Penang Sangam High School
P.O. Box 44, Rakiraki
Year 13 Agriculture Lesson Notes Week 17

Strand	**AS 13.3 Agronomy**
Sub-Strand	**AS 13.3.2: Horticulture**
Content Learning Outcome	**AS 13.3.2.4 Explore relevant research on the production of three potential crops recommended for cultivation in the locality and present findings.**

Lesson 1: Horticulture

Trend - a general direction in which the production of any crop product is developing or changing

Potential crop – a crop having or showing the capacity to become or develop into a major prospect in future

2018 – Define the term potential crops (1 mark)

Trends in crop production for top three potential crops in Fiji

Crop	Top 3 Commodities	Major Producers (Province)
Root crops	Cassava	Tailevu
	Dalo	Tailevu
	Kumala	Tailevu
Vegetables	As. vegetables	Nadi/Navua
	Egg plant	Ba
	Potato	Ra
Tree crops and fruits	Coconut	Lomaiviti
	Pineapple	Ba
	Banana	Tailevu
Others	Yaqona	Naitasiri
	Rice	Macuata
	Ginger	Naitasiri

2018 – MC No. 15

Categories of Potential Crops in Fiji

Category	Crops
Vegetables	Wild ferns, Rourou, Eggplant, Bele
Shrubs	Pandanus, Water Chestnut, Sago
Ornamentals	Jasmine, Orchids, Gardenia, Carpet grass, Blue grass
Tree Crop	Pawpaw, Mangoes, Heart of Palm, Mulberry
Weeds	Sea weeds
Grasses	Duruka, Navua sedge, Rice, Spices, Bamboo, Lemon grass
Fungi	Mushroom

2019 – MC No. 15

Most potential crops for production in Fiji are edible bamboo, paper mulberry and mushrooms. The increasing number of foreigners in Fiji has resulted in the demand for these potential crops

and has given the opportunity for local production and exports in the future.

2018 – Select one crop that you have studied and explain one potential use of the product produced. (2 marks)

Lesson 2: **Mulberry as a potential crop in Fiji**
Lesson Outcome: At the end of this lesson student will be able to:
1. discuss origin, varieties and importance of mulberry production in Fiji.
2. elaborate on cultivation practices of mulberry crop.
3. discuss harvesting, post-harvest treatment and use of mulberry crop products and by-products.

Paper Mulberry - a deciduous and dioecious shrub or tree usually growing 10 to 20 meters tall and is used for making food, fiber and medicine.

Dioecious- male and female flowers are produced on separate trees.

Deciduous - "falling off at maturity" or "tending to fall off", and it is typically used in order to refer to trees or shrubs that lose their leaves seasonally (most commonly during autumn) and to the shedding of other plant structures such as petals after flowering or fruit when ripe.

Masi- a Fijian bark cloth made from paper mulberry tree.

Tapa – a decorative bark cloth similar to Masi, unlike the printed motifs of Masi the designs on tapa are usually hand printed.

Coppiced- regularly cut at near ground level.

Origin: East Asia (Taiwan and Japan)

Varieties: Male clones

Distribution in Fiji: Brought in by Polynesian migrations. The male clones were brought, transported and planted as rootstock or stems.

Systems of production:
-*Broussonetia papyrifera* is insect - and wind-pollinated, and is dispersed by birds, bats and mammals.
-In Fiji, tree does not produce seed (all male clones) thus there are no seedlings
-Vegetative propagation, either from root or stem cuttings

Importance of Paper Mulberry:
-strong, fibrous bark used in making native bark cloth is commonly known as tapa cloth or tapa and paper.

Site Selection:

- ✓ open habitats such as forest and field edges
- ✓ light (sandy), medium (loamy) and heavy (clay) soils
- ✓ well-drained soil and nutritionally poor soil
- ✓ suitable pH is acidic, neutral and basic (alkaline)
- ✓ cannot grow in shade
- ✓ prefers dry or moist soil and can tolerate drought
- ✓ can also tolerate atmospheric pollution

Clearing: Land is cleared of any weeds, shrubs and stones for planting.

