An Overview of Rural Development and Small-Scale Beekeeping in Fiji

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Introduction

Beekeeping and Rural Development

Beekeeping is an income generating activity which provides a range of benefits economically, environmentally, and socially to individuals and communities (Bradbear, 2009; Schouten & Lloyd, 2019). Honey bees produce several valuable products that may be used as a source of income for beekeepers. Honey is in high demand internationally, used around the world for its taste, nutritional benefits, and medicinal properties (Ahmad, Joshi, & Gurung, 2007). Further, beeswax can be sold raw, processed, or transformed into value-added products such as cosmetics and candles (Aguiree & Pasteur, 1998; Bradbear, 2009; Hilmi, Bradbear, & Mejia, 2011). Additional profitable products include royal jelly, propolis, pollen, queen bees, and nucleus colonies (Bradbear, 2009; Krell, 1996). Evidently, there are great economic incentives for those involved in beekeeping.

Beekeeping has been recognized as a less labor intensive and a less time-consuming means of agricultural income generation for both men and women (Griffiths, 2004). Hives require little space to be productive, allowing those who do not own land to undertake beekeeping (Bradbear, 2009). Beekeeping can also be undertaken alongside other agricultural activities without competing for essential resources, while simultaneously increasing crop yields (Ahmad et al., 2007; Bradbear, 2009; Sharma & Abrol, 2014). In this sense, beekeeping can improve the productivity and profitability of current farming activities, while supplementing and diversifying income streams. A diverse stream of income assists with income smoothing and managing the seasonality of agricultural production while also mitigating against risks and sudden shocks (for example, disease, extreme weather events, regional economic conditions; Department for International Development, 2000; Ellis, 1999). Hence, there is great potential for beekeeping to enhance the resilience of rural livelihoods.

In addition to the economic and social benefits of beekeeping, the contribution of bees to the surrounding ecosystem is important. Pollination by honey bees provide ecosystem services that contribute to the maintenance of biodiversity, increased crop production, and improved food security (Hilmi et al., 2011; Klein et al., 2007; Olschewski, Tscharntke, Benítez, Schwarze, & Klein, 2006). This is especially important in regions experiencing a decline in the population of native pollinators (Kluser & Peduzzi, 2007). Given that honey production is dependent on the surrounding floral resources available to beekeepers, beekeeping communities may be incentivized to conserve forest areas that afford them high yields and incomes (Bradbear, 2009; Schouten, Lloyd, & Lloyd, 2019). Therefore, beekeeping could be used to assist in protection of forest reserves and biodiversity surrounding apiaries.

Despite the great potential for beekeeping to provide income and employment opportunities for rural livelihoods, many development programs encouraging beekeeping have struggled to improve the livelihoods of the intended beneficiaries, some inadvertently disempowering those it sought to empower (Otis & Bradbear, 2003; Schouten & Lloyd, 2019). Amulen et al. (2017) found a lack of both training and provision of protective equipment limited the ability for beekeeping programs to improve the wellbeing of the participants. A study by Schouten and Lloyd (2019) on factors influencing the success of development programs found access to floral resources and continuous extension and training support to be extremely important. Beekeeping requires a foundational set of knowledge and skills of bee complexities and beekeeping practices in order to create successful bee-based businesses. Beekeepers who are limited in technical skills and support often struggle to manage and maintain their apiary, and pests and diseases (Jacques et al., 2017). As a result, untrained beekeepers pose biosecurity threats to existing beekeepers. Further, without adequate training and mentoring, beekeepers are prone to limited economic efficiency (Kuboja, Isinika, & Kilima, 2017), characterized by low honey yields and high rates of colony losses. Ultimately, inadequate support mechanisms for the development of technical beekeeping skills can result in a loss of potential income and beekeeper self-esteem, as well as, reduced aid effectiveness.

