in 1995. One of the reasons fewer females participate in such events may be due to gender-bias cultural expectations. Usually in the Pacific Islands region, including in Samoa, females are expected to stay at home and prepare food and take care of other domestic duties including child care, while males have the freedom to leave the home and attend public events, especially on week days.

Table 1. Socio-demographic characteristics of participants in the sensory evaluation (n = 65).

Characteristic	Category	Number of participants	Percentage (%)
Gender	Male	49	75
	Female	16	25
Age group	15–17	0	0
	18–24	8	12
	25–34	12	18
	35–44	11	17
	45–54	11	17
	55–64	11	17
	65 and above	7	11
	No response	5	8
Ethnic background	Samoan	48	74
	European	5	8
	Mixed	6	9
	Asian	3	4
	Other	3	5
Origin	Upolu	60	92
	Savaii	1	2
	Manono	1	2
	Apolima	0	0
Education	Outside Samoa	3	5
	1–8 years	4	6
	9–13 years	18	28
	14+	25	38
	No response	18	28



Fish consumption characteristics of participants

Table 2 shows that 42% of participants consume fish more than twice per week at home (68%), in restaurants or both (28%), with home consumption significantly higher ($P < 0.05$). Results also showed that people prefer marine fish to freshwater fish. Only 9% of respondents had previously consumed tilapia, despite the fact that tilapia has been produced in Samoa for over a decade. As suggested by Fitzsimmons (2016), consumption of tilapia could be increased by more consumer recognition, improved quality and variety

of products, better marketing and overall increased demand for fish products.

There are many different species of fish caught and readily available for sale in Samoa, with tuna (55%) the most commonly consumed fish, followed by parrotfish, and tilapia the least consumed. These data suggest that the people of Samoa appear to be marine fish eaters, with higher dependency on tuna and other reef fish.

Annual fishery product consumption in Samoa was estimated to be 46.3–71.0 kg/year/person (Gillet 2009). Bell et

Table 2. Fish consumption characteristics of participants in the sensory evaluation (n = 65).

Characteristic	Category	Number of consumers	Percentage (%)
Fish consumption	Once a month	3	5
	2–3 times a month	11	17
	Once a week	16	25
	≥ twice a week	27	42
	Seasonally	3	5
	Other	5	8
Where fish is consumed	Home	44	68
	Restaurant	1	2
	Both home and restaurant	18	28
	At a party or gathering	0	0
	Other	2	3
Fish types consumed*	Parrotfish	26	40
	Goatfish	16	25
	Emperor fish	22	34
	Mullet	22	34
	Snapper	22	34
	Tuna	36	55
	Grouper	21	32
	Spinefoot	13	20
	Tilapia	6	9
	Other	30	46
Attributes influencing choice of fish for purchase*	Appearance	23	35
	Flavour	17	26
	Taste	20	31
	Cost	15	23
	Freshness	31	48
	Texture	13	20
	Size	9	14
	Species type	8	12
'Farm-raised Nile tilapia tastes equal to marine fish'	Strongly agree	12	18
	Agree	18	28
	Neither agree nor disagree	11	17
	Disagree	9	14
	Strongly disagree	11	17
	Other	4	6

* Consumers were allowed to choose more than one category, so category percentages do not add up to 100.

al. (2008) worked out the annual per capita fish consumption in Samoa by household income and expenditure survey (HIES) results and showed an average national consumption of 87.4 kg, with 45.6 kg for people in urban centres and 98.3 kg for rural dwellers.

Fish consumption in Samoa and other Pacific Islands is remarkably higher than the global average per capita fish consumption of 16.5 kg (Bell et al. 2008; Gillett 2009). The result in the current study is not surprising because over 40% of Samoa's non-tourism export earnings come from the export of fish, especially tuna to the cannery in Pago Pago, American Samoa.

Perception of fish's sensory attributes

It is recognised that various attributes play a part in determining consumers' choice in the purchase of goods including food. Food attributes such as appearance, flavour, taste, texture, freshness, size or weight, species and price all contribute to the decision made by consumers, and understanding the decision making is therefore complicated.

The results in Table 2 show that freshness (48%) appears to be the most significant factor ($P < 0.05$) that influences the choice and purchase of fish in Samoa, followed by appearance and taste. This is in line with the findings of Drake et al. (2006), who demonstrated freshness as the most important factor influencing the choice of fish. Freshness in fish is usually associated with fresh mild seaweed and metallic odour; shiny, bright appearance with tightly adhered scales; firm, elastic and moist flesh with almost translucent colour; bright, clear and full eyes, with black pupils and transparent corneas; gills bright red or pink in colour with little visible mucus or slime; and no bruising, blood spots or browning.

Price of the fish is also a factor but not as important as freshness. Species and size of fish were indicated as contributing factors but were the least important attributes when choosing and buying fish in the market. However, to some customers size of fish may be important to ensure there is enough for the whole family. Some prefer to purchase serving portion size fish, i.e. a whole fish around 300–500 g, while others prefer bigger fish because of too many bones in small fish.

Perception of tilapia's sensory attributes

When consumer panelists were asked to respond to the statement 'Farm-raised Nile tilapia tastes equal to marine fish', 46% of respondents either agreed (28%) or strongly agreed (18%) to this statement, but these figures were not significantly different ($P > 0.05$), despite the fact that few participants (9%) had previous experience in tasting tilapia (Table 2). This is an interesting result indicating that Samoans do value and accept tilapia as being as good as marine fish, and may mean that tilapia has the potential to be marketed at a higher price in Samoa. This result is in agreement with findings of Mulipola et al. (1997) who reported that 62% of respondents preferred tilapia to reef fish. Similar sentiments for aquacultured Southern Flounder were expressed by consumers who believed that farmed fish normally exhibit different sensory properties to wild fish (Haard 1992; Drake et al. 2006). This was also stated by Mohr (1986) who wrote that meat of farmed fish tends to be softer in texture and have a milder, less robust flavour than that of wild fish. However, it appears that most consumers were unable to discern these differences between wild fish and cultured fish hence the reasons for variation in response and sensory behaviour of consumers. Perhaps further investigation of relationships between perceptions of farmed fish and its consumption is warranted due to limited research in the area.

Figure 1 shows that taste was the most important attribute for tasty tilapia (18%), followed by texture (16%) and appearance (15%). Size was the least important attribute, however some respondents also ranked fillet as an important attribute. It is interesting to note the difference in responses between fish in general (Table 2) and tilapia, with the most important attribute of fish in general being freshness, while tilapia's most important attribute is taste. These differences may be due to the common perception that tilapia is tasteless or bland when cooked on its own. This was one of the reasons for brining the tilapia, i.e. for flavour enhancement. Studies have also shown that different purging times mixed with different salinity levels could improve the taste of tilapia, and improve its popularity in the market over marine fish (Gell et al. 2010).

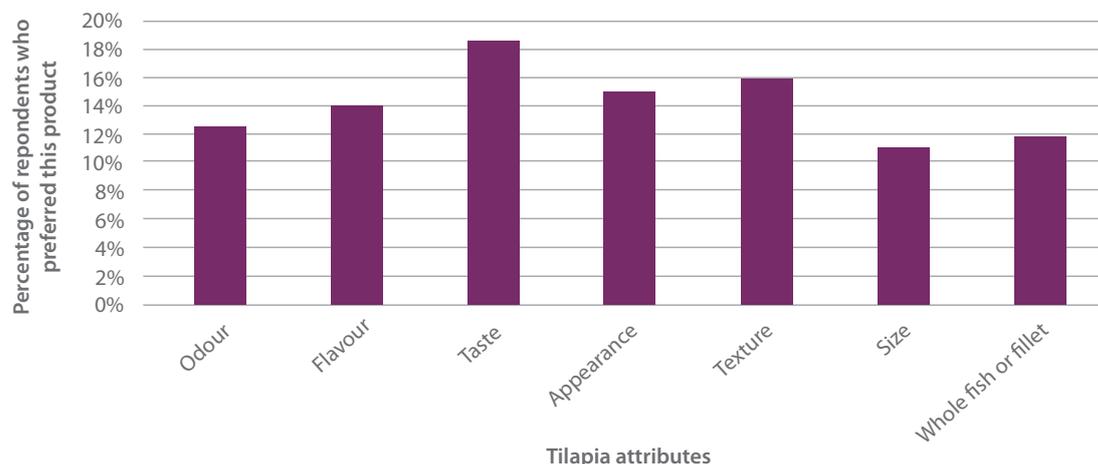


Figure 1. Perception of important attributes that contribute to tasty tilapia.