Soil Preparation:
- ✓ moist volcanic soils are preferred
- ✓ soil texture should be light and medium (sands, sandy loam, loams and sandy clay loams)
- ✓ soils with free drainage
- ✓ seasonally and continually water-logged soils

Selecting Planting Material:
- root shoots (suckers)
- cut matted roots
- stem cuttings
- sections of second growth stems

2019 – Name the planting material for one of the potential crops you have studied. (1 mark)

Planting: (Direct seeding, transplanting or planting)
In Fiji, direct seeding is not possible since plants do not produce seeds because they are male clones.

Transplanting root shoots is easiest method. It is best to cut from mother plant using sharp knife, and then left to harden in place for a month before they are transplanted into the field.

When shoots are gathered, care should be taken not to break the tap root. The plant will dry up if this happens thus the prepared shoots are placed in holes 80cm apart in rows and 1.2-1.8m apart.

Stem cuttings can also be directly planted in the ground at a spacing of 1m apart in rows and 1m apart.

Crop Care

1. Selective weeding:
-Manual weeding is practiced to protect shoots.
-Weeding continues for two to three times a year and cutting off any excess shoots leaving only four to five on each tree.

2. Pest/Disease:
-Aphids are the major pest but in Fiji there is no major pest for the crop.
-The diseases are bacterial blight (*Pseudomonas syringe)* and fungus (*Phytophthora boehimeriae*) but the diseases are not present in Fiji for the crop.

3. Irrigation:

- ✓ requires continuous soil moisture for proper growth and development
- ✓ can tolerate periodic water logging in soils

4. Trees grow best in open sunny places and it does not grow well in heavy shade.

Signs of Maturity:

- ✓ female flowers mature into red ball-shaped aggregate fruits
- ✓ male trees produce long clusters of flowers
- ✓ bark is pale grey and very shallowly ridged
- ✓ bark is yellowish at the base

Harvesting:

Can be harvested for its bark 6-12 months after initial establishment and gives a yield of 2400 - 2800 kg/ha of bark

Tree is widely coppiced for tapa and paper production, with the young trees cut every 6 months.

The optimal stem diameter is to be between 2 cm and 4 cm. Three to five branches are harvested on each tree.

2019 – Explain how one of the potential crops you have studied is harvested. (2 marks)

Post - Harvest Treatment:

- ✓ bark is peeled from the cut stem to obtain a single long strip
- ✓ inner bark or bast is separated from outer bark
- ✓ after scraping and washing, strips are pounded to flatten them
- ✓ resulting sheets are felt together to form tapa, which could be bleached out in sun and printed with native dyes to produce the finished traditional tapa cloth

Use of Harvested Yield:

The paper mulberry has the following uses:

1. **Fruit** – are edible but in the Pacific basin such as in Fiji no fruit is formed because sterile clones are present.
2. **Leaf vegetable** - young leaves are steamed and eaten in Asia.
3. **Medicinal** – slimy sap used as laxative, infusion of crushed leaves used for treating stomach and abdominal pain.
4. **Animal Fodder** - leaves fed to animals such as pigs and silk worms in China.
5. **Fuel wood** - stems are used for kindling after removing the bark cloth called tapa.
6. **Fibre and Clothing** – making paper and textiles. Traditionally, it is used to make bark cloth tapa. Tapa is worn in traditional ceremonies in Fiji and other Pacific Island countries.
7. **Rope / Cordage / String** - bark fibre can be used to make rough cordage as can the roots.

Use of Crop Residues / By-Products:

1. Leaves used as animal feed

2. Leaves are used as mulch
3. Stems used as firewood after taking out the bark

Potential Use of Products and By-Products:
Products - tapa cloth used as ceremonial clothing like in weddings. It can also be used as handicrafts to lay on the walls, tables or on other furniture.

