

Kava (*Piper methysticum*) - An Important Source of Income for the Rural Farmers in Fiji Islands.

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Correspondence Author: Avin Ashitesh Prasad, College of Agriculture, Fisheries and Forestry, Fiji National University, Koronivia Campus, Nausori, Fiji Islands. Tel: +6799163890.**E-mail:** avin.prasad@fnu.ac.fj**Abstract**

Kava (*Piper methysticum*) production is decreasing very rapidly on a yearly basis. Kava is the traditional ceremonial drink and one of the major source of income for the farmers in Fiji Islands. Kava farming is practiced by many Fijians in the highlands of Fiji. Fiji is a tropical country, prompt to cyclones and adverse weather conditions, these adverse weather conditions has continuously contributed towards decreasing kava production in the country and other Pacific Islands. There are 12 cultivars of kava distributed across the Pacific Island and Fiji itself acquires 12% of the total cultivars, besides Vanuatu which acquire 82% of the cultivars. Kava takes minimum of 3 years to attain its full maturity and in that 3 years plants go through various kinds of survival pressure and apart from weather conditions, Kava farmers face crop management issues such as Kava pests and diseases.

Keywords: kava, cultivars, Fijians, Pacific Island, Vanuatu, tropical country, Fiji Islands.**1. Introduction**

Kava (*Piper methysticum*) also known as yaqona by the population of Fiji and pacific Islands. Being not just a major income generator for the local household, Kava has been served as the local traditional drink for many villages in the Fiji Islands. Following its initial discovery, domestication and diffusion throughout the Pacific kava has become an integral part of Pacific Island religious, economic, political and social life today. In recent years the uses have expanded, the range of kava products has diversified and the demand of kava now comes from people all over the world. Kava has moved away from being a traditional crop for ceremonial and personal use.

Kava originated from a plant of the same species (*Piper wichmani*), which grows as a wild in Fiji, New Guinea, the Solomon Islands and Vanuatu. The wild plant is known in Fiji as yaqoyaqona and does not contain kava lactones that produce the soporific effect of kava. The Kava cultivars were originated 3,000 years ago, farmers in the northern island of Vanuatu were the first to select and develop kava cultivars to improve their yield and chemical composition. Over the years it has become an integral part of Pacific Island's religious, economic, political and social life. In Fiji Samoa, Tonga and Vanuatu, it has been developed into an important cash crop both for the local market and for export.

Fiji is currently suffering from kava shortage. As per the recent survey, the shortage of kava supply in the country was not caused by severe Tropical Cyclone Winston. Instead, it is because the country does not have enough kava, reported in the (Fiji Times, June 14, 2016). As per the farmers and the market vendors the increase in price of kava came well before the cyclone in February. When the cyclone struck, it put a stoppage to the supply and the demand for kava increased alongside with the price. Kava is presently retailing at around \$60 to \$90 (US\$29-\$43) a kilogram in most market places

nationwide. According to the (Fiji Times, June 14, 2016) in 2014, Fiji earned around \$7 million- \$8m (US \$3.4-3.9 million) annually from kava exports. The country is also the second- biggest importer of the crop from Vanuatu behind New Caledonia. Government is urging the rural farmers to plant more kava in order to meet the increasing demand.

Fiji produces approximately 4,000 tonnes of dried kava a year and exports to a range of countries including within the region, New Zealand and the USA. Although there is enormous potential to increase exports, approximately 95% of kava being produced is currently supplied to the domestic market, as reported in the (Fiji Sun, September 12, 2017).

2. Geography

Fiji is located in the south pacific region, around 1,300 miles northeast of New Zealand's North Island. Fiji comprises of more than 332 Islands of which 110 are inhabited and consisting of additional 500 islets.

Viti levu and Vanua levu are categorized as the two largest Island, consisting of up to 87% of the total landmass in between them to make up Fiji. About 75% of the population lives on Viti levu and 18% on Vanua levu. Highest point of 4, 341 feet (1,324m) is known as Mount Tomanivi, which is situated at the main Island of Viti levu. Viti levu itself spreads over 10, 388 square km whereas the other half Vanua levu spreads 5, 587 square km.