Acceptance of and preferences for tilapia products

Sensory evaluation of the four tilapia value-added products showed that all the products were liked by the consumer panelists in Samoa (Figure 2). Paste was preferred by 31% of the participants, followed by brine-smoked (28%), surimi (22%) and cure-smoked tilapia (19%). Statistical analysis by one-way ANOVA showed no significant difference ($P \geq 0.05$), implying that the products were all acceptable by the consumers, and indicating good market potential for such value-added products from farmed tilapia.

The mean scores and the inter-quartile range for the sensory attributes of the four value-added products are given in Table 3, which reveals very high acceptability scores.

There were no significant differences between attributes of brined cold-smoked fish ($P = 0.19$), surimi ($P = 0.745$) and paste ($P = 0.463$). The results indicate that the five attributes for these products were equally liked by the consumers. However, a statistical analysis revealed that significant differences exist within the attributes of cured cold-smoked fish ($P = 0.03$). There was a statistically significant higher degree of liking for appearance for cured cold-smoked tilapia compared to the other attributes ($P < 0.005$). Haard (1992) argued that overall appearance is particularly important in the market acceptability of fishery products. The higher boundary of attribute intensities for the given hedonic scale was set as 'like extremely (= 1) to like moderately (= 3)' to represent the acceptance of the attributes. Sensory attributes such as colour, aroma, flavour and texture play important roles in consumer decisions in the purchase and consumption of a food product (Sulaeman et al. 2002).

In the current study, appearance, odour, flavour, taste and texture were rated as good for all the four products. For brined cold-smoked tilapia, the majority of the consumers rated odour (86%), flavour (83%), taste (82%) and texture (86%) as good, while 75% rated appearance as good. Similar trends were also noticed for cured cold-smoked tilapia, surimi and paste, indicating that appearance of these products was the least important for consumer panelists when compared to odour, flavour, taste and texture. However, the differences in the sensory attributes among the four products are not

significant ($P > 0.05$) which indicates that these value-added tilapia products are acceptable by consumers in Samoa.

A limited number of females participated in the sensory evaluation event, thus representation on gender was generally poor for comparison purposes. The results in Figure 3 show that the preferred product for the male respondents (32%) was brined cold-smoked, followed by paste (28%), surimi (21%) and cured cold-smoked (19%). For the female respondents, paste was the preferred product (30%), followed by brined cold-smoked (26%), while cured cold-smoked (22%) and surimi (22%) shared similar ratings. Gender-based differences were not significant.

Table 4 shows preference in relation to respondents' education level. About 2% of the 1–8 years of education category preferred brined cold-smoked; for the 9–13 years category, 10% preferred brined cold-smoked; while for the 14+ years category, 12% preferred brine cold-smoked. These findings are significantly different ($P \leq 0.05$). When Bonferroni's test was conducted, results revealed that people with higher education (14+ years) tended to accept new tastes better than people with less education. Similarly, the results show that the younger generation seems to prefer smoked products and surimi while the older generation prefers the paste; here again these differences are significantly different ($P \leq 0.05$). Bonferroni's test indicated that people aged 46 years and above prefer tilapia value-added products than people of other ages. A study by Corredor et al. (2010) also showed that acceptance and purchase intent are affected by education/profession.

Table 5 shows value-added product taste evaluation in relation to ethnic background. The majority of the participants were Samoans (79%), the remaining being European (9%), mixed ethnicity (8%), Japanese (3%) and people of other origins (2%). Results indicate that most Samoans preferred brined-smoked tilapia (24%) while most Europeans preferred the paste (4%), mixed ethnicity participants preferred brined-smoked and paste (3% each), Japanese preferred brined-smoked, surimi and paste at 1% each, while people from other origins preferred the paste (2%). There is a significant preference for brined cold-smoked tilapia among the Samoan respondents ($P < 0.05$).

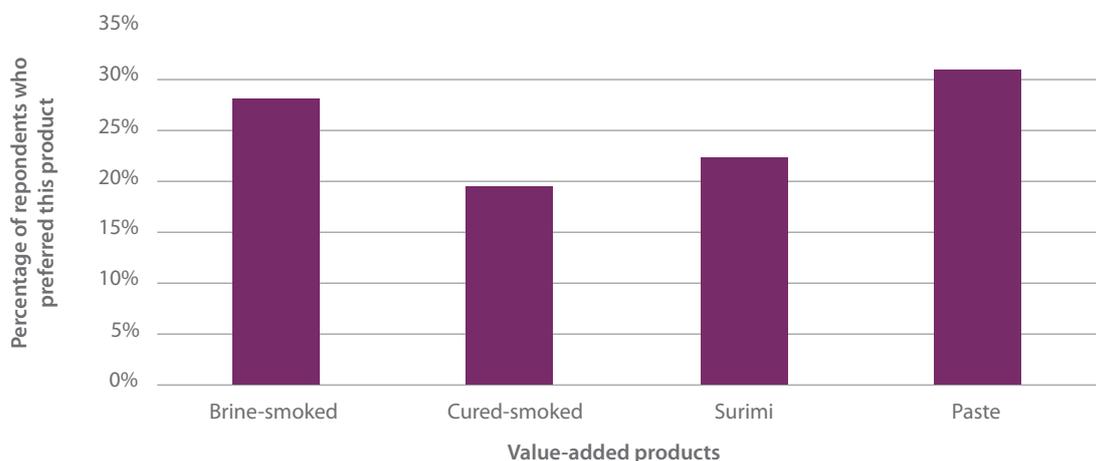


Figure 2. Consumer ranking of the four tilapia products.

Table 3. Mean scores and inter-quartile range of tilapia products using Friedman test.

Attribute	Mean rank	Inter-quartile range			P-value
		Highest score	Median score	Lowest score	
Brined, cold-smoked tilapia					
Appearance	3.3	1	3	6	0.19
Odour	2.7	1	2	8	
Flavour	3.0	1	2	6	
Taste	3.1	1	2	7	
Texture	3.0	1	2	7	
Cured, cold-smoked tilapia					
Appearance	3.4	1	3	6	0.03
Odour	2.9	1	2	5	
Flavour	2.9	1	2	8	
Taste	2.8	1	2	4	
Texture	2.9	1	2	6	
Surimi					
Appearance	3.1	1	2	8	0.745
Odour	2.9	1	2	7	
Flavour	3.0	1	2	7	
Taste	3.0	1	2	8	
Texture	3.0	1	2	9	
Paste					
Appearance	3.0	1	2	7	0.463
Odour	2.9	1	1	5	
Flavour	3.0	1	1	7	
Taste	3.2	1	2	4	
Texture	2.9	1	1	5	

1 = like extremely, 2 = like very much, 3 = like moderately, 4 = like slightly, 5 = neither like or dislike, 6 = dislike slightly, 7 = dislike moderately, 8 = dislike very much, 9 = dislike extremely.

