

Penang Sangam High School
P.O. Box 44, Rakiraki
Year 13 Agriculture Lesson Notes Week 18

Strand	AS 13.4 Livestock Production
Sub-Strand	AS 13.4.1 Potential Livestock
Content Learning Outcome	AS 13.4.1.1 Explore relevant research on the production of three potential livestock recommended for raising in the locality and present findings.

Lesson 1: History of Aquaculture in Fiji

History of Aquaculture development in Fiji

2018 – MC No. 18

Year	Event
1954	* Fresh water aquaculture * Tilapia (mossambicus) was introduced into ponds in Nacocolevu Agri. research station to support diet for pigs
1971	* Mangrove land (100 acres) was provided to try out aquaculture signaids, milk fish, mullets and prawns/ shrimp.
1975	* Carps from India were introduced to ponds in Lami to control water weeds 2019 – MC No. 16 2018 – State one reason why grass carp was introduced to Fiji. (1 mark)
1976	* Naduruloulou Govt. Freshwater station was established and the carps and tilapia from Lami were transferred here * Fingerlings were released
1984 - 1989	* Silver and big head carps were introduced/ JICA assistance * Garden snail from Japan introduced accidently and became pest
1980	* Macrobrachium (Giant Malaysian) Freshwater Prawn brought from Hawaii
1984 - 1989	* JICA assisted Aquaculture Research & development project based at Naduruloulou
1973 - 1978	* Brackish water aquaculture Prawns culture began with trials at Raviravi with assistance of FAO
1982	* First hatchery established * Raviravi Farm turned into a first commercial shrimp farm
1990	* Australian group took over Raviravi Farm
1991	* Establishment of second commercial farm in Navua
1998	* The Department of Fisheries established a hatchery in Navua * 4 commercial farms were established around Navua

Why there is a need for commercial aquaculture?

1. Create food security
2. Income, employment and increasing foreign exchange earnings
3. To substitute imports of fish and fishery products
4. Meeting the needs of the aquaculture industry and the market
5. To improve exports

2018 – Explain one need for commercial aquaculture. (2 marks)

Aquaculture/Aqua farming – raising of aquatic organisms such as fish, crustaceans, mollusks and aquatic plants for food, income and other purposes.

Lesson 2: Importance of Potential Livestock in Fiji

Potential livestock - are those that can provide us with food, income, materials, ornaments and other products of value.

Importance	Examples
Income	fishermen, boat builders, captains, divers, etc
Materials	shells, pearls, etc
Food	prawns, mussels, crabs, etc
Leisure	photography, viewing, diving, aquariums, etc

Lesson 1: Environments in which Aquatic organisms live

Aquatic ecosystem - is an ecosystem in a body of water.

The two main types of aquatic ecosystems are marine ecosystems and freshwater ecosystems.

Types of freshwater ecosystems

Type	Explanation with examples
1. Lentic	Slow moving water eg. pools, ponds and lakes
2. Lotic	Faster moving water eg. streams and rivers
3. Wetlands	Areas where the soil is saturated for at least part of the time eg. swamps

2018 – Distinguish between a pond and a river in relation to water flow in a freshwater ecosystem. (2 marks)

Types of marine ecosystems

Type	Explanation with examples	
Ocean	Main body of salty water that is divided into oceans and seas eg. Pacific Ocean, Indian Ocean, Arctic Ocean, Atlantic Ocean and Southern Ocean.	
Inter-tidal zone	Area which remains underwater at high tide and remains terrestrial at low tide eg. wetlands, rocky cliffs and sandy beaches	
Estuaries	Areas between river and ocean that is prone to tides and inflow of both freshwater and saline water. Estuaries have high levels of nutrients eg. inlets, lagoons, harbors etc.	2019 - MC
Coral reefs	Mounds found in marine waters as a result of accumulation of calcium carbonate deposited by marine organisms like corals and shellfish. "Rainforests of the sea"	2018 - MC

Aquatic environment performs many environment functions such as:

1. Nutrient recycling
2. Water purification
3. Attenuate flood
4. Recharge ground water
5. Provide food and habitat to the marine resources

Major systems in which aquatic organisms live

Aquaculture practices are used world-wide in three types of environments:

1. Freshwater aquaculture – in fish ponds, fish pens, fish cages or, on a limited scale, in rice paddies.
2. Brackish water aquaculture - in fish ponds located in coastal areas.
3. Marine culture - fish cages or substrates for mollusks and seaweeds such as stakes, ropes, and rafts.

