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**FIJI ISLANDS**

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**FRESHWATER**

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**AQUACULTURE**

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**SECTOR PLAN**

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**2005-2010**



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# FOREWORD

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**A**quaculture can offer a natural alternative to natural resources depleted by disturbance of habitats and ecosystems and can provide support for sustainable development. In many places, declining wild catches from fisheries have to an extent been gradually offset by increasing aquaculture activities.

Fiji is not going to be any different. Growth in its fisheries sector is largely expected to come from aquaculture in the next 10 years. Critical to this development is the need to fully appreciate weaknesses and threats to aquaculture development in Fiji if meaningful and effective strategies are to be incorporated into strategic planning targeting growth. Policies and legislation need to be conducive to the development of aquaculture. Capacity building and awareness campaigns need to be heightened to ensure skills development.

In many cases, aquaculture is the answer to the need for improved land utilization. It can make a positive contribution to poverty alleviation and food supply, providing a source of protein and alternative economic livelihood for people living in rural areas. It also offers the most cost-effective land use options for Fiji.

The future for freshwater culture will be farming of improved stocks. To maintain industry development, farmers must have quality stock. Therefore, stock improvement programs should be developed, decisions on which stocks to farm must be based on rigorous evaluation, and introduction of new strains should be controlled and poor performing lines culled to reduce chances of contaminating high performing lines.

In that regard, Naduruloulou will be developed as a national and regional research station for new introductions, quarantine, strain evaluation, broodstock management, stock improvement programs and training. High performing stock would be disseminated from there.

Having this dream come true is threatened by uncontrolled logging, which is causing natural waterways to dry up or become shallow, by pollution and by the chemical residues from land use. These are issues that need to be controlled to support development of aquaculture in the future.

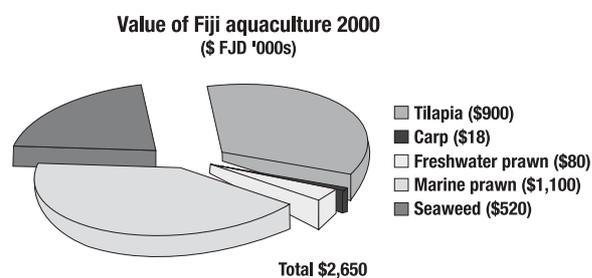
**Mitieli Baleivanualala**

*Chief Executive Officer for Fisheries and Forestry*

# BACKGROUND

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- Globally, aquaculture is in a growth phase. Technological advances in sciences such as engineering, genetics and nutrition have led to higher productivity. The global economy and information networks have enabled greater penetration of markets. According to the UN Food and Agriculture Organization (FAO), aquaculture is the fastest growing food sector amongst fisheries and terrestrial systems.
- In the Fiji Islands, aquaculture was not traditionally a widespread practice and the modern industry is just several decades old. The sector has managed to achieve modest success in terms of economic growth and food security. In 2000 the value of production from the sector was \$FJD2.7 million. Freshwater aquaculture commodities contributed about 40 percent, or just fewer than one million dollars of the total.



- Freshwater aquaculture has been mostly characterized by three main commodities, tilapia, carp and freshwater prawn. A chronology of important milestones leading to the present status of this industry includes the following events:

- 1954** ○ Mossambicus tilapia introduced.
- 1968** ○ Nile tilapia introduced.
- 1972** ○ Raviravi Fish Farm project initiated.
- 1972–1978** ○ Government and FAO project

undertakes various brackish water farming trials of mullet, rabbitfish, tilapia and milkfish.

**1975** ○ Naduruloulou aquaculture station established.

**1980** ○ First tilapia fish farm established at Nukuloa village.

**1981–1985** ○ Development Plan 8 target of 500 tonnes fish realizes only 3 tonnes.

- Research into red hybrid tilapia conducted.