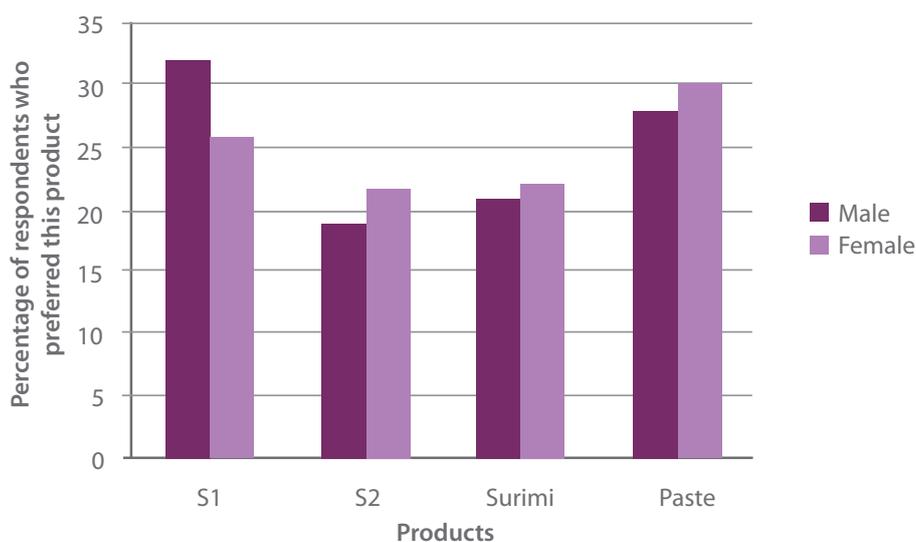


Figure 3. Preferences for the tilapia products by gender. S1 = brined, cold-smoked tilapia; S2 = cured, cold-smoked tilapia.



The overall taste evaluation of tilapia value-added products (Table 6) showed that paste was the preferred product, followed closely by brined cold-smoked fish, surimi and cured cold-smoked fish. Differences, however, were not significant ($P = 0.185$).

While value-added products from tilapia are shown to be acceptable by consumers in Samoa, 42% of the respondents still preferred to buy live tilapia and 20% prefer fresh, untreated tilapia as shown in Figure 4. It appears that there is little scope for the sale of frozen tilapia, however value-added products such as fried-salted, smoked, surimi, paste and other products received 5%, 10%, 8%, 9%, 4% popularity, respectively. Given the outcome of the current sensory evaluation of Nile tilapia, commercial food processing of this fish species may provide further marketing opportunities. This study suggests that commercial processing of tilapia could be a viable venture in Samoa, and

could contribute to food security through better utilisation of a currently underutilised fish species. This may also help divert fishing pressure from the already overexploited near-shore and offshore fisheries.

Conclusion

Farmed Nile tilapia value-added products have been well accepted in Samoa. Various opportunities for income generation exist through increased participation in farming and product development of similar underutilised fish species, which will also contribute to national food security.

Acknowledgements

The authors would like to express their gratitude to the Pacific Agriculture Research Development Initiative of the Australian Centre for International Agricultural Research for

Table 4. Preferences for the tilapia products by respondents' level of education.

Number of years of education	Percentage of respondents who preferred this product*					P-value
	None	Brined, cold-smoked	Cured, cold-smoked	Surimi	Paste	
1–8	0	2	1	3	1	0.916
9–13	0	10	6	6	9	
14+	1	12	6	7	9	
Total	1	24	7	16	19	

* Consumers were allowed to choose more than one category, so category percentages do not add up to 100.

Table 5. Preferences for the tilapia products by respondents' ethnicity.

Product	Samoa	European	Mixed ethnicity	Japanese	Others
Brine-smoked	24	2	3	1	1
Cured-smoked	17	1	2	0	0
Surimi	19	2	0	1	0
Paste	19	4	3	1	2

Table 6. Overall preference for tilapia value-added products (respondents could have several equally preferred products).

Product	Number of consumers	Percentage of consumers*	P- value
Paste	33	51	0.185
Brined cold-smoked	30	46	
Surimi	24	37	
Cured cold-smoked	21	32	

* Consumers were allowed to choose more than one category, so category percentages do not add up to 100.

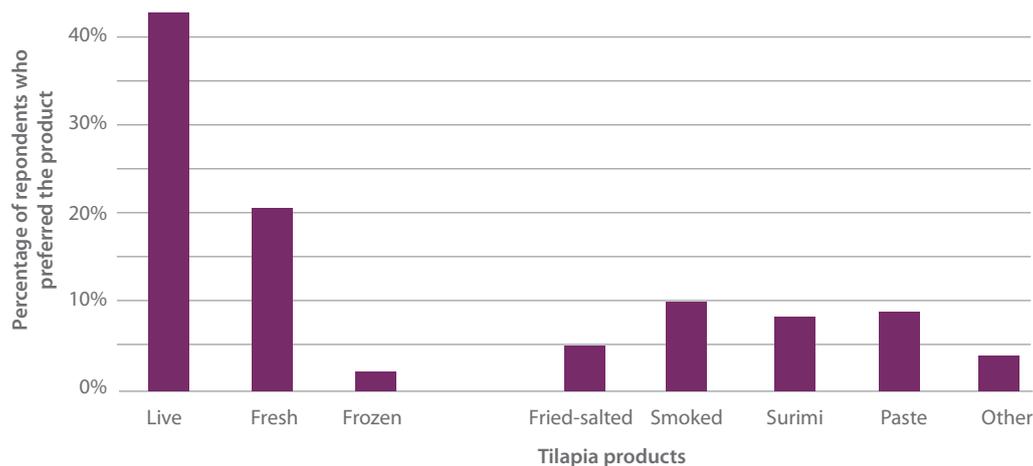


Figure 4. Preference for different types of tilapia products.

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References

- Abu-Tarboush H.M., Al-Kahtani H.A., Atia M., Abou-Arab A.A., Bajaber A.S. and El-Mojaddidi M.A. 1996. Irradiation and post irradiation storage at $2\pm 2^{\circ}\text{C}$ of tilapia (*Tilapia nilotica* x *T. aurea*) and Spanish mackerel (*Scomberomorus commerson*): Sensory and microbial assessment. *Journal of Food Protection* 59(10):1041–1048.
- Akande G., Eyo A. and Adelowo E. 1993. Quality changes in canned tilapia stored at ambient and accelerated temperatures. pp. 62–74 in 10th Annual Conference of the Fisheries Society of Nigeria (FISON), 16–20 November 1992, Abeokuta, Nigeria.
- Al Kahtani H.A., Abu Tarboush H.M., Bajaber A.S., Atia, M., Abou Arab A.A. and El Mojaddidi M.A. 1996. Chemical changes after irradiation and post irradiation storage in tilapia and Spanish mackerel. *Journal of Food Science* 61:729–733.
- Bell A., Mulipola A. and Matsunaga Y. 1997. Comparative taste study on line tilapia (*Oreochromis niloticus*) and marine fish in Samoa. Part I: With deep bottom fish and skipjack. [<http://www.fao.org/docrep/005/AC895E/AC895E02.htm>].
- Bell J.D., Kronen M., Vunisea A., Nash W.J., Keeble G., Demmke A., Pontifex S. and Andréfouët S. 2008. Planning the use of fish for food security in the Pacific. *Marine Policy* 33:64–75.
- Brander K.M. 2007. Global fish production and climate change. *Proceedings of the National Academy of Sciences*. [<https://doi.org/10.1073/pnas.0702059104>]
- Corredor J.A.H., Prinyawiwatkul W., No H.K., Chompreeda P., Garcia K., Saidu J.E.P. and Khachatryan A. 2010. Influence of education/profession of Mexican consumers on the acceptance and purchase intent of corn tortilla. *Journal of Sensory Studies* 25:108-126.
- Da Silva Afonso M. and Sant'ana L. 2008. Effects of pre-treatment with rosemary (*Rosmarinus officinalis* L.) in the prevention of lipid oxidation in salted tilapia fillets. *Journal of Food Quality* 31:586–595.
- Diao S., Wu Y., Wang J., Li L., Chen P., Yang X. and Hao S. 2007. Research on application of ozone ice in tilapia fillet preservation *Journal of Food Science* 8.
- Drake S.L., Drake M.A., Daniels H.V. and Yates M.D. 2006. Sensory properties of wild and aquacultured Southern Flounder (*Paralichthys lethostigma*). *Journal of Sensory Studies* 21:218–227.
- FAO. 1997. Fisheries and aquaculture in the South Pacific: Situation and outlook in 1996. FAO Fisheries Circular 907 FIP/C907. Rome, Italy: Food and Agriculture Organization of the United Nations.
- FAO. 2010. The state of world fisheries and aquaculture 2010. Rome, Italy: Food and Agricultural Organization of the United Nations.
- FAO. 2011. Fishery and aquaculture statistics: Aquaculture production. FAO yearbook. Rome, Italy: Food and Agriculture Organization of the United Nations.
- Fitzsimmons K.M. 2016. Global tilapia market update 2015. Las Vegas, NV: World Aquaculture Society.
- Gillett R. 2009. Fisheries in the economies of the Pacific Island countries and territories. Pacific Studies Series. Mandaluyong City, Philippines: Asian Development Bank.
- Haard N.F. 1992. Control of chemical composition and food quality attributes of cultured fish. *Food Research International* 25:289–307.
- Jarding S., Windmar L., Paterson R. and Fjallsbak J.P. 2000. Quality issues in commercial processing of tilapia (*Oreochromis niloticus*) in Zimbabwe. pp. 588–594 in R.D. Guerrero and M.R. Guerrero-del Castillo (eds), *Tilapia farming in the 21st Century: Proceedings of the International Forum on Tilapia Farming 25–27 February 2002, Los Baños, Laguna, Philippines*.
- Josupeit H. 2005. World market of tilapia. FAO Globefish Research Programme, 79.