Fiji

The Republic of the Fiji Islands is an archipelago situated in the Pacific Ocean located between 16-20° S and 176-179° E (Ash, 1992). Fiji consists of more than 300 islands, around 100 inhabited, comprising a total land area of approximately 18,270 square kilometers (Food and Agriculture Organization [FAO], 2016). The islands have a population of around 890,000 (United Nations Department of Economic & Social Affairs, 2019), majority of whom are located on the two main islands Viti Levu and Vanua Levu. The two main islands, and a number of smaller islands, have mountainous centers with dense forests. The south-easterly trade winds bring heavy rainfall to the eastern regions of many islands where majority of the tropical forests are located (Leslie & Tuinivanua, 2010). On the western regions of the islands, there are typically dry, open forest and grassland landscapes (Leslie & Tuinivanua, 2010). The topical climate means Fiji is warm year-round, with distinct wet and dry seasons from November to April and May to October respectively.

Fiji is considered to be one of the most developed economies in the Pacific (Asia Development Bank [ADB], 2018; BBC News, 2018), classified as an upper

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middle-income country (ADB, 2019), with rates of poverty amongst the lowest in the region (World Bank, 2018). When measured against the international poverty line (2011 PPP US$1.90 per person per day), only 1.4% of the population were estimated to live in extreme poverty in 2013-14 (World Bank, 2018). While the rate of extreme poverty in Fiji is low, relative poverty persists. The Fiji Bureau of Statistics (FBoS) use a 'basic needs poverty line' in the household income and expenditure survey (HIES) to measure relative poverty. The 2013-14 HIES classified urban poverty at FJ$55.12 per adult equivalent per week and rural poverty at $49.50 per adult equivalent per week. In this survey, the FBoS recorded 28% of the population living in poverty (an improvement from 31% in 2008-09; FBS, 2015). The results identified the proportion of those living in poverty is greater in rural areas (37%) as compared to urban regions (20%; FBS, 2015). As such, alleviating rural poverty remains a concern and a major focus for the Fijian Government, aid and donor agencies, and non-government organizations (NGOs).

In rural areas, agricultural activities typically form the major source of income and employment (Alexandratos, 1995). Fiji's agricultural industry is a primary sector of interest with data from the FBoS indicating agriculture is the fourth largest industry in Fiji[1] contributing 8.2% of Gross Domestic Product (GDP); behind the manufacturing industry at 14.1%, the sale and repair of motor vehicles at 11.7%, and the finance and insurance sector at 9.2% (FBS, 2018). With agriculture as a great contributor to the economy in Fiji, beekeeping has the ability to complement and enhance agricultural production for rural communities (Sharma & Abrol, 2014; Klein et al., 2007). Further, beekeeping can benefit the rural poor by facilitating an additional and diverse source of income (Bradbear, 2009). Therefore, small-scale beekeeping can be a means to enhance rural livelihoods in Fiji. This has formed the foundation of targeted Government, aid, and NGO development programs.

History of Beekeeping

While there are no naturally occurring honey bees in the Pacific Islands (Bradbear, 2009), European bees were believed to be introduced by early settlers in the nineteenth century (Driscoll, 2009; Roper & Gonzalez, 2013). The North-Western European dark bee (*Apis mellifera mellifera*), also referred to as the German 'black' bee, was reportedly the first honey bee species introduced to Fiji (Goldsworthy, 2017; Roper & Gonzalez, 2013). These bees are considered by beekeepers in Fiji to be more defensive and less productive than other bee subspecies, notably the Italian bee (*Apis mellifera ligustica*; J Caldeira, personal communication, 8 August, 2019; Goldsworthy, 2017; Roper & Gonzalez, 2013). During the 1970-80s, New Zealand aid programs attempted to improve the genetic stock by importing Italian bees, which then cross-bred with the German black bee (J Caldeira, personal communication, 8 August, 2019; Goldsworthy, 2017).

Geography of Beekeeping

The majority of beekeeping is located in the drier areas in the Western and Northern Divisions (Figure 1). Although, there are rich native forestry and mixed land-use areas which are yet to be exploited for honey production.

Further research is needed to identify key pollen and nectar sources of importance to beekeepers in Fiji, however, preliminary discussions with key informants and observations suggest some of the main floral resources include the raintree (*Samanea saman*), coconut tree (*Cocos nucifera*), mangrove spp., wattle spp., coral vine (*Antigonon leptopus*), citrus spp., Nuqa (*Decaspermum fruticosum*), *Geissois* spp., and bushweeds (*Flueggea flexuosa*; in Rotuma Island).