3. Climate and Cultural Requirement

Kava cultivation requires high rainfall, sloppy area and needs an average temperature range of 20-30°C with high humidity. At altitudes of less than 400m the plant requires annual rainfall of over 2200mm and at higher elevations kava requires less water at list 1800mm. However, this does rule out cultivations for areas having dry season provided adequate amount of irrigation is provided. Planting is mostly carried out at the beginning of rainy season, so that the plants can get maximum benefits during its critical months of growths. During the first six months, kava is susceptible to moisture stress. Accurate amount of watering and mulching to prevent moisture loss is required. Shading and wind breaks are also needed to prevent moisture loss for windy areas.

The site for kava should be well drained and should have high humus content. The soil should be rich in organic matter and have a soil pH of 5.5-6.5. Land is mostly prepared by digging the area with fork and cuttings having at least 2-3 nodes are directly planted on prepared mounds.

4. Botany and Genetics

Kava is a member of pepper family (*Piperaceae*). It has sterile flower incapable of reproducing itself sexually. So, improving propagation sexually would be a difficult practice. Therefore, paramount importance is given while carefully preserving the existing germplasm for future use. Kava has been always propagated vegetatively through cuttings, so there is a high chance of pathogen infections throughout its entire production. Planting materials should be carefully selected to avoid production loss.

Piper methysticum is a slow growing perennial plant with an attractive shrub that can attain a height of more than 3 meters. Cultivated for its root stock, which is referred to as stump. The stump is a knotty, thick and tuberous, often containing holes or cracks created by partial destruction of parenchyma tissues. From a root stock, fringe of lateral roots extends up to 3-meter long. The roots consist of a multi ligneous fibres containing more than 60% of starch, making it very difficult to extract the active ingredient. Root stock colour varies from white to dark yellow depending upon the amount of psychoactive kava lactones, which contain lemon yellow resins.

5. Kava Cultivars

Kava cultivars recognized in Fiji.

1. **Loa Kasa Leka**- Dark purple, short and thick internodes with various lenticels. Normal general appearance, no leaf pubescence with regular lamina, purple linage on the insert point of the petiole, dark green lamina.
2. **Loa Kasa Balavu**- Dark purple, long and thin internodes with various lenticels erect general appearance, no leaf pubescence with regular lamina, purple linge on the insert point of the petiole, dark green lamina.
3. **Vula Kasa Leka**- Light green, short and thick internodes with various dark green lenticels, prostrate general appearance, pubescence on the edge of the lamina, opened and regular lamina, light (pale) green.
4. **Vula Kasa Balavu**- Light green, long and thin internodes with various dark green lenticels, prostrate general appearance, pubescence on the edge of the lamina, opened and regular lamina, light (pale) green.
5. **Dokobana Vula**- Light green, long and thick internodes with various lenticels, erect general appearance, no pubescence, opened and regular lamina, dark green.
6. **Dokobana Loa**- Purple with green linge, long and thick internodes with various lenticels, erect general appearance, opened and regular lamina, no pubescence, dark green lamina.
7. **Qila Leka**- Dark green, short and thick internodes with very few lenticels, on the upper part of the internodes only, normal general appearance, drooping and elongated lamina, pubescence on the edge, dark green lamina.
8. **Qila Balavu**- Dark green, long and thick internodes with various lenticels, erect general appearance, drooping and elongated lamina, pubescence on the edge of the lamina, dark green lamina.
9. **Matakaro Leka**- Green with purple linge on the nodes of the orthotropic stems (vertical), and on the plagiotropic branches (lateral), short and thick internodes with various lenticels, undulate lamina, erect general appearance, no pubescence, pale green lamina.
10. **Matakoro Balavu**- Green with purple linge at the nodes, long and thin internodes with various lenticels, erect general appearance, no pubescence, pale green lamina.
11. **Honolulu**- Light green, long and thin internodes with few dark green lenticels on the upper part only, bottom part uniform with dark green tinge regular and round lamina, no pubescence and normal general appearance, pale green.
12. **Damu**- Purple with green tinge, short and thick internodes with very few lenticels, regular and round lamina, normal general appearance, no pubescence, dark green lamina.