- Korel F., Luzuriaga D. and Balaban M.Ö. 2001. Objective quality assessment of raw tilapia (*Oreochromis niloticus*) fillets using electronic nose and machine vision. *Journal of Food Science* 66:1018–1024.
- Liu S., Fan W., Zhong S., Ma C., Li P., Zhou K., Peng Z. and Zhu M. 2010. Quality evaluation of tray-packed tilapia fillets stored at 0 °C based on sensory, microbiological, biochemical and physical attributes. *African Journal of Biotechnology* 9:692–701.
- Martinsdóttir E., Odoli C.O., Lauzon H.L., Sveinsdóttir K., Magnússon H., Arason S., Jóhannsson R. and Matis S. 2009. Optimal storage conditions for fresh farmed tilapia. *Skýrsla Matis*, Report No. 38-09.
- Mohr V. 1986. Control of nutritional and sensory quality of cultured fish. In D.E. Kramer (ed.), *Seafood Quality Determination*. Amsterdam.
- Mulipola A., Bell L., Skelton P., Sasi T., Matsunaga Y. and Alefaio F. 1997. Comparative taste study on Nile tilapia (*Oreochromis niloticus*) and marine fish in Samoa and Nauru. Rome, Italy: Food and Agriculture Organization of the United Nations.
- Ninan G., Bindu J. and Joseph J. 2010. frozen storage studies of value added mince based products from tilapia (*Oreochromis mossambicus*, Peters 1852). *Journal of Food Processing and Preservation* 34:255–271.
- Odoli C.O. 2009. Optimal storage conditions for fresh farmed tilapia (*Oreochromis niloticus*) fillets. University of Iceland. Thesis submitted in partial fulfilment of the requirements for the Degree of Masters in Science, Department of Food Science and Nutrition University of Iceland. 82 p.
- Oliveira Filho P.R.C., Maria Netto F., Ramos K. K., Trindade M.A. and Viegas E.M.M. 2010. Elaboration of sausage using minced fish of Nile tilapia filleting waste. *Brazilian Archives of Biology and Technology* 53:1383–1391.
- Ou C. Y., Tsay S.F., Lai C.H. and Weng Y.M. 2002. Using gelatin-based antimicrobial edible coating to prolong shelf-life of tilapia fillets. *Journal of Food Quality* 25:213–222.
- Peng C., Cen J., Li L., Yang X., Ma H., Diao S. and Wu Y. 2009. Effects of gas ratio on shelf-life of tilapia fillets with modified atmosphere packaging [J]. *South China Fisheries Science* 5:1–7.
- Ramirez J., Diaz-Sobac R., Morales O. and Vazquez M. 1999. Evaluation of freeze-dried surimi from tilapia and fat sleeper as emulsifiers. *Ciencia y Tecnologia de Alimentos* 2:210–214.
- Reddy N., Schreiber C., Buzard K., Skinner G. and Armstrong D. 1994. Shelf life of fresh tilapia fillets packaged in high barrier film with modified atmospheres. *Journal of Food Science* 59:260–264.
- Reddy N., Villanueva M. and Kautter D. 1995. Shelf life of modified-atmosphere-packaged fresh tilapia fillets stored under refrigeration and temperature-abuse conditions. *Journal of Food Protection* 174(58):908–914.
- Reddy N., Paradis A., Roman M., Solomon H. and Rhodehamel E. 1996. Toxin development by *Clostridium botulinum* in modified atmosphere packaged fresh tilapia fillets during storage. *Journal of Food Science* 61:632–635.
- Siskos I., Zotos A. and Taylor K. 2005. The effect of drying, pressure and processing time on the quality of liquid smoked trout (*Salmo gairdnerii*) fillets. *Journal of the Science of Food and Agriculture* 85:2054–2060.
- South G.R., Morris C., Bala S. and Lober M. 2011. Value adding and supply chain development for fisheries and aquaculture products in Fiji, Samoa and Tonga. Suva: Pacific Agribusiness Research and Development Initiative.
- SPC. 2011. SPC Aquaculture Portal – Countries: Fiji Islands. Secretariat of the Pacific Community. [http://www.spc.int/aquaculture/index.php?option=com_countries&view=country&id=5&Itemid=17]
- Sulaeman A., Tan K.B., Taylor S. and Driskell J. 2002. Sensory acceptability of a deep-fried carrot chip product as evaluated by American and Southeast Asian consumer panels. *Journal of Food Quality* 25:453–467.
- Swastawati F., Surti T. and Apriliani D. 2011. Analysis of thiobarbituric acid and benzo pyrene value of smoked Nile tilapia (*Oreochromis niloticus*) using different liquid smokes. *Journal of Coastal Development* 13:160–165.
- Teri J. and Pickering T. 2008. Final report for Mini-project MS0507: Productivity and constraints in tilapia fish and freshwater prawn aquaculture in Fiji. Australian Centre for International Agricultural Research.
- Yamprayoon J. and Noomhorm A. 2000. Geosmin and off-flavor in Nile tilapia (*Oreochromis niloticus*). *Journal of Aquatic Food Product Technology*, 9(2):29–41. [DOI: 10.1300/J030v09n02_04]
- Yanar Y., Celik M. and Akamca E. 2006. Effects of brine concentration on shelf-life of hot-smoked tilapia (*Oreochromis niloticus*) stored at 4°C. *Food Chemistry* 97:244–247.
- Zhou A., Gong J., Xing C., Liu X. and Chen Y. 2005. Changes in biochemical and gelling properties of tilapia and bighead surimi during frozen storage [J]. *Journal of South China Agricultural University* 3.
- Zhou A., Benjakul S., Pan K., Gong J. and Liu X. 2006. Cryoprotective effects of trehalose and sodium lactate on tilapia (*Sarotherodon nilotica*) surimi during frozen storage. *Food Chemistry* 96:96–103.

Trailblazers: Conversations with Pacific women driving scientific advances in fisheries

Melinda Morris

Pacific islanders have a close relationship with the ocean that surrounds their island homes, and this can bring a unique perspective to the field of fisheries science. Promoting gender equality in fisheries science is critical to achieving development and conservation goals, but a significant gender gap still exists at all levels.