Key informants of this study reported two annual harvests or honey flows; one mid-year (May-June) and the other towards the end (November-December). Although, focus group discussions with beekeepers revealed that apiaries situated near mangrove forests could harvest honey year-round. Key informants reported the vast majority of beekeeping in Fiji is stationary and located around beekeeper's farms or villages. Only a few larger commercial beekeepers manage remote apiaries or migrate their hives to benefit from abundant or different flowering sources in the region.

All honey sampled was polyfloral, with no single-source or monofloral honey observed. However, during observational apiary visits, some smallholders noted word-of-mouth benefits from buyers who prefer their predominantly coconut flower honey and predominantly mangrove honey due to taste, suggesting an opportunity to capitalize on niche markets.

Beekeeping and Development

In Fiji, there have been a number of aid and development organizations who promote and support beekeeping for rural development. These organizations encourage small-scale beekeeping by supplying new beekeepers with hives, equipment, and/or finance. While many have benefitted from these programs, key informants from Government departments, the private sector, and beekeeping associations, have expressed their concern as many new beekeepers have been inadequately trained and unable to manage their hives, leading to colony losses and biosecurity issues. This issue is not isolated in Fiji (Amulen et al., 2017; Schouten & Lloyd, 2019; Wagner, Meilby, & Cross, 2019). As such, a greater understanding of how beekeeping programs can be enhanced to contribute to rural development and improved livelihoods is required. To address this, an extensive description of the factors which

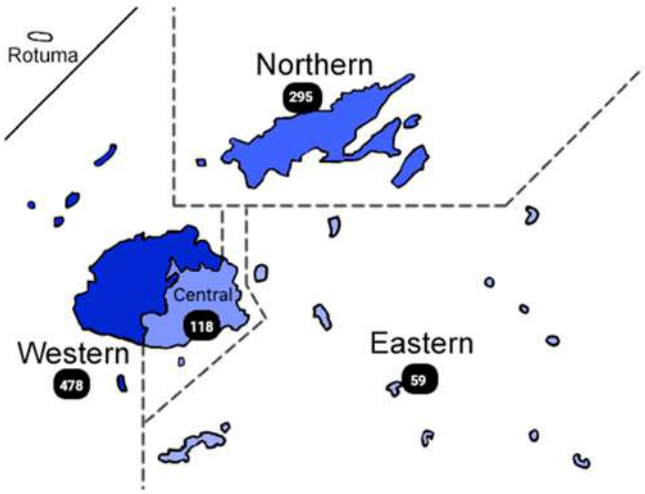

Figure 1. Number of beekeepers registered by division (Ministry of Agriculture, 2018). Image adapted from "Local Government in Fiji", by Golbez, 2006 (https://en.wikipedia.org/wiki/Local_government_in_Fiji). Creative Commons Attribution 2.5 Generic.

influence the success of these programs and the industry dynamics from the perspective of small-scale beekeepers is also necessary. The purpose of this paper is to: provide an overview of the beekeeping industry in Fiji from the perspective of small-scale beekeepers; identify the strengths, challenges, and opportunities facing small-scale beekeepers; and, to provide recommendations for interventions to improve the productivity and profitability of small-scale beekeeping in Fiji.

Methods

To achieve the aims of this study, mixed methods were employed pragmatically to gain a detailed understanding of the current context for small-scale beekeepers in Fiji (Creswell & Plano Clark, 2011). Key informant interviews were undertaken with Government representatives from ministries and departments involved in the apiculture sector, including the Ministry of Agriculture and Biosecurity Authority of Fiji. Key industry stakeholders were interviewed using semi-structured interviews (Bryman, 2001), including commercial honey producers, finance and input suppliers, and processers and packagers. NGOs, including regional beekeeper cooperatives and community beekeeping groups were also interviewed. As this research was exploratory in nature, beekeepers were sampled using a convenience sampling strategy (Saumure & Given, 2008) for two focus groups and questionnaires (n = 25). Further information was gathered through observation (McKechnie, 2008) during visits of commercial and small-scale farmer apiaries, honey processing and packaging sites, honey retail sites (including farmers markets, minimarkets and supermarkets), beekeeping research stations, and apiculture laboratories.