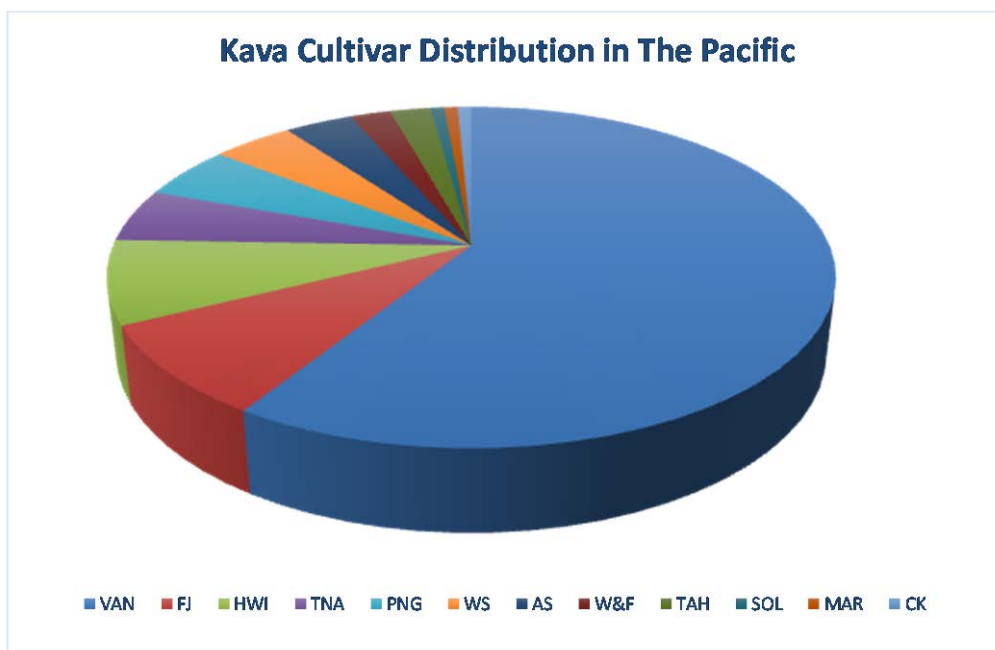


Figure 1: Showing different types of Kava cultivars distributed across the Pacific Islands.

Key:

VAN- Vanuatu (82%), FJ-Fiji (12%), HWI- Hawaii (11%), TNA- Tonga (7%), PNG- Papua New Guinea (7%), WS- Western Samoa (6%), AS- American Samoa (5%), W&F- Wallis & Futuna (3%), TAH- Tahiti (3%), SOL- Solomon (1%), MAR- Marquesas (1%), CK- Cook Islands (1%)


6. Active Ingredient

The active ingredient present in kava are Kavapyrones also known as (Kavalactones). These has similar effects to alcohol and helps in relaxation. Kava enhances talkativeness and euphoria while maintaining mental clarity. Kava has been found to have anxiolytic properties and is used with patients to treat anxiety disorders, insomnia, premenstrual syndrome and stress. Kava appears to have a potential of abusive characteristics if over dosed, but it is rare with conventional doses.

However there has been a serious concern that excessive kava intake may cause liver damage. Due to this reason, the use of kava has been prohibited in many countries around the world such as Germany, Great Britain, Canada, France and Switzerland. In Europe, more than 30 cases of liver damage have been reported. It is a major concern and researchers are still in a process of confirming if kava has the potential of toxifying liver. It's still not clear whether taking kava in combination with other drugs or herbs is the real reason behind liver damage or kava itself causes liver damage.

Kava roots are chewed for their medicinal value, in some parts of the world. It is also available in liquid form as standardized extracts or as tinctures, powders in capsules and tablets.