In celebration of the International Day of Women and Girls in Science on February 11, the Pacific Community Fisheries, Aquaculture and Marine Ecosystem Division took the opportunity to hear from four Pacific women working in the region in fisheries science.

Lucy Joy

Lucy is a Junior Professional with the Data Management Division of the Oceanic Fisheries Programme at SPC. Previously, she worked with the Vanuatu Fisheries Department as their National Tuna Data Coordinator.

What challenges have you faced as a woman working in fisheries science, and how did you overcome them?

As a woman in fisheries, there will be challenges faced whether internally or externally in this field as it is traditionally a male-dominated field. A challenging experience I have encountered was giving instructions and not having them followed or taken seriously only because of the mentality and belief that women are inferior to men in many areas of work and life.

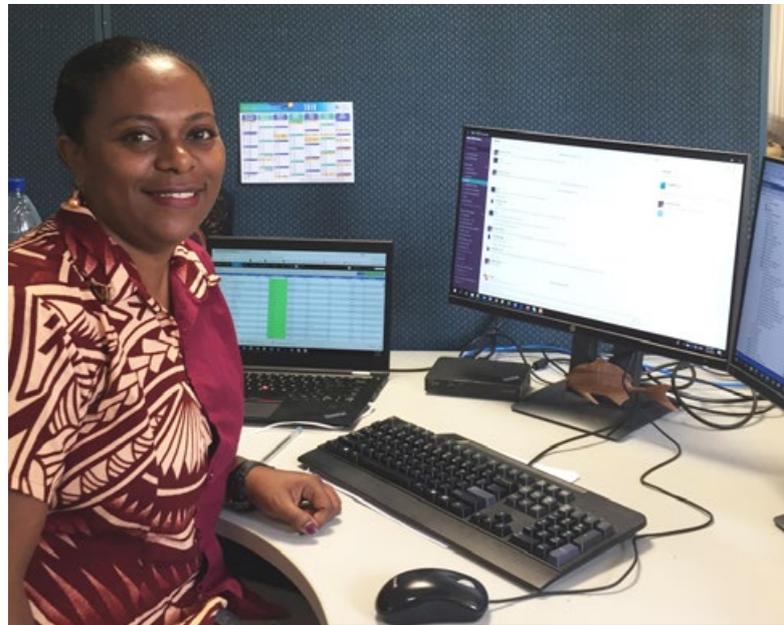
No matter how difficult the situation, I have learnt that being vocal and speaking out to correct issues and promote respect at work has helped to overcome any challenges I have faced.

What motivates you to work in this field?

Having grown up in a Pacific Island country surrounded by ocean, I have experienced the high dependency that our people have on our marine resources both as a source of food and income. Our ocean plays a large role in the welfare of our people.

Working in fisheries has helped me to appreciate the significant contribution that our marine resources play, and our role as resource owners and managers of our fisheries. We are responsible for the protection, management and conservation of our resources from issues such as over exploitation, illegal, unreported and unregulated (IUU) fishing and much more.

My motivation in this field lies greatly on my acknowledgement of the importance of this resource in the lives of our people. As resource owners, we need to work together to understand, protect and conserve this resource for the future. It is my hope that through my work in this area, I am able to contribute towards these goals.



Lucy Joy, Junior Professional (Oceanic Fisheries), SPC FAME Division.

What advice would you give to young women and girls considering a career in fisheries science?

Fisheries science, like many other careers is an exciting career path to pursue – especially for young women. It is a broad area, which comes with various professions such as being a marine biologist, an aquaculturist, a fish inspector, an observer and many more. It is a great profession for anyone, but especially so for Pacific islanders as it is one of our main resources.

My advice to young women wanting to consider a career in fisheries is to go for it, it is a great career that has a lot to offer you. Like all other professions, it will have its challenges also. But I believe that when you have your heart and mind set on something, nothing can stop you from achieving it – no matter your gender.



Esther Leini

Esther is a Mariculture Scientist with the National Fisheries Authority in Papua New Guinea. In 2017, she was one of the delegates at SPC's first South–South Exchange on Sandfish Aquaculture for Restocking.

What challenges have you faced as a woman working in fisheries science, and how did you overcome them?

It is a constant struggle to achieve research goals with limited resources and skill-set, and sometimes being a woman in a male-dominated field can make my work more difficult than it is for my male counterparts. I overcome these challenges with hard work and determination – I aim for success and do everything I can to achieve it!

What motivates you to work in this field?

I really enjoy researching suitable mariculture techniques for marine target species as a benchmark study in my country. I love that my work allows me to discover new information, and then use that information to help protect PNG's unique marine ecosystems and contribute to food security. Working in fisheries gives me the opportunity to make a real difference.

What advice would you give to young women and girls considering a career in fisheries science?

Take up the challenge and don't feel that you're not good enough. There is so much to discover and research in this field, and we women have the patience and persistence to be great fisheries scientists.



Esther Leini, Mariculture Scientist with the National Fisheries Authority in Papua New Guinea, adding pearl oyster settlement baskets to a tank.

Maria Fiasoso Sapatu

Maria is a Programme Associate with Conservation International's Pacific Islands & Ocean Program, based in Samoa. Previously, she worked with the Samoa Fisheries Division of the Ministry of Agriculture and Fisheries for around 10 years.



Maria Fiasoso Sapatu, Programme Associate with Conservation International's Pacific Islands & Ocean Program in Samoa.

What challenges have you faced as a woman working in fisheries science, and how did you overcome them?

Fisheries science is a male-dominated field that for me is quite a challenging career both physically and mentally. Mentally, it can sometimes be hard when colleagues don't take young women seriously when she voices her ideas and issues. Physically, field work that is easy for a man can be more challenging for a woman. In saying that, it doesn't mean that it can't be a career for a woman.

I learned to tackle such challenges by being a doer and making people believe in the work I can do to contribute. At the same time I was lucky to work with great colleagues (both men and women) that helped me shape my career, and gain skills to manage the physical side of my work effectively.

What motivates you to work in this field?

As a Pacific Islander, we depend heavily on the ocean for our livelihood. To be in a field that contributes to sustainable management and conservation of marine resources is very rewarding.

What advice would you give to young women and girls considering a career in fisheries science?

My advice to young women interested in fisheries science is to be bold and take on the challenge, and always have confidence in what you do and say. Also remember that sometimes being a woman in a male-dominated field can actually be an advantage!

Sarah Botaake Teetu

Sarah is the Assistant Secretary at the Ministry of Environment, Lands and Agricultural Development in Tarawa, Kiribati. She attended the University of the South Pacific, and has worked in community aquaculture and fisheries.

What challenges have you faced as a woman working in fisheries science, and how did you overcome them?

My working environment is dominated by men, which can at times be quite isolating. Sometimes I have not been able to participate in activities such as diving, cleaning tanks and raceways and cleaning hatchery equipment for micro-algae mass culture. When this happens and I need to delegate tasks to my male colleagues, I am still present to give the right advice and support. In my last role, I focussed on capacity building and training staff, so that when I left to join the Ministry as Assistant Secretary, most of my male colleagues were fully trained on hatchery protocols, guidelines and methods.

What motivates you to work in this field?

I know that most marine resources are overexploited, and require good and careful management. My studies at the University of the South Pacific and my roles in aquaculture and fisheries mean that I can play a role in restocking depleted marine resources. It feels great to be working in jobs that I enjoy, and that I can have a real impact in.

What advice would you give to young women and girls considering a career in fisheries science?

My advice to girls who wish to become fisheries scientists and managers is to consider studying marine management or marine science at the tertiary level. It is a fascinating job and important to protect and conserve the marine ecosystems that God has blessed us with, and restocking is one way to achieve this. It is fun to work in fisheries, and most importantly it is a crucial job that contributes so much to food security and achieving the sustainable development goals.



Sarah Botaake Teetu, Assistant Secretary, Ministry of Environment, Lands and Agricultural Development in Tarawa, Kiribati with sandfish.