Results & Discussion

Current industry Trends, Strengths & Opportunities

Beekeeping in Fiji is predominantly subsistence in nature (1-40 hives); 51% of the total number of hives registered are held by subsistence beekeepers (Ministry of Agriculture, 2018). The other 49% of hives belong to semi-commercial (41-75 hives) and commercial (≥76 hives) beekeeping operations (Ministry of Agriculture, 2018).

Statistics from the Ministry of Agriculture's first quarterly apiculture report for the 2018-19 year indicate there is a total of 950 beekeepers registered, holding over 12,000 hives and producing 109 tons of honey for the quarter (Table 1). However, in personal communication with key informants, these data have been contested due to a lack of beekeepers registering. Key informants have indicated the actual numbers of hives to be higher. Therefore, these figures can be seen as indicative, with a more comprehensive census proposed in upcoming research activities.

While there are no accurate figures on the participation of women in the industry, key informants from the Fiji Beekeepers Association estimate the overall participation of women to be between 25-35% (J Caldeira, personal communication, 23 June, 2019). With beekeeping identified as a less labor-intensive activity accessible to women for income generation and improved livelihoods (Griffiths, 2004; Ogaba, 2002; Pocol & McDonough, 2015), there is great opportunity to increase the participation of Fijian women in beekeeping activities through targeted training and extension support.

Fijian beekeepers benefit from biosecurity regulations restricting the importation of honey (excluding some large manufacturers of food products), due to the threat of bacterial and parasitic diseases (BAF, 2014). Currently, all honey sold in retail outlets in the country is being domestically produced. The restriction of supply, and increasing demand, has resulted in increased prices for honey producers in the country. The wholesale per-kilogram price of honey in Fiji is high when compared to global markets, as seen in Figure 2. The high value of Fijian honey has resulted in greater profitability for beekeepers and other actors involved in supplying the market.

Fiji's clean green image as a tropical paradise provides great potential for Fijian bee products to enter and capitalize on high-value markets. In addition to the potential for single-source honey, further opportunities exist in gaining Fair Trade and organic certifications for honey producers on outer islands that are not impacted by agriculture and honey bee pest and diseases.

Interviews with key informants from commercial honey suppliers and the Agricultural Marketing Authority of Fiji revealed some processers and packagers struggle to secure consistent supply to meet their demand. Increasing the production of small-scale beekeepers can provide flow on benefits to assist processing and packaging companies to meet their orders.

At present, there is great potential to develop the use of wax for value-added products. Beeswax is a highly versatile product and can be used to create cosmetic and household products (candles, soaps, balms), to produce beekeeping inputs (wax foundation), and can be sold raw or processed which has a high demand in international markets (Bradbear, 2009; Hilmi et al., 2011; Krell, 1996). Key informants reported a few large-scale beekeepers selling wax to producers of cosmetic products. Although, there was little value-added products observed in retail sites, indicating this to be at a limited extent. During focus group discussions, the majority of beekeepers reported discarding their wax, missing the opportunity to earn additional income at no more expense. Further, when asked if they sold any other bee-related products (i.e. wax), 85.7% of questionnaire respondents (n = 14) indicated they did not sell any other products. Facilitating the development of wax processing and the production of value-added products can therefore enable greater profitability for current beekeeping operations (Bradbear, 2004).

Challenges

Many households benefit from beekeeping in Fiji, yet the industry has faced challenges and setbacks in recent years and there is still great opportunity for industry development with the potential for export. During February of 2016, Fiji was

Table 1. Number of farmers, hives and production levels by division.

Location	Farmers	Hive numbers	Honey production (Tons)
Western	478	6448	82.40
Northern	295	4675	14.07
Central	118	538	5.95
Eastern	59	702	6.74
Total	950	12,363	109.16

Source: Ministry of Agriculture Apiculture Report Q1 2018-2019 (Ministry of Agriculture, 2018).