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By-Products - used as a leaf vegetable, animal feed, edible fruit, medicine, mulch and firewood.

Marketing of the Product:
The strips of inner bark (raw – uncolored) tapa cloth and finished cloth are sold in the local markets and handicraft shops around Fiji.

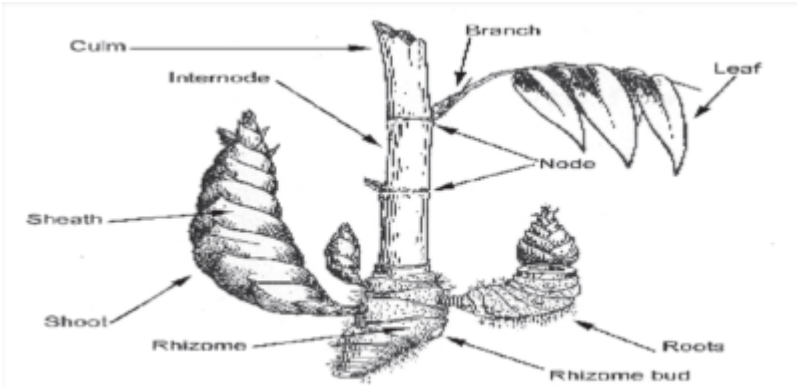
The finished tapa cloth is the most common product, and this is exported as a handicraft in many countries or sold online.

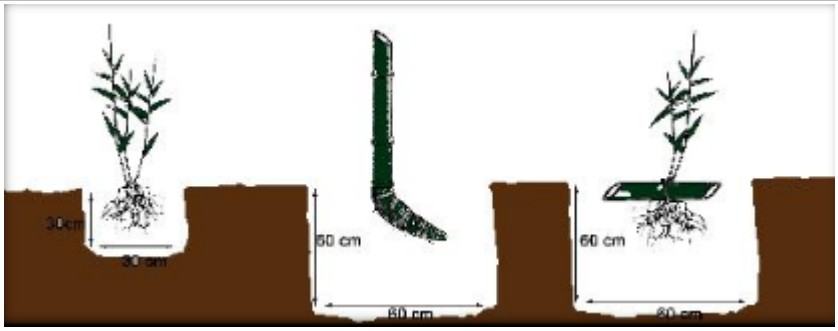
Prices of the product may range from F$40 to F$1000 or more depending on the size and art work.

Lesson 3: **Edible Bamboo as a Potential Crop in Fiji**

Lesson Outcome: **At the end of this lesson student will be able to:**
1. discuss the origin, varieties and importance of edible bamboo production.
2. elaborate on the cultivation practices of the edible bamboo crop.
3. discuss the harvesting, post-harvest treatment and use of the edible bamboo crop products and by-products.

Origin	China
Varieties	Phyllostachys decora Edible Phyllostachys dulcis Delicious Phyllostachys edulis Good Phyllostachys edulis f. edulis Delicious
Importance	1. They are a popular landscape plant because they grow rapidly, are evergreens, and create a tropical or exotic atmosphere. 2. Edible young bamboo shoots are used in cooking, while mature canes (or culms) are harvested for timber uses that include fences, stakes, fishing poles, crafts, flooring, and furniture. 3. They are capable of removing high levels of carbon dioxide from the atmosphere 4. Soil and wildlife conservation 5. Habitat restoration 6. Bamboo foliage is reportedly nutritious forage for grazing cattle 7. Low in fat, high in edible fiber and rich in mineral elements.