Women in fisheries in Asia: 1978–2016¹

Meryl Williams², Choo Poh Sze, Kaniz Fatema, Jayne Gallagher, Malasri Khumsri, Jin Yeong Kim, Mayanggita Kirana, Nalini Nayak, Mohammad Nuruzzaman, B. Shanthi, Indah Susilowatu and Veikila Vuki

From fisherwomen's struggles against unfair taxation in the 1970s in India to organising global programmes to forge common understanding and strategy, women in fisheries in Asia have come a long way

This article on the milestones achieved by women in fisheries in Asia-Pacific is based on existing material and contributions from several colleagues. Many more milestones are still to be added, but the following gives a flavour of what has happened. The milestones summarised here are varied – sometimes uplifting, often depressing, some big, others small – but all indicative of women fishworkers' struggles. The milestones are just a start and are somewhat biased towards research and government agency actions, and contain less than we would like on grassroots action. Part of the lack of grassroots coverage is due to the lack of public visibility, especially on the internet, of women's grassroots groups and actions. Often, grassroots groups are hosted under national fisheries federations and do not have their own identities, websites and secretariats. Therefore, the present version of the Asia-Pacific milestones could be considered a work in progress, and we hope to keep it updated. Your contributions, corrections and comments are welcome.

1978

In Kerala, India, women fishworkers protested against exorbitant market taxes and won the struggle to not pay market tax if they took only one head load of fish to the market.

1982

In Kerala, India, women demanded the right to use public transport to take their fish to market. Without access to transport, women had to walk a long way, sometimes up to eight or ten kilometres, to and from the market. After two years of discussions with the government, a decision was made to provide special buses for women to take their fish to the market. Eventually, these buses were run by the MatsyaFed (Kerala State Co-operative Federation for Fisheries Development). Initially there were several buses but the numbers gradually reduced as the bus timetables did not respond to the times that women demanded, or too few women used the services. Coordination of the service was poor and the MatsyaFed lacked the will to find amicable solutions. Nevertheless, a couple of buses still travel to the fish landing centres for women to purchase fish and bring it back to the market to sell.

1989

In 1989, women in Kerala, India, were registered separately in the Fishermen's Welfare Corporation so that they too could get the benefits of the cooperatives and the famine-cum-relief scheme which recognised even single women fish vendors.

From its headquarters in Noumea, New Caledonia, the Pacific Community (SPC, then the South Pacific Commission) began women in fisheries work, with a focus on women in

post-harvest processing. In 1991, SPC appointed its first Women's Fisheries Programme Officer, but the post was only filled for about a year and then remained vacant until 1995.

In Maharashtra, India, following a petition from women to the Railway Minister by the National Fishworkers Federation, a wagon on the train from Palghar to Mumbai was provided for women fish vendors. This is still operating.

1990

At the suggestion of Dr M.C. Nandeesh, the Asian Fisheries Society (Indian Branch) conducted its first Women in Fisheries in India workshop in Mangalore, India, and published the proceedings³ in 1992.

1993

A Pacific Women in Fisheries Network⁴ was established in Fiji. The network is registered under the (Fiji) Charitable Trusts Act, and is a consortium of fishers, researchers, gender and development specialists and scientists from non-government organisations (NGOs), civil society organisations (CSOs), governmental and regional agencies that share a common interest in addressing the urgent need to strengthen the involvement and improve the conditions of women in the fisheries sector in Fiji. At its height in the 1990s, it had some 60 members in the Pacific region. There was a ten-year lapse of activity due to core members proceeding on professional development stints but it was revived in mid-2013. In 1995, it published 'Fishing for Answers: Women and Fisheries in the Pacific Islands'.⁵ The network now has a full-time coordinator and is currently working closely with the World Conservation Society (WCS) in Fiji.

¹ This article was first published in issue No. 51 of *Yemaya, the International Collective in Support of Fishworkers' Newsletter of Gender and Fisheries* (<https://www.icsf.net/en/yemaya/detail/EN/2216.html>). It is reproduced here with their kind authorisation.

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³ <https://genderaquafish.files.wordpress.com/2012/07/1992-procs-india-women-in-fisheries-1990-workshop.pdf>

⁴ <http://siccode.com/en/company/women-in-fisheries-network-fiji>

⁵ <http://www.spinifexpress.com.au/fasiapub/fiji/fiji2.htm>

1994

At the instigation of Dr M.C. Nandeessa, the non-government organisation Partnership for Development in Kampuchea (PADEK) and partners organised the Women in Fisheries Cambodia Workshop, and published the proceedings. (Note: For copies of the proceedings, please contact the author.)

1995

At the 4th Asian Fisheries Forum in Beijing, the Asian Fisheries Society and PADEK held a women in fisheries photo competition.

The UNDP Women in Fisheries Asia-Pacific Regional Workshop was held in the Philippines and, in addition to a large volume of proceedings, agreed upon the Iloilo Resolution (UNDP SU/TCDC 1995)⁶ that was sent to the 4th World Conference on Women in Development, held in Beijing, China.

Also this year, SPC started a Women's Fisheries Development Section and appointed an officer to lead it.

1996

PADEK and several national partners held a 'Women in Fisheries in the Indo-China' workshop in Phnom Penh, Cambodia, and published the proceedings. (Note: For copies of the proceedings, please contact the author.)

In South Korea, the first meeting of women in fishing villages was jointly organised by five fisheries cooperatives. Women's greater political activity in fishers' organisations was preceded by demographic changes, such as the ageing of the rural population, increasing work opportunities elsewhere, and declining fisheries resources. The work women did in the fisheries was being transformed, with some women even going to sea with their husbands.

1997

The Cambodian Women in Fisheries Network was established by the Cambodian Fisheries Administration (FIA).

The *SPC Women in Fisheries Information Bulletin* was launched.⁷

1998

The Asian Fisheries Society (AFS) Symposium on Women in Fisheries in Asia was held during the 5th Asian Fisheries Forum in Chiang Mai, Thailand. This was the first such event by the AFS and the predecessor of similar events at each of the subsequent Asian Fisheries (and Aquaculture) Forums.

In the Philippines, registration of fisherfolk began to include women, in contrast to the previous practice of recognising only male fishers. The 1998 Fisheries Code (Section 19) provided for registration of municipal fisherfolk by local government units.

In the Pacific, SPC transformed its Women's Fisheries Development Section into the Community Fisheries Section. At this time, in the Western and Central Pacific region, many male fisheries leaders expressed concern that development work that focused on women was not inclusive of all members of the community. By 2003, the Community Fisheries Section had moved even further from focusing on women when it became the Coastal Fisheries Management Section.

1999

Yemaya, the International Collective in Support of Fishworkers (ICSF)'s newsletter on women and fisheries, was launched from the ICSF Secretariat Office in Chennai, India. *Yemaya* regularly covers gender issues in fisheries. It has systematically documented various forms of gender-based inequalities. Its articles deal with issues that are of direct relevance to women and men of fishing communities, including recent research or meetings and workshops that have raised gender issues in fisheries. It also contains life stories of women and men of fishing communities working towards a sustainable fishery or for recognition of their work within the fishery.

Also this year, the Vietnamese Women in Fisheries Network was established by the Vietnamese Department of Fisheries; and the Lao Women in Fisheries Network was established by the Lao Department of Fisheries and Livestock and the Living Aquatic Resources and Research Center.

2000

Philippines researchers and other experts established the nationwide NGO National Network on Women in Fisheries (WINFISH)⁸ to maintain the visibility of the women and gender agenda in agency programmes, and undertake research and advocacy work through its biennial conference, training engagements, publications and individual members' areas of influence. WINFISH was officially incorporated in 2001.

The Thailand Women in Fisheries Network was established by the Thai Department of Fisheries.