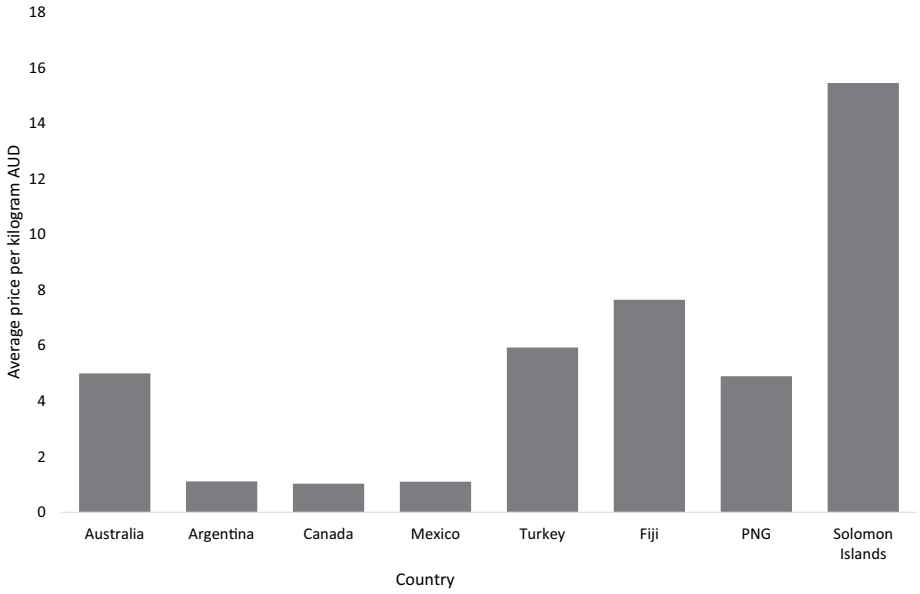

Figure 2. Average Wholesale Price per Kilogram of Honey 2017.

devastated by the largest tropical cyclone recorded in the Southern Hemisphere, Tropical Cyclone Winston. For the country's beekeepers, many lost their hives and equipment. Figures on national apiary and hive numbers from the Ministry of Agriculture (Figures 3 and 4) show a great decline following this disaster with the industry still to recover to pre-TC Winston levels. Although, recovery efforts by the Pacific Community (SPC), funded by the European Union, facilitated training and provided equipment to over 200 bee farms to assist with reestablishing and strengthening beekeeping activities (SPC, 2017). Further research is required to gain an accurate representation of the industry's recovery.

Formerly, Fijian beekeepers benefitted from favorable conditions having plentiful floral resources for bees and being free from many major pests and diseases. However, the presence of American Foul Brood (AFB) (*Paenibacillus larvae*) disease and the limited ability for small-scale beekeepers to identify, manage and monitor outbreaks has impacted honey production and led to hives and entire apiaries dying (Lloyd, 2019). Colony losses have reportedly had detrimental impacts on honey yields and associated income from beekeeping for affected farmers. The Biosecurity Authority of Fiji (BAF) and Fiji Beekeepers Association have been proactive in their management in their pursuit to eradicate AFB.

A recent incursion of *Varroa jacobsoni* (Ministry of Communications, 2019) discovered in October 2018 (World Organization for Animal Health, 2018) has become a major concern for BAF and beekeepers. *V. jacobsoni* incursions can result in weaker bees, a greater susceptibility to viruses, and honey bee population losses (Queensland Government Department of Agriculture & Fisheries, 2019). This can consequently affect honey production and the profitability of beekeeping enterprises. Following the identification of *V. jacobsoni*, BAF established a fast-action eradication plan. BAF has also successfully implemented a *V. jacobsoni* control program to reduce mite population throughout Fiji. In the event *V. jacobsoni* becomes established, then a management plan is required in order to minimize the effect on beekeepers. Although, the use of miticides to combat *V. jacobsoni* may impede the ability for Fijian beekeepers to enter high value organic markets for both honey and wax.