**1986–1990** ○ Development Plan 9 establishes 40 fishponds.

**1997** ○ Commodity Development Framework (CDF) leads to commercial farming of tilapia and freshwater prawn.

**1997** ○ Genetically Improved Farmed Tilapia (GIFT tilapia) introduced.



## PART 1 • Introduction and Objectives

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### ○ *Why and how the Strategic Plan has come about*

- Freshwater aquaculture is recognized as having a major potential impact in the rural areas of Fiji.
- In the recent past the support provided through government programs was well targeted and there is a need to consolidate progress and establish clear and valid objectives.
- A Strategic Plan is required to “market” the sector in order to raise investor confidence, support government budgetary appropriations and encourage more positive interventions by organization such as donors.

### ○ *Methods used to develop the Plan*

- In order to guide the development of this Plan a national census of the freshwater industry was conducted to determine the

actual status of the sector and emerging issues and trends.

- The objectives and indicators for the Plan were developed through a facilitative workshop held at the Tanoa Hotel, Nadi, in August 2004. A complete hierarchy of stakeholders was represented including, for example, the Minister of Fisheries and Forestry and Provincial Fisheries Extension Officers.
- Further stakeholder consultations and refinements were carried out under the direction of the MFF and with the assistance of SPC to refine the final product.

### ○ *Objective*

- This Plan is intended to put in place a five-year framework to develop the freshwater aquaculture sector in Fiji. It recognizes that the Government of Fiji is the main driver for the sector and has a major stakeholder interest in the Plan.

## PART 2 • Status of Freshwater Aquaculture

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### ○ **Characteristics**

Up until the late 1990s freshwater aquaculture in Fiji had primarily social objectives:

- Improve the nutritional status of rural populations
- Generate supplementary income
- Diversify activities
- Create opportunities to stem the flow of migration from rural to urban areas

In recent years the sale of freshwater aquaculture products at outlets such as the Nausori and Suva municipal markets has highlighted the opportunity of the sector to create cash crops which could

generate significant economic wealth and compete with imported protein.

However, the majority of farmers are still small-scale using semi-intensive techniques and low cost feeds. More intensive systems using pelleted feeds are exceptions. The integration of aquaculture with terrestrial livestock and crops has only made minor progress.

### ○ **2004 Census**

According to the freshwater aquaculture pond census of 2004, the typical profile of a farmer is of Fijian ethnicity, middle aged and male. There were a

total of 110 existing farmers including those with farms under construction. The census reported a further 57 ex-farmers who had become disillusioned with their prospects or cited a lack of government support.

Nile tilapia (*Oreochromus niloticus*) and giant freshwater prawn (*Macrobrachium rosenbergii*) were the two main commodities. Thirty tonnes of tilapia valued at \$125 thousand and 1.7 mt of prawn worth \$30 thousand were produced. Two thirds of the ponds were farming tilapia and 10 percent were prawn, although one third of the farmers wished to cultivate prawn if possible.<sup>1</sup> Up to 20 percent of the farms were integrated with crops or other livestock.

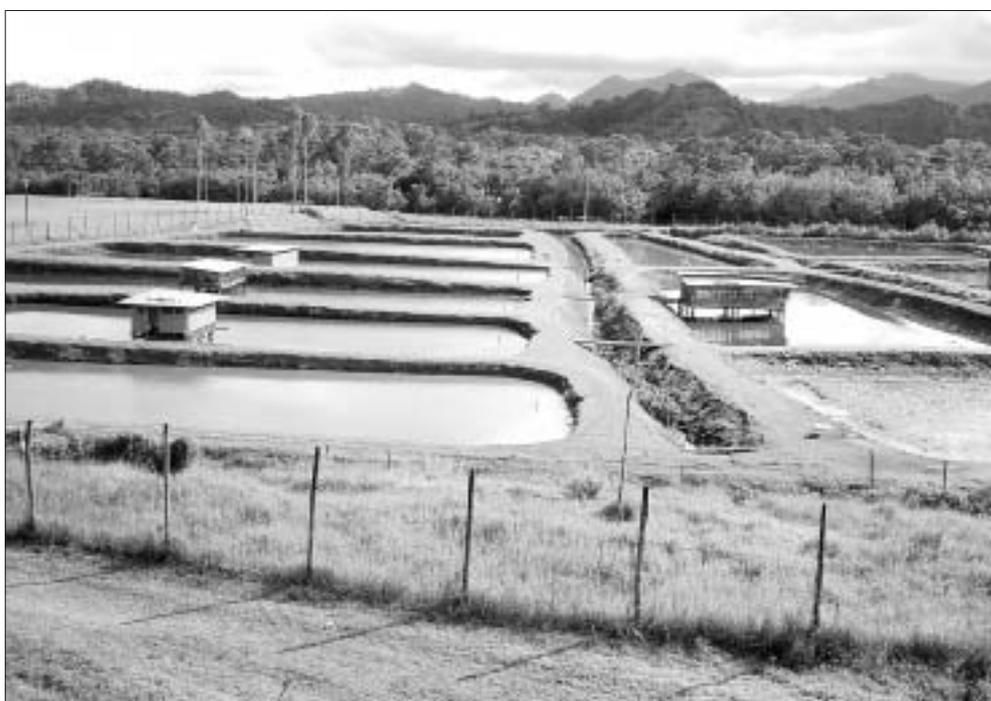
The total area of pond is 25 hectares. Forty percent of the ponds are located in Naitasiri Province. Half of the farms are on *mataqali* owned land with the