2019 – Differentiate between freshwater aquaculture and brackish water aquaculture. (2 marks)

Parameter	Extensive	Semi-intensive	Intensive
Species Used	Monoculture or Poly culture	Monoculture	Monoculture
Stocking Rate	Moderate	Higher than extensive culture	Maximum
Engineering Design and Layout	May or may not be well laid out	With provisions for effective water management	Very well engineered system with pumps and aerators to control water quality and quantity
	Very big ponds	Manageable-sized units (up to 2 ha each)	small ponds, usually 0.5-1 ha each
	Ponds may or may not be fully cleaned	Fully cleaned ponds	Fully cleaned ponds
Fertilizer	Used to enhance natural productivity	Used regularly with lime	Not used
Pesticides	Not used	Used regularly for prophylaxis	Used regularly for prophylaxis
Food and Feeding Regime	None	Regular feeding of high quality feeds	Full feeding of high-quality feeds
	Depending on stocking density used, formulated feeds may be used partially or totally		
Quality of Product	Good quality	Good quality	Good quality
	Culture species dominant but extraneous species may occur	Confined to culture species	Confined to culture species
	Variable sizes	Uniform sizes	Uniform sizes

2019 – Explain one reason why the size of aquatic organisms raised in an extensive system varies compared to those raised in an intensive system. (2 marks)

2018 - Describe one way in which water quantity and quality is maintained in an intensive system of aquaculture. (1 mark)

2019 – Describe the type of feeding practiced on aquatic organisms raised in a semi-intensive system (1 mark)

Lesson 3: Basic requirements for aquatic organisms

1. Water – for movement and obtain oxygen
2. Light – growth of algae and movement
3. Shade/shelter – for protection
4. Food – for energy, growth and development
5. Adequate temperature – for comfort
6. Security – for protection
7. Pollution free space – for comfort

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2018 – State one basic requirement of aquatic organisms. (1 mark)

8. Pest free space – for protection and good health
 9. Disease free space – for protection and good health

Provision of livestock basic requirements will allow healthy and quality harvest as they will grow to their full potential. This ensures that the owners will get good return on their investments.

2019 – A farmer needs assistance in setting up a commercial aquatic farm. Discuss one requirement that a farmer must consider to be able to have a healthy harvest. (3 marks)

Lesson 1: Challenges and Suggested Solutions

1. Acclimatization – to adjust or adapt to a new climate, place or situation
 2. Predators - an animal that lives by killing and eating other animals
 4. Eradication - to get rid of something completely or destroy something bad

Livestock farming continues to face many challenges which could directly and indirectly affect the quality and yield of livestock. Some of these challenges are:

Challenges	Descriptions	Solutions	2018 – MC No. 20
1. Climate change	- Environmental concerns	- Sustainable practices	
2. Acclimatization	- Lack of trained personnel - Breeds cannot withstand local climate	- Encourage cross breeds to adapt to local conditions. - Get well trained individuals to carry out cross breeding.	
3. Feed	- High cost of imported feed - Non-availability of feeds	- Use local feed ingredients to lower production costs and increase efficiency.	
4. Water	- Limited freshwater (some areas)	- Have reliable water supply. - Clear water ways.	
5. Security	- Lack of secure property rights - Land issues - Human stealing	- Fence area securely - Aquaculture rules and regulations by Fisheries Dept. - Govt. to ensure safety of farmers and their farm investment.	
6. Adverse weather	- Floods/cyclones	- Proper site selection	
7. Competition from imports	- Long distance to export markets - Lack of infrastructure - High transportation costs	- Improve product quality to capture customer's interest	
8. Predators & Pests	- Injure/kill livestock - Lower production	- Secure fencing - Security officers	
9. Disease	- Local diseases	- Minimize visitors - Test and eradicate diseased stock	
10. Financial	- Lack of capital/subsidies - Lack of farm inputs	- Govt. financial institutions. eg FDB - Govt. subsidy	

11. Habitat Destruction	- Cutting of mangroves - Pollution in rivers and lakes	- Stakeholder education/ community awareness. - Banning destructive fishing methods
12. No size limits	Continuous harvest of undersize organisms	- Strict size limit of harvested organisms

2018 – An aquatic farmer noticed that aquatic organisms raised on the farm were light and small. Discuss how the farmer can improve the quality of aquatic organisms produced from the farm. (3 marks)

2019 – State one challenge facing the aquatic industry in Fiji. (1 mark)

Lesson 2: Aquatic Farming Structures

Aquatic organisms must be well looked after if they have to be commercialized. To achieve this, they must be farmed sustainably to ensure quality and continuous harvest. These organisms may be farmed in open net pens, cages or ponds.