One of the key constraints for small-scale beekeepers is their limited technical skills and knowledge, consequent of limited access to quality training programs and beekeeping information books. During apiary visits and focus group discussions, beekeepers exhibited a poor understanding of honey bee nutrition and supplementary feeding strategies which was found to result in insufficient food reserves for bees to survive dearth periods. Few beekeepers indicated the use of supplementary feeding programs, with many unaware of the benefit. During focus groups, beekeepers reported harvesting honey during times of dearth to pay for their children's school expenses, uninformed of negative consequences including starvation and possible colony collapse. Many small-scale beekeepers displayed little understanding of the need to re-queen to optimize honey yields and reduce swarming tendencies and aggression. Observations in apiaries and during training sessions showed that many small-scale beekeepers were unable to conduct colony splits and could not replace failed hives nor increase their hive numbers. This is a critical skill for beekeepers to sustain and grow their operations, affecting the productivity and longevity of their activities. Focus group discussions highlighted that small-scale beekeepers would benefit greatly from training in general beekeeping skills, producing splits, constructing inputs, managing swarms, and managing pests and diseases. Beekeepers would also benefit from basic business and management training (FAO, 1994). Training is required on bookkeeping, cash flow management, planning for equipment maintenance and replacement, and marketing strategies.

Discussions during key informant interviews and focus groups highlighted the success of mentorship style training program by the Fiji Beekeepers Association which provide long-term support for new beekeepers to develop their skills and grow their activities. Further research is needed to evaluate the effectiveness of village-based mentorship programs to determine which factors contribute to successful and mutually beneficial beekeeping relationships. The development of participatory guarantee systems among mentors and mentees may help to identify different mechanisms that can be trailed (i.e. the exchange four-frames of bees as a nucleolus colony for lessons on how to make colony splits). Developing beekeeping education and extension materials in both English and the local iTaukei language was also highlighted as means to improve accessibility of information for learning core beekeeping skills among rural beekeepers. Overall, increasing the skills and knowledge of new beekeepers will enable them to increase the productivity and profitability of their beekeeping activities. Consequently, beekeepers can earn greater incomes and produce greater livelihood outcomes.

At present, key informants from the Fiji Beekeepers Association have identified two major quality issues affecting Fijian honey. Firstly, the high humidity common to tropical regions, and the harvesting of uncapped frames, has led to a high moisture content in the honey. When the moisture content is greater than 20% honey will ferment, reducing the product's shelf life and excluding it from export markets (Codex Alimentarius, 1994). Secondly, bees located near sugarcane

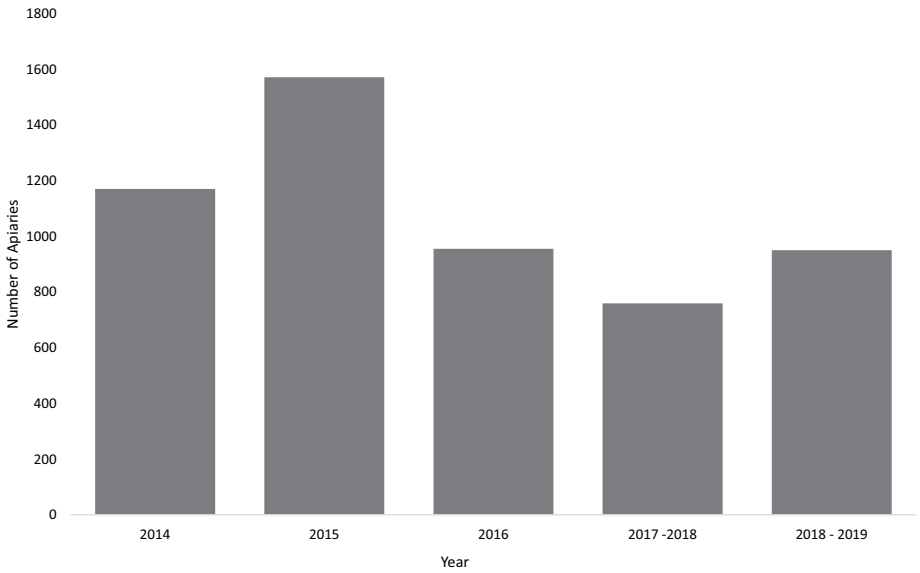

Figure 3. Number of Apiaries (Source: Ministry of Agriculture Apiculture Report Q1 2018-2019 (Ministry of Agriculture, 2018).