The Mekong Network for Gender Promotion in Fisheries Development (NGF) was formed, as a regional forum for the networks already established in Cambodia, Laos, Thailand and Vietnam. The NGF has been continuously supported by the Mekong River Commission's Fisheries Programme in organising its regular annual meetings for updating of network activities implementation and sharing experiences on gender awareness and mainstreaming activities implemented in the four member countries.

In Australia, the national Women's Industry Network Seafood Community (WINSOC)⁹ was formed and incorporated as a registrable Australian body. WINSOC is the only national organisation in Australia that represents the women of the seafood industry. It provides a unique network role for tapping a valuable resource of Australia.

⁶ UNDP SU/TCDC. 1995. Regional workshop on the role of women in fisheries development in the Asia-Pacific, Report of proceedings, Iloilo, Philippines.

⁷ <http://www.spc.int/coastfish/en/publications/bulletins/women-in-fisheries>

⁸ <https://www.facebook.com/profile.php?id=100006287505655&fref=ts>

⁹ <http://winsoc.org.au/>



2001

The Asian Fisheries Society Symposium on Women in Global Fisheries was held in Kaohsiung, Taiwan, as part of the 6th Asian Fisheries Forum. After this conference, the organisers decided to broaden their theme to 'gender and fisheries (and aquaculture)'.

In Bangladesh, the government passed a law prohibiting harvest of wild shrimp post-larvae (PL) from coastal river mouths. More than a decade later this law, driven by conservation considerations, was to have unintended gender consequences when it was finally policed. In 2015, with the help of the Navy and Coast Guard, PL gears and traps were destroyed. Some 400,000–500,000 PL collectors living in coastal slums lost their livelihoods, leading them to migrate to inland cities and towns, even though they lacked the skills and capital to prosper there. Women and children have been particularly affected. They now urgently need new livelihood options.

2002

At SPC, the European Union funded the PROCFish project on coastal and invertebrate fisheries. By the time this project finished in 2009, it had collected and analysed a large volume of gender-disaggregated catch and fishing participation data. The final report of the PROCFish project is available on the web.¹⁰

2004

The Asian Fisheries Society First Global Symposium on Gender in Aquaculture and Fisheries (GAF1) was held in Penang, Malaysia, at the 7th Asian Fisheries and Aquaculture Forum.

2005

In 2005 in Indonesia, the fisherwomen's cooperative Puspita Bahari¹¹ was initiated to change the marginalisation of women. Puspita Bahari works with the community to educate about gender equality and income-generating activities.

2006

With the increasing feminisation of the Bangladesh fishery sector labour force, especially the shrimp and aquaculture segments, the United Nations Industrial Development Organization (UNIDO) began a capacity-building programme for factory workers and managers. Through the programme, over several years, UNIDO produced a training manual, and carried out training of trainers to develop master trainers, and gender-focused training for factory workers in most of the operating factories in the major coastal districts.

In the shrimp industry in Bangladesh, the Solidarity Center, a US-based NGO working on labour rights, lodged a Global System of Preferences (GSP) withdrawal case against Bangladesh, blaming the use of child labourers and causing Bangladesh to lose its trade preference status. As a result many workers, including many women, lost their jobs.

In Mumbai, Maharashtra, India, the women members of the Maharashtra Fishworkers Union succeeded, after several years of action, to get the government to accept that they had rights and that street and other markets should be protected. Later, the government assisted them to map their markets so that their rights to the public space would be protected, in keeping with the Street Vendors Act of 2012.

In Tamil Nadu, India, a study was undertaken from 2006 to 2015 by researchers at the Central Institute for Brackishwater Aquaculture to gain a picture of rural women in small-scale aquaculture. Urban male migration and other social problems were leading to an increased number of permanent or temporary women-headed households. The nature and extent of involvement of women in aquaculture was found to vary greatly from place to place, and within a place it varied according to caste, religion and position in the family hierarchy.

2007

The Asian Fisheries Society held the 2nd Global Symposium on Gender in Aquaculture and Fisheries (GAF2) in Kochi, India, at the 8th Asian Fisheries and Aquaculture Forum.

2009

The Government of the Republic of the Philippines proclaimed Act No. 9710, 'An Act Providing for the Magna Carta of Women' – landmark legislation that was enacted in March 2010. Its provisions address rights, benefits and the role of women fisherfolk especially in coastal communities.

2010

The 2010 the Food and Agriculture Organization of the UN (FAO)– Network of Aquaculture Centres in Asia-Pacific (NACA) Global Aquaculture Conference in Phuket, Thailand, included a gender-themed paper for the first time, 'Sustaining aquaculture by developing human capacity and enhancing opportunities for women'. The resulting Phuket Declaration called all to 'support gender sensitive policies and implement programmes that facilitate economic, social and political empowerment of women through their active participation in aquaculture development, in line with the globally accepted principles of gender equality and women's empowerment.'

At Mahabalipuram, India, the ICSF held a global workshop 'Recasting the net: Defining a gender agenda for sustaining life and livelihoods in fishing communities'.¹² This was a defining event and its comprehensive report was very important as an input to the consultative processes of the Small-scale Fisheries Guidelines, adopted in 2014.

The Spain–FAO Regional Fisheries Livelihoods Programme (South and Southeast Asia) (RFLP, 2009–2013) began its gender element, working on normative products and projects in Cambodia, Indonesia, the Philippines, Sri Lanka, Timor-Leste and Vietnam.

¹⁰ https://www.spc.int/DigitalLibrary/Doc/FAME/Reports/PROCFish/PROCFish_2010_Regional_Report.html

¹¹ <https://www.facebook.com/Puspita-Bahari-1090161124347159/timeline>

¹² <https://www.icsf.net/en/proceedings/article/EN/111-recasting-the-n.html>

2011

The Spain–FAO RFLP produced the manual ‘Mainstreaming gender into project cycle management in the fisheries sector’.

The Asian Fisheries Society 3rd Global Symposium on Gender in Aquaculture and Fisheries (GAF3) was held in Shanghai, China, as part of the 9th Asian Fisheries and Aquaculture Forum. Back to back with this event, FAO held a ‘Workshop on future directions for gender in aquaculture and fisheries: Action, research and development’. This workshop subsequently led FAO to undertake an internal stocktaking and planning exercise on ‘Mainstreaming gender in fisheries and aquaculture’.

In South Korea, the National Federation of Fisheries Cooperatives adopted a Charter on Fisherwomen. The Federation of Korean Fisherwomen was launched under the National Federation of Fisheries Cooperatives.

2012

Arising from global FAO promotion of gender awareness in food and aquaculture, and also from the GAF3 events of 2011, the Indian Council for Agricultural Research undertook internal planning and produced the ‘Gender in fisheries roadmap’¹³ for India.

2013

The Asian Fisheries Society 4th Global Symposium on Gender in Aquaculture and Fisheries (GAF4) was held in Yeosu, South Korea.

In South Korea, 39 regional unions had a membership of 7,702 fisherwomen. The Female Farmers and Fishers Act was passed to help improve the status of fisherwomen; the act protects women’s rights and interests, and gives the women professional status. State and local governments supported the political, economic, social and cultural development of fisherwomen’s skills. The act also established a comprehensive policy to improve the quality of life, and provided financial support. Fisherwomen’s technical training was developed, and producer groups supported. Fisherwomen’s participation in decision-making has since improved, along with women’s status in fisheries.

In the Philippines, the Bureau of Fisheries and Aquatic Resources (BFAR) drew up a Comprehensive Gender Mainstreaming Program that integrates the gender dimension in its structures, policies, procedures and culture with gender equality as a goal. BFAR reconstituted the Gender and Development Focal Point System and has an active Facebook page¹⁴ promoting news of its gender equality activities.

2014

In 2014 in Bangladesh, following the disastrous Rana Plaza (garment factory) building collapse in 2013, the International Labour Organization (ILO) took over the fish-processing factory work initiated in 2006 by UNIDO. For the shrimp factories, ILO initiated health risk assessment training and the UNIDO BEST project started occupational health and safety training.