Type	How do they work? What do they farm?	Advantages	What are the issues/Disadvantages?
Open net pens and Cages (Needs calm seas) Submersible net pens	-encloses fish in off-shore coastal areas or in fresh water lakes *Salmon, tuna , shell Fish	-water is kept fresh by the current -extra feed can be supplied -waste is washed away by the current	-Waste from fish passes into surrounding environment, polluting wild habitats -Farmed fish can escape and compete with wild fish for natural resources -Escaped fish can interbreed with wild fish compromising their hardiness -Diseases and parasites can be spread to wild fish living or swimming nearby 2018 – MC No. 19
Suspended Organisms Shellfish culture Suspended culture	-grow shellfish on benches or suspend them in water by ropes, nets, bags, plastic trays or mesh bags *oysters, mussels and clams 2019 - MC No. 20 2019 – State one advantage of raising aquatic organisms in suspended culture. (1 mark)	-very sustainable -no need for additional feed -habitat damage and impacts from effluent are minimal	-farming shellfish in high densities in areas with little current or tidal flow can lead to the accumulation of waste -shellfish culture has been responsible for introduction of exotic species that out-compete native species for natural resources

Ponds	-ponds enclose fish in a coastal or inland body of fresh or salt water *Shrimp, catfish and tilapia	-waste water can be contained and treated 2019 - MC No. 19	-construction ponds in mangrove forests have destroyed coastal habitat important to fish, birds and humans -discharge of untreated waste water from the ponds can pollute surrounding environment and ground water

Bag/Rack - In bag-and-rack shellfish culture juveniles are cultivated in bags on racks above the sea beds

Lesson 3: Common Care and Management Practices for Aquatic Cultivation

1. Control of pests/weeds and predators
2. Cut grass on the verges regularly
3. Monitor water level
4. Record keeping
5. Feeding
6. Checking water quality

Lesson 1: Classification, species and prawn major identification grouping

Prawns have very high demand in Fiji markets and commercializing its farming could solve the problem of poverty (food and income), meet market demands and improve living standard.

<u>Classification</u> <u>Livestock:</u> Prawns <u>Phylum:</u> Arthropoda <u>Class:</u> Malacostraca <u>Order:</u> Decapoda	<u>Species common to Fiji</u> 1. <i>Penaeus monodon</i> 2. <i>Macrobrachium rosenbergii</i> 3. Red cave shrimp (Vatulele Island, Fiji) 4. Spot prawn <i>Pandalus platycaros</i>
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Lesson 2: Prawn Culture Systems

Post Larvae Prawn: 15 – 20 days old prawns which are stocked in the nursery

Type	Description	Advantages	Disadvantages
Extensive	-rearing in ponds, reservoirs and rice fields -produce less than 500 kg/ha/yr		-no control of water quality -growth or mortality is not monitored

	-stocking at 1-4/m ²		-supplemental feeding and organic fertilization is not normally supplied
Semi Intensive *Common in tropical areas	-stocking at 4-20/m ² -produce more than 500 kg/ha/yr	-fertilization and a balanced feed ration is supplied -predators and competitors are controlled -water quality, prawn health and growth rates are monitored	
Intensive	-farming in small earth or concrete ponds (up to 0.2 ha) -stocking at more than 20/m ² -output of more than 5000 kg/ha/yr.	-strict control of water quality -use of a nutritionally complete feed -elimination of predators and competitors	-construction and maintenance costs are high -high degree of management is required

Lesson 3: Pond Stocking

The stocking rate you need to use depends on:

1. Size of animals you will be selling
2. Length of growing season
3. Management system used

The lower stocking rates will tend to result in prawns of a larger average size. Higher stocking rates tend to result in greater total productivity but smaller average prawn size.

Pond Stocking

1. Stock ponds immediately after filling them with filtered water to reduce competitors and predators.
2. Acclimatize the PL to the temperature of the pond water by floating the transport bags in the pond for 15 minutes before emptying them into the water.