7. Table 1: Kava Production Analysis

Kava Production Analysis for Year 2016-2017					
	Farming System- Traditional			Plant Density: 2500 mounds	
	Assumptions				
1	Spacing	3m X 3m			
2	Production & Income Schedule				
	Number of plants	ha	1		10000
	Yield per plant Waka	kg			0
	Lewena- per plant	kg		0	
	Production- Waka Dried	kg	0	0	
	Lewena Dried	kg	0	0	
	Marketable Production (90%)- Waka	kg	1890	1890	
	- Lewena				
	Price/ kg (Waka)	\$	90	90	
	Price/ kg (Lewena)	\$	60	60	
	Value of Waka				
	Value of Lewena				
	Gross Value of Output	\$	170,100	170,100	
		Unit	Quantity	Unit Cost	
3	Direct Costs			Total Costs	
	Inputs				
	NPK	kg	75	1.88	
	Urea	kg	75	1.64	
	Glyphosate CT	litre	4	7.5	
	Paraquat	litre	12	8.5	
	Planting Material	Cutting	7500	0.3	
	Total Input Costs			2646	

4	Labour Inputs				
	Land Clearing	Person/day	50	20	1000
	Digging	Person/day	30	20	600
	Plantinig	Person/day	30	20	600
	Spraying/ Weed Control	Person/day	177	20	3540
	Fertilizer Application	Person/day	44	20	880
	Harvestiing	Person/day	60	20	1200
	Cartadge	Person/day	30	20	600
	Washing	Person/day	25	20	500
	Sundrying	Person/day	30	20	600
	Grading/Sorting	Person/day	10	20	200
	Bailing	Person/day	4	20	80
	Total Labour Days @ \$20/ personday		490		9,800
5	Transport	trip	1	500	500
6	Total Variable Costs	\$			12,946
7	Gross Margin/ha including Labour	\$			157,154
8	Gross Margin/ha excluding Labour	\$			166,954
9	Return/ Labour Inputs	\$			320.72

Pests and Diseases

Pests

Pests can transmit diseases between plants and also make kava plants more susceptible to disease and decrease growth. This reduces productivity and the quality of kava. There are no records of major pests of kava in Fiji but there are some general pests to be aware of.

These are:

WEEVILS

Weevils are small insects that can damage roots or stems by burrowing into them and encouraging rots to develop. Resting the land after harvesting kava can help reduce populations of weevils.

APHIDS

Aphids are small flying insects that can damage the leaves by feeding on them and spreading diseases like kava dieback and other viruses. Removing weeds and not growing kava near vegetables including cabbage, cucumber, pumpkin, tomato and chillies can help to control aphids.

NEMATODES

Nematodes are very small worm like pests that are found in the soil throughout Fiji. These pests can damage the roots and rhizomes by feeding on them and spreading diseases which can then cause rots to develop. Resting the land after harvesting kava and not growing kava with vegetable crops can help to control nematodes.

SNAILS AND SLUGS

Snails and slugs damage emerging shoots of young plants. Note: Can be controlled by applying snail bait around plants or plantations. Wood ash applied around the plants or plantation may also help to control snails and slugs.

Diseases

The major disease of economic importance to the kava industry in Fiji is kava dieback.

Kava dieback is caused by a virus (cucumber mosaic virus or CMV) and can be more severe if the kava is also stressed such as due to shortages of water or nutrients. It is spread on infected planting material and by aphids.

The stems of infected plants will rot and die back to the stem which can completely kill the plant. Earlier symptoms can include the leaves becoming yellow and they also may have dead and brown edges and crinkling, blistering or puckering.