remaining equally divided between freehold and leased arrangements.

Half of the farmers surveyed indicated that a lack of fingerling and feed supply is the greatest impediment to farming. The majority were unable to get financing, although almost half of the farmers were recipients of government subsidies. Almost all of the farmers would like training in every aspect of aquaculture.

### ○ Farmgate production

Almost all of the value and output attributed to the sector is confined to two commodities, tilapia and macrobrachium prawn. A peak in production was reached in 2000 when the farmgate value of the crop was estimated to be worth about one million dollars. Between 2000 and 2004 there has been decline in production to less than a quarter of the previous total.



<sup>1</sup> Some farms which farmed tilapia also cultured prawns. About 20% of the ponds were not stocked at the time of the census survey.

**Table 1: Farmgate production**

	1983	1993	1997	2000	2004
<i>Value (\$ thousand)</i>					
Tilapia	126	368	735	880	125
Prawn			46	82	27
<i>Quantity (metric tonne)</i>					
Tilapia	0.61	63	245	220	32.2
Prawn			3	5.3	1.7
<i>Area (hectare)</i>					
Tilapia	0.49	40	37	46	26
Prawn					3
<i>No. of farmers</i>					
Tilapia	15	128	295	300	136

## PART 3 • Future Outlook

### ○ Where is the future growth potential for the sector?

The main focus for future growth is the areas targeted for rice culture in Navua (450 hectares) and Lakena (300 hectares). Tilapia and macrobrachium prawn will continue to be the mainstay of the industry. After these key commodities are

established it is expected that flow-on effects will enable other species such as carp and ornamental fishes to become viable commodities also.

The best scenario of strong growth suggests that freshwater aquaculture could achieve an annual production of \$62 million by the year 2010 (Table 2).

**Table 2: Growth to 2010**

	<i>Area (hectares)</i>			<i>Quantity (mt)</i>			<i>Value (\$ million)</i>		
	2006	2008	2010	2006	2008	2010	2006	2008	2010
<i>Tilapia</i>	100	200	300	2,000	4,000	6,000	10	24	42
<i>Prawn</i>	50	100	150	240	480	720	5	10	18
<i>Others</i>				40	80	120	1.3	1.6	1.9
<i>Total</i>	<b>150</b>	<b>300</b>	<b>450</b>	<b>2,280</b>	<b>4,560</b>	<b>6,840</b>	<b>15.3</b>	<b>35.6</b>	<b>61.9</b>

## PART 4 • Key Stakeholders

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### ○ Key organizations involved in the freshwater aquaculture sector

- Lead agency: Ministry of Fisheries and Forestry, with responsibility for:

- Coordination
- Policy formulation
- Dispute resolution
- Technical services

- Other government agencies: Ministry of Lands (tenure, NLTB), Ministry of Agriculture and ALTA (livestock production, animal health, quarantine, integrated farming, farmer resettlement), Investment Board (small business development), Ministry of Health (food safety, nutrition), Ministry of Regional