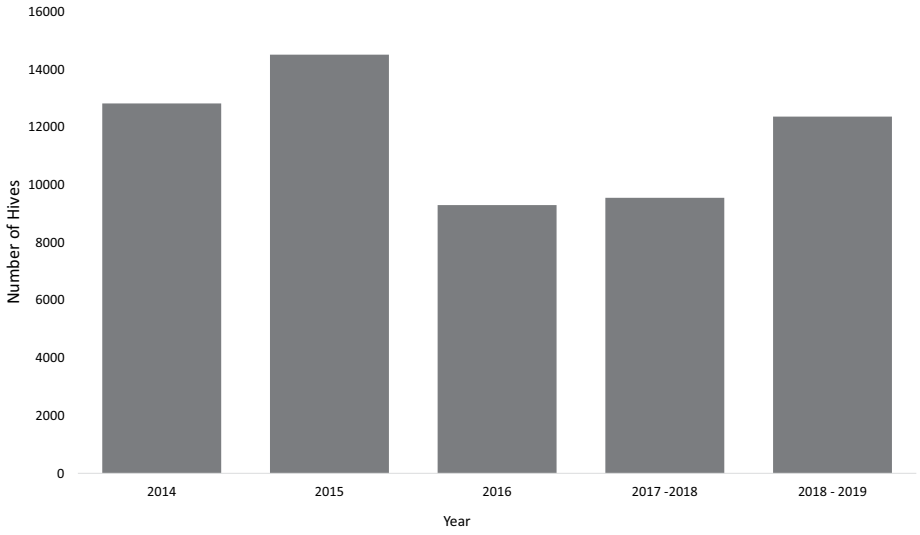

Figure 4. Number of Hives (Source: Ministry of Agriculture Apiculture Report Q1 2018-2019 (Ministry of Agriculture, 2018).

crops have been reported and observed to be feeding on the burnt cane resulting in a molasses flavor and dark colored honey. While sugarcane fields offer a rich source of sugar to bees, the honey has a high sucrose content. These factors reduce the quality of the honey, affecting domestic demand and consumer trust, while also affecting the ability for Fijian honey to enter high-value and export markets.

Conclusion

This paper provides an overview of the beekeeping industry in Fiji from the perspective of small-scale beekeepers and has identified means of improving the productivity and profitability of beekeeping activities to enhance rural livelihoods. The study found market and industry development and capacity building to be key avenues for benefits to small-scale beekeepers.

Increasing the technical skills and capacity of beekeepers is required to increase productivity and profitability of small-scale beekeeping (Schouten & Lloyd, 2019). Training is required in basic beekeeping principles, managing swarms, producing splits, constructing inputs, and managing pests and diseases. Additionally, to increase the productivity of rural income-generating activities, further emphasis is required on managing beekeeping as a business (FAO, 1994; Otis & Bradbear, 2003). This involves basic business training as well as an emphasis on the approach of beekeeping as a family enterprise. Increasing the overall skill level of beekeepers will not only benefit their livelihoods through greater income, but can benefit the industry at large by increasing supply to meet the demand.

Despite great potential for increased profits for various actors in the beekeeping industry, the wax market remains underutilized. Increasing the capacity for producers and processors to create value-added products will provide ample benefits to small-scale and commercial beekeepers (Bradbear, 2009; Hilmi et al., 2011; Krell, 1996).

Improved marketing strategies by small-scale and commercial beekeepers, as well as processing and packaging agents, will enable greater access to high value markets, allowing premium pricing and greater profits for those involved in supplying the market (Keegan & Green, 2016).

It is recommended that more effective and on-going beekeeping and business management training and mentorship programs be integrated into current beekeeping development programs. Emphasis should be placed on capacity building with local industry stakeholders to provide practical training that is conducted in small groups, by enthusiastic and effective teachers who have sound beekeeping technical skills, as opposed to classroom based and theoretical approaches (Breece & Sagili, 2015).

While beekeeping has many positive contributory factors and has been widely promoted as a sustainable development activity, attrition of participants following the implementation of such projects remains substantial. Further research is needed to examine the effectiveness of beekeeping interventions in order to inform effective policy and technical delivery.

Note

1. While tourism is a major contributor to GDP and Foreign Investment in Fiji (ADB, 2018), the tourism-based industries are disaggregated in the FBoS dataset.

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