	8. It is rich in vitamins, cellulose, amino acids and trace elements and has the same nutritional value as an onion and is a good source of fiber. <u>Health Benefits of Bamboo Shoot</u> 1. Aids in weight loss 2. Reduces risk of cancer 3. Strengthens immune system 4. Helps improve cardiovascular health 5. Effective against respiratory diseases 6. Useful in curing snake and scorpion bites 7. Provides relief from stomach ailments 8. Beneficial for controlling cholesterol levels
Cultivation	<u>System of Production</u>**:** There are two ways of propagating bamboos: sexual (mature seeds – only few produced) asexual (offsets, culm (or branch) cuttings, stumps with rhizomes, and rhizomes)  **Figure 1:** *Parts of the Bamboo plant*
Site Selection	1. Well drained, moist, fertile soil preferably loamy and sandy loamy soils. 2. Hillsides are potential sites for bamboo production
Clearing	The planting site must be cleared of bush, grasses and other unwanted vegetation.
Soil Preparation	1. Planting spots are dug at a suitable spacing 2. Larger and deeper planting holes are always better and allow for easier establishment of newly planted bamboos
Planting	1. The rhizome portion of the offset should be placed 10-20 cm below the ground level and covered with soil. 2. After placing the plant (either seedling or offset) in the hole, cover with soil and always lightly press the soil around the plant.

	 Planting holes for seedlings, offsets, and culm derived seedlings
Crop Care: a) Weeding	1. Competition from weeds should be minimized. 2. Mowing, mulching and use of herbicides to control weeds.
b) Shading	1. Shade must initially be provided to protect them from direct sunlight. 2. The shade, mostly of thatch or any other material could be removed during the onset of cool weather.
c) Watering	1. During cold weather, watering may be done once per day. 2. In the dry season, watering should be done twice a day.
d)Treatments	1. After one month, it is recommended that sprouts from cuttings are treated with some effective fungicide (e.g. Copper sulphate) to avoid fungal attack. 2. If necessary, farmyard manure may be applied to increase the vigor of the sprouts.
e) Fertilizing and Earthing-up	1. Chemical fertilizers are usually applied two to four times during the shooting stage at intervals of one or two months. 2. It is applied in 10-15 cm deep drills that are prepared about 50-60 cm around the clump 3. Green manure can be used as fertilizer and can also serve as a protective layer to reduce evaporative moisture loss. 4. Earthing-up can be done to the base of the clump to a depth of 20-30 cm at the beginning of shooting.
Signs of Maturity	1. Edible shoots are harvested at the first indication that tips are emerging from the soil. 2. The bamboo shoots are light yellowish sheath at maturity. 3. The culms must be at least 3-5 years old before harvesting for wood uses.
Harvesting	1. Edible shoots emerge from the soil as they are cut by hand below ground at the point of rhizome attachment. 2. Harvested shoots are washed, weighed and packed in crushed ice. 3. Shoots can also be frozen and sold during the off-season.

	4. Cutting of mature stems can be done at intervals of four or more years.
Post-harvest treatment	1. Purpose of storage and preservation is to maintain the color, smell and taste of the natural bamboo shoot, to reduce rotting and increase its selling price. 2. Maintain moisture in the shoot 3. It is necessary to decrease the respiration rate and the consumption of carbohydrates during storage. A. Store bamboo shoots in a cool and moist place in order to decrease respiration rate. ***The temperature in storage should be maintained at about 5°C and the relative air humidity at about 85%. The temperature must not be so cold such that the cells freeze. B. Add some salt to control enzyme action. C. Place bamboo shoots in cans and kill bacteria by high temperature treatments. D. Store bamboo shoots under oxygen insulation conditions to control the activity of microorganisms.
Use of products	1. Edible Bamboo shoots are used as food. 2. Stem used for fencing, farming, construction and scaffolding, handicraft, furniture, pulp and paper and biomass for wood production.
Use of by-products	Leaves are used as feed for the livestock or as a mulch.
Marketing	1. Edible bamboo has a ready market in Fiji. There are a rising number of Asians in the country especially the Chinese nationals as there is a high demand for the product. 2. Fiji will also have the opportunity to export the edible processed bamboo to neighboring countries in the Pacific and around the globe.

Student Activity

1. What are some of the initiatives that the agriculture ministry can undertake to encourage the farmers to invest in a crop like edible bamboo.