There is no single chemical control for kava dieback but instead a package of practices should be followed:

- Start by using healthy seedlings or clean cuttings from healthy plants which come from disease-free areas.
- Stick to traditional methods of growing kava in sites of well separated and spaced intercrops and trees under natural forest systems. Good intercrops are crops such as dalo, dalo-ni-tana and under coconuts-based farming systems.
- Grow only on good soils with adequate shade and avoid nematode infested areas and nematode harbouring plants.
- Regularly check kava plants and destroy infected plants from plantations by removing them from the field and burn or bury them.
- Remove weeds and other plants that can be infected by dieback such as cabbage, cucumber, pumpkin, tomato, watermelon or chillies.
- Promote good growth as vigorous kava plants are less likely to be affected (e.g. fertile soil, mulching, good drainage, shading, protection from wind).
- It is very important to clean tools like digging forks, sticks and knives between uses in different locations and farms or even between plants to stop the spread of any possible diseases especially kava dieback. All tools are to be cleaned after use and stored in a covered and dry area away from crawling insects and pests.
- The kava crop should be monitored regularly for aphids and if they appear to be a problem, it may be possible to control them with appropriate pesticides.

It is recommended that land should be rested after harvesting kava for a period of least 3 years. During this break that land should not be used to grow kava or other crops that are harvested. This break prevents the build-up of disease in the soil and allows the soil to replenish its nutrients and organic matter.

8. Harvesting

Harvesting is a critical stage in producing a good quality kava. One should be very careful when uprooting the kava plants and make sure that roots come out intact to prevent the plants from getting spoiled.

Damaging kava at harvest may result in a lower quality product and poor prices. As the kava plants get older their rhizomes and roots get bigger and have more dry matter (so less moisture). The size and dry matter of the rhizome and roots produced by the plant over time depends on the variety and locating. Harvesting needs to be done once the kava plants are mature enough to ensure that there is an acceptable yield and kavalactone content. This is generally when the plants are at least 3 years old. Plants can be left longer in the field as long as the plants are healthy. Depending on age and the variety, the large rhizome can be 30–60cm thick and the upper roots 2 to 3m long or longer at harvest.

Harvesting of kava plants begins by cutting the leaves and stems of the plants above the first two nodes. If being used for direct planting or propagation the stems should be treated carefully so as not to damage them then separated into the different varieties ready for planting. Soil around the plant is loosened using a digging fork or stick to expose all surface and subsurface lateral roots before digging under the rhizome for the anchor roots to loosen the plant from the soil before lifting it off the ground. Make sure as many roots as possible are uprooted with the plant. During harvest, care should be taken to ensure there is little or no damage to the plant and no foreign matter, weeds or toxic plants are mixed with the harvested kava. Clean tools (forks, spades) between uses in different locations to stop the spread of any possible diseases. It is important to clean and sharpen knives before use to avoid introducing disease or damaging propagating material. Clean and store all tools in a covered and dry area (not on the ground) away from animals.

Freshly harvested kava should be cleaned and dried as soon as possible after harvest to avoid further damage and spoilage. Any parts of the kava plants not being used as well as any damaged or diseased kava (including damaged and diseased roots), and any weeds and rubbish should be collected and disposed of in an area of the farm that is not used for planting kava.

Collecting is a basic stage in creating a decent quality kava. One ought to be extremely watchful while removing the kava plants and ensure that roots turn out in place to keep the plants from getting ruined.



Figure 2: Farmers harvesting Kava in Tavueni, Fiji.

Post – Harvest Management

The process of washing, cutting, trimming and drying harvested kava is an important step in ensuring quality. This processing helps to: allow the kava to be thoroughly cleaned from soil and foreign materials; reduce drying time; prevent

damage from mould, other microorganisms and insects; and reduce or remove toxic chemicals in some plant parts. Care is needed to make sure that once clean the kava stays clean and does not get dirty or contaminated. Contamination can include soil, insects, grass, foreign material like plastic or animal waste. During all steps in this process, any decomposed and damaged kava should be identified and discarded in order to avoid a loss of product quality. Depending on the export market the kava may need to be supplied to the processor/exporter in dried or fresh form and certain plant parts. The handling of kava by farm workers during harvest and when washing, drying and packing is important for quality. Good hygiene of workers and clean equipment is an important part of ensuring a quality product.