Causes of prawn mortality

- ✓ thermal shock
- ✓ sudden changes in pH

Lesson 4: Care and Management

Ponds to be well-maintained:

- ✓ prevent pond bank erosion by planting vegetation
- ✓ maintenance of water inlet and outlet structures
- ✓ maintain pond depth at an average of 0.9 m
- ✓ maintain adequate phytoplankton density to control growth of weeds

Careful monitoring and record keeping of:

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- water quality
- stocking rate and date
- daily feeding quantities
- dates on which water changes are made (and how much)
- harvesting dates and quantities, etc

Reasons for not applying organic fertilizers

- ❖ vary in composition (nutrient content is not known)
- ❖ have to be applied in large quantities
- ❖ creates an oxygen demand in pond water
- ❖ leaves organic residues on the pond bottom

Feed Type

1. Commercial feeds
2. Natural productivity of ponds and supplementary feeding
3. Fertilization, rather than feeding, at the beginning of rearing period
4. Initial algal bloom through addition of inorganic fertilizer

Watching for Signs of Problems

1. Phytoplankton may cover surface of pond causing low DO₂ problems.
2. High pH levels can cause prawn mortalities. High pH is caused by dense phytoplankton blooms.
3. Heavy mortalities caused by poor management, poor water quality and diseases.

Source of external water pollution is from pesticides and herbicides used on neighboring farms.

Dealing with Problems of Predation

1. Human predation can be minimized by perimeter fences, dog, lighting and watchmen
2. Prevent entry of fish and insects by passing the intake water through suitable screens or gravel filters
3. Netting or string stretched across top of ponds or bird-scaring devices to control birds
4. Offer prawns at a discounted price to your laborers to discourage theft

Lesson 5: Coping with Diseases

Disease	Muscle necrosis
Susceptibility	All life stages of freshwater prawns
Symptoms	1. Whitish color in striated muscle of tail and appendages 2. Necrotic areas increase in size and become reddish (color similar to cooked prawns)
Causes	1. Secondary pathogens (bacteria and fungus Fusarium) 2. Poor management 3. High stocking rates and handling stress 4. Poor environmental conditions (temp. and salinity fluctuations)

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Prevention	1. Follow good management practices 2. Regularly monitor water level and temperature
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Lesson 7: Harvesting market-sized prawns

Harvest in the morning when it is cooler and to avoid low water levels

If water becomes shallow, temperatures quickly rise to danger level which will lead to high mortality.

2018 – Select a potential livestock that you have studied and
(i) describe when it is ready to be harvested. (1 mark)
(ii) state one importance of the selected livestock. (1 mark)

There are two methods of harvesting:

1. Culling (cull-harvesting) - harvest market-sized animals from pond at intervals and removes the faster growing prawns. The rest of the prawns are caught when the ponds are drained at the end of the grow-out cycle.

Disadvantage

Some marketable animals remain in the pond longer than necessary and the smaller prawns do not get the maximum chance to grow faster.

2. Draining (drain-harvesting) - partially draw down pond water level during the night before harvesting commences in the morning.

Lesson 8: Post Harvest Management

The value of harvested product will depend on its quality. Speed during and after harvesting, getting the prawns on ice and out of the sun, and care in handling to prevent physical damage will all reap valuable reward.

1. Good handling and processing and avoid poor harvesting practices
2. Do not allow prawns to become 'stacked up' to avoid damage to the internal organs
3. If prawns are not to be sold live, wash in clean water, kill them and wash them in chlorinated water

2019 – With reference to one of the potential livestock you have studied
(i) describe one management practice used to raise the livestock. (1 mark)
(ii) state one post-harvest procedure of the livestock chosen. (1 mark)

Handling and Marketing of Freshwater Prawns

Type	Handling	Marketing
Fresh	-keep them very cool -not to die by leaving them out of water -do not place live prawns straight onto ice	-sell at lower prices compared to shops or markets -advertise and display at peak hours -display in clean and hygienic conditions
Frozen	-freeze them immediately	-sell them within a three month period.
Live	-change water regularly -transport temperature to be 20-22°C.	-cool transport to maintain water quality -transport on shelves stacked vertically

Lesson 10: Uses of Prawns and Its By-Products

Uses of products

1. Provide food eg. meat, seasoning, crackers, pickle, etc
2. Provides income
3. Recreation

Uses of By-products

1. Wastewater from ponds can be used for irrigation of crops
2. Shrimp meal used for livestock feed
3. Prawn Shell Waste (Chitin/Chitosan) for wound healing, dental adhesive
4. Coatings/coverings: coatings for biodegradable packaging
5. Agriculture: nematode control, seed coatings, fruit coatings, feed additives

Student Activity

1. Explain some causes of mortalities in PL during the stocking process and discuss ways to overcome these factors.

2. Give one reason for floating the PL inside a transparent bag in the pond before slowly releasing them.