2. How will the crop benefit towards Fiji's economy.

<u>Lesson 4</u>: <u>Tall Spike Rush</u> (Kuta as a Potential Crop in Fiji)

<u>Lesson Outcome</u>: At the end of this lesson student should be able to:
1. discuss the origin, varieties and importance of Kuta production.
2. elaborate on the cultivation practices of the Kuta crop.
3. discuss the harvesting, post-harvest treatment and use of the Kuta crop products and by products.

Origin	Tropical West Africa
Scientific name	*Eleocharis dulcis*
Varieties	1. *Eleocharis dulcis* (kuta or taria in Fijian) 2. *E. ochrostachys* (sasa or voca in Fijian) 3. *E. geniculata* (L.)
Importance	The stems are harvested, dried, and woven into: 1. Soft sleeping mats 2. Decorative round mats or 3. Traditional funeral waist (formal sash) mats (*ta'ovala kuta*) worn by Tongan people.  

Distribution in Pacific	1. Melanesia and Palau 2. Tonga and Samoa 3. Hawaii 4. Fiji (Vanua Levu - Dreketi)
Systems of production	1. The spike shaped inflorescence at the tip of each shoot produces small, nut-like seeds that germinate on damp ground. 2. The seedlings then spread vegetatively by creeping rhizomes.
Site Selection	1. Swamps, marsh and wet areas 2. Shallow lakes and ponds
Clearing	1. Weed free freshwater pond is preferred for growing Kuta. 2. The pond is cleared of all weeds to allow the growth of nut-like seeds to germinate into seedlings and spread vegetatively by creeping rhizomes.
Soil Preparation	Grows in shallow freshwater lakes and ponds of 1 m depth or less.
Selecting planting material	The Kuta planting material has to be weed free and fast growing.
Planting	The nut-like seeds from the kuta plant to germinate into seedlings and spread vegetatively by creeping rhizomes.
Crop Care: a) Weeding	1. Regular weeding in the pond or swamps is important for the growth of Kuta reeds. 2. Native trees are usually planted around the swamp or ponds to protect it from soil erosion and silting of the ponds.
Signs of Maturity	1. It forms clumps of densely packed, bright-green or yellow-green stems (culms) that arise from woody underground stems (rhizomes). 2. The stems emerge 1.5m above the water surface, and total stem length may be 3 m.
Harvesting	1. Kuta reeds are harvested after 6 months of growth. 2. Harvesting is generally done by cutting the stems beneath the water to encourage new growth in the next year and prevent damage to the plant. 3. To harvest the reeds, special knives are used to cut bundles of *kuta* at their base.
Post-harvest treatment	1. After harvesting, the kuta reeds are tied in bundles and carried vertically to avoid breakages. 2. The reeds are wrapped for four days and four nights so not to allow any breeze to touch them.

	3. Then it is left to dry in the sun for 5 days to give the reeds their golden brown color.
Use of products	The reeds are used for: ✓ floor mats ✓ infant cradles ✓ blankets, and ✓ *ta'ovala*, (the traditional formal sash worn by Tongans). 
Use of by-products	The finest reeds are selected for making mats whereas the non- finest reeds are spread on the earthen floor or used as straw mulch.
Marketing	1. Kuta products such mats, cradles, and other traditional formal attire are sold locally and overseas. 2. Kuta products have a high potential market as it is readily sold online for purchasing which comes in various designs, patterns and sizes. 3. The price may vary according to the quality of the Kuta reeds and usually sold between FJ$150 - FJ$1500 depending on its size and other quality.

Student Activity

1. How can the agriculture ministry encourage the growing of kuta crop in Fiji?

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2. How will the crop benefit towards Fiji's economy.

Harvest and Post-harvest of Kuta Reeds

Activity	Photograph
Harvesting	 
Bundling and Vertical Arrangement	
Sun drying	 
Walking to flatten reeds	

	
Post drying	
Weaving kuta mats	 

Student Activity

Discuss how 'Kuta' production in Fiji can build its export market around the globe.

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