Cutting/ Separation

During and after washing the kava roots should be separated to help drying and ensure that soil is properly removed from around the roots. Cutting is done to separate the roots and make sure that all parts of the root can be cleaned. After cutting no large pieces of soil should be attached to the roots, and the roots should be ready for more thorough washing. As part of the separation process contaminated or diseased parts of the plant should be removed and put to one side for disposal. Clean and sharp knives should be used to avoid contamination of the kava.

Washing

The kava should be thoroughly washed to remove all soil particles. The soil can reduce the quality of the kava by encouraging rot and buyers or importers may not accept a dirty product. Washing should be done in a flowing stream or with high pressure hoses using clean water. Kava can be cleaned in a water tub or an open drum if running water is not available and then rinsed with clean water to ensure it is thoroughly cleaned. Properly cleaned kava should have no visible dirt on its surface. Chemicals (including soaps, detergents and bleaches) should NOT be used during washing. When roots are very dirty they may be soaked overnight to ease the cleaning process.



Figure 3: Farmer washing freshly harvested Kava.

Cutting/Chipping

The rhizome of the plant (lewena) where the roots join the stem should be separated and then peeled, well cleaned, and cut/chopped into thin even slices for drying. Lewena should include, at most, only the first two nodes of the stem (kasa). The slices should be no more than 1.5cm thick to ensure quick and even drying. In most cases the chipped lewena is soaked in water overnight before drying. Again, it is important that sharp, clean knives are used and that the lewena is kept off the ground and away from any possible contamination. Peeling removes the outer layer which can contain toxins (alkaloids) and should be done with a clean, sharp knife or a peeler. Peelings are of very poor quality and should be kept separate and disposed of. Peelings should not be sold or consumed as they are a poor-quality product that contain toxins.

The quality of different parts of a kava plant vary significantly, particularly the kavalactone content, and it is important that the different parts of the plant are kept separate. Keeping the different parts of the plant separate also helps to ensure the different parts are dried uniformly and that the different parts can be sold separately at the market. Different buyers may want different products but the recognized kava products are:

- Roots or waka (loose or bundled)
- Chips or lewena (rhizome, must always be peeled).

To begin with, the roots (waka) are cut off and the waka should then be kept separate from other parts of the plant. The kava may need to be washed again as this process can expose dirt that has been hidden in the plant. It is important that sharp, clean knives are used and that the kava is kept off the ground to avoid contamination from soil, insects, grass, or foreign material like plastic or animal waste. The stems (kasa) are a low-quality product with low quantities of kavalactones and are not recommended to be sold or consumed.



Figure 4: Farmer cutting Lewena chips.

Drying

Thorough drying is crucial. The biggest challenges are getting the moisture content as low as possible to prevent the kava from mould and that it does not get dirty or contaminated during this process. Kava that is not dried properly is lower quality and can result in a lot of waste. Care must be taken to achieve uniform drying and this is helped by regularly turning or stirring the pieces of kava. Typically, 4 to 6kg of green kava is required to produce 1 kg of dried kava. The kava needs to be dried to 12% or less moisture to prevent mould growth. When it is dry enough it should easily snap when bent with your fingers. It needs more drying if it is soft and can bend. The different plant parts should be dried separately because they take different times to dry.

Packaging and Marketing

After the final drying day, the lewena (chips) are packed in an empty propylene bags and the waka (roots) are made into a bundle of weights ranging from 5-12kg each. Prepared kava bundles and bags are taken to the local markets, export companies and sold at a reasonable price according to its quality.

9. Conclusion

Indeed, it can be stated that to continue carrying out the same ancestral farming of kava is starting to be a great challenge for the Fijian farmers today. Changing weather patterns and introduction of devastating pests and diseases has seriously

decreased the total revenue for the farmers and the country has a whole. Due to which the local market value of kava has doubled and the local population are finding it very hard to purchase kava for their traditional and other gathering functions. Government of Fiji is trying their very best to encourage young kava farmers to continue farming by providing all sorts of necessary assistances inform of planting materials, pesticides etc.

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