Also in Bangladesh, the Labour Laws 2006 were amended in 2014. Over 80 provisos were changed with the aim to provide better treatment of women workers. Explicit labour rules were enacted in 2015 for the first time.

In Indonesia, 2014 saw a drop recorded in female employment in fisheries with 14.5 million women found to be working in fisheries-related jobs, down from the 2008 figure of 16 million. This drop was attributed largely to industrial modernisation and mechanisation.

The NACA-USAID MARKET gender project in Cambodia, Laos, Thailand and Vietnam was launched. This was the first gender project of the Network of Aquaculture Centers in Asia-Pacific. It was finalised in 2015.

2015

From 2015 in Bangladesh, the Solidarity Center (SC) ended nine years of lobbying against the shrimp industry and began to engage with the shrimp processing factories. SC started running factory-based training for the shrimp processing workers. Of 50,000–60,000 workers in the Bangladesh fish and shrimp processing factories, the UNIDO, ILO and SC programmes have trained 7,500 people in labour rights.

In Manila, Philippines, 14 civil society organisations from Southeast Asian countries met in the Regional Workshop on Management of Community-based Coastal Resources. The workshop discussed the importance of women’s roles and the need to protect their rights in small-scale fisheries and coastal resource management.

¹³ <https://genderaquafish.files.wordpress.com/2013/03/gender-in-fisheries-final.pdf>

¹⁴ <https://www.facebook.com/bfargad.ph/>



Women in Fisheries Network¹

Loata Leweniqila²

Through needs-based training and capacity development, the Fiji-based Women in Fisheries Network hopes to aid women's value-added participation in the fisheries sector

Despite women playing a crucial role in the marine environment, particularly in the fisheries economy, their contribution is poorly acknowledged. Women fishers generally dominate inshore fisheries in many countries of the Pacific region and play important roles in both subsistence and commercial fisheries, but have poor access to training and are not strongly engaged in decision-making on fisheries development and management. Since 2016, the Women in Fisheries Network (WIFN), Fiji, has turned its attention to many of these issues. One important activity has been research into specific areas identified under a study done on the status of fisheries in Fiji.

Although there has been substantive progress in some areas of fisheries regarding women's participation, mostly in relation to the marketing and distribution of products, several challenges remain. Many of these challenges relate to the non-enumeration of women in fisheries because they mainly work in the subsistence sector and the informal sector. The lack of information and data on women's participation in different aspects of the fisheries makes it difficult to assess the economic contribution of women in the numerous fisheries sectors and activities in which they are engaged.

There is little documentation on the various aspects and dynamics of seafood marketing with respect to the involvement of women. Transportation needs and access to markets and market space are still some of the main challenges women face in their selling and distributing activities. Lack of direct access to credit and finances restrict women from participating equally in the fisheries sector. Most community-based work suffers from a dearth of women trainers and facilitators. Although women are included, sometimes strategic approaches to gender are not. Most work done to assist women in fisheries has a narrowly defined focus and therefore has little impact.

There is a great need for research into participation of all ethnic groups in fisheries, and new fisheries legislation and other policies on fisheries resource use, marketing and distribution mechanisms to enable the full engagement of fisherwomen. Some research undertaken by the WIFN includes looking into the mud crab and *kai* (freshwater

mussels) fishery, which is providing crucial information that could assist in the sustainable harvest of these species.

To commemorate International Women's Day on 8 March 2017, and in recognition of our women fishers, the WIFN hosted a meeting, the Women in Fisheries Forum, which created a space where various stakeholders could discuss the progress and challenges faced by women in the fisheries sector. One of the main targets of the forum was to network and build the capacity and the reach of the WIFN. The forum brought in stakeholders including representatives from the government, conservation practitioners, civil society organisations and fishing communities to present the latest science, management, development and policy work on women in the fisheries sector. It also created a space for dialogue with women fishers to listen and learn more about their issues, needs and priorities. Issues discussed included how women fishers can be connected to seafood supply chains to enhance their businesses; value chain analysis of freshwater mussel; the impact of Tropical Cyclone Winston on some fisheries; as well as discussions on the organisations and associations that the network could work with.

As the Status of Women in Fisheries in Fiji report had earlier found, gender disparities are evident in most areas of work in Fiji, including the fisheries sector. Women's involvement is mainly in the informal, as opposed to the formal, sector. Studies have shown that with only 109,000 females in the formal labour force, and 121,000 registered as doing 'household work', more than a half of women's work is being defined as 'economically inactive' because it is in the household (and unpaid) category. Most fishing activities for household consumption done by women are in the subsistence sector; these are therefore not enumerated and fall into the unpaid work category. Studies have also shown that women spend more time than men on work overall, have fewer hours in paid work, and, in general, have less discretionary time than men.

Work on gender issues in Fiji is directed by eight major international agreements on gender equality and the advancement of women. Three of these are the Committee on the Elimination of Discrimination against Women

¹ This article was first published in issue No. 54 of *Yemaya, the International Collective in Support of Fishworkers' Newsletter of Gender and Fisheries* (<https://www.icsf.net/yemaya/article/EN/54-2277.html>). It is reproduced here with their kind authorisation.

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(CEDAW), the Sustainable Development Goals (SDGs) and the Pacific Platform for Action, which provide an opportunity for reporting on the state of women in the country. The challenge is whether the provisions from these instruments, such as those relating to non-discrimination by sex, and equal access to resources and opportunities, are reflected in fisheries policies or their implementation. In February 2014, the Fiji National Gender Policy was launched with a mission to promote gender equity, equality, social justice and sustainable development through the promotion of 'active and visible gender mainstreaming in all sectors'. The promotion of gender mainstreaming will become a part of government work in the fisheries sector and this will provide opportunities for more gender-focused initiatives, which will raise the profile of women's engagement and role in fisheries. To enable the inclusion of women fishers in discussion at the national level, the WIFN has to direct more efforts towards engaging with the Department of Women, and finding new ways to work on the Fiji National Gender Policy in areas that relate to women in fisheries. Business representatives at the Women in Fisheries Forum, as well as the regional organisation PIPSO (Pacific Islands Private Sector Organization), which looks after small business enterprises and the involvement of women, helped facilitate the discussion on opportunities and challenges in the private and marketing sector.

A highlight of the Women in Fisheries Forum was a session where women fishers from rural locations in Fiji shared their experiences, challenges and aspirations. This opened the space for discussions on practical issues that women face daily in their fisheries participation. This very informal session, titled *talanoa* ('talking to each other'), was a break from the traditional format of the conference. The session provided a much-needed space for women to sit and discuss

issues openly. Although the women were from different parts of the country, the challenges they faced and their concerns were similar. These include the lack of formal support for the work that women fishers do; the participation of women throughout the fisheries supply chain; and the economic empowerment opportunities that the women are busy with, along with the traditional, gender-based obligations and commitments they are expected to fulfil in the communities they come from. These women are still the primary caregivers in their families and are not released from this role when they engage in economic activities, thus having to shoulder a double burden of work. Women are still dominant fishers in the inshore areas, gleaning, collecting and using traditional skills and knowledge to forage for seafood both for home consumption and to sell. As more and more rural areas of Fiji are being infiltrated by the modern market economy, many coastal rural households are becoming dependent on women's income-generating activities to secure their livelihoods. Most women engage in these activities without any proper training or skills, using whatever resources are available to earn income. Because of the informal nature of their engagement in the economic sector of the fisheries, women lose out in many ways: they do not know how to set prices; they lack bargaining power; they have little knowledge of issues related to quality and safe processing techniques; and they have little or no access to secure finance to set up small, professional businesses.

The WIFN, in its strategic plan, aims to engage women in training and capacity building to enhance their practical and value-added engagement in the fisheries sector. The network hopes to assist women by facilitating them in the work they already do in the different sectors of fisheries.



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