Development (rural development), Ministry of Fijian Affairs (affirmative action), Ministry of Public Enterprises (Viti Corp), Ministry of Education (vocational training), Ministry of Women Affairs (gender development)

- Private sector: farmer associations (Tilapia Council), Fiji Cane Growers Council (displaced farmers)

- Inter-governmental organizations: SPC (networking, technical support), USP (training, education and research), WorldFish Center-INGA (genetic improvement), FAO (policy, technical support)

- Others: JICA, ACIAR (donor, technical support)



# PART 5 • The Plan

## FRESHWATER AQUACULTURE STRATEGIC PLAN 2005-2009

OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
<b>1</b>	<b>Policy &amp; Legislation</b>	
1.1	<p>Draft Aquaculture Sector Industry Plan, including integration and coordination with other sectors/industries</p> <p>Consult with stakeholders</p> <p>Conduct public awareness campaign to raise awareness on goals of legislation</p> <p>Finalize Aquaculture Sector Industry Plan</p> <p>Revise quarantine legislation to harmonize with FAO Code of Conduct</p>	<p>Draft Plan circulated for stakeholders input by first quarter 2005</p> <p>Final consultation mid 2005</p> <p>Public awareness campaign started by early 2005</p> <p>Appropriate legislation for aquaculture development enacted by end of 2005</p> <p>Quarantine legislation harmonized with FAO Code of Conduct by 2005</p>
1.2	<p>Develop policy for "satellite" farming scheme</p> <p>Develop standardized pond size and farm size from satellite farming model</p> <p>Continue support to subsistence farms for protein supply</p> <p>Develop policy for support to subsistence farms</p>	<p>Guidelines for the implementation of satellite farming system established by early 2005</p> <p>Implementation of satellite farming scheme begun in 2005</p> <p>Protein supply support for farmers continuing</p> <p>Guidelines for support to subsistence farms established by early 2005</p>
1.3	<p>Draft policy and guidelines to focus efforts on the culture of proven quality species of prawn and tilapia</p>	<p>Culture efforts focused by early 2005</p>
1.4	<p>Develop and establish an active research programme on stock evaluation and genetic improvement</p> <p>Establish quarantine best practice standards and procedures for the safety and maintenance of quality stock</p>	<p>Research programme in place by end of 2005</p> <p>Quarantine protocols in place by 2005</p>



OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
2 Research & Development		
2.1 "Research culture" in stock improvement developed for freshwater aquaculture	<p>Evaluate the performance of the current broodstock</p> <p>Undertake rigorous stock improvement and develop better husbandry practices</p> <p>Isolate and maintain high quality broodstock and continue genetic research improvement program</p> <p>Collaborate with regional and international institutions regarding detection of pathogens</p> <p>Formulate quarantine protocols for cultured and introduced species (post-larvae, juveniles, broodstock and micro algae)</p> <p>Collaborate with regional, international and private institutions</p>	<p>Evaluation work on target species started early 2005</p> <p>Performance of main species known by mid 2005</p> <p>Stock improvement and better husbandry on farms started in early 2006</p> <p>Genetic research and possible introduction of genetically improved strains from internationally recognized aquaculture institutions begun in 2005</p> <p>Establish research capacity for detection of pathogens</p> <p>Ongoing work on quarantine protocols with USP and SPC</p> <p>Ongoing collaboration</p>
2.2 High quality feed developed	<p>Develop feed formulations using locally available materials</p> <p>Continue research on feed formulation for hatchery feed and grow-out to meet local and regional demands</p> <p>Maintain collaboration network on feed formulation analysis with NGOs, regional and international institutions</p>	<p>Profiling of locally available ingredients and assessments started in 2005</p> <p>Ongoing research and trials of feed formulations for tilapia and prawn</p> <p>Measurable increases in growth performance of farmed stocks due to increased crude protein level in feeds</p> <p>Naduruloulou research station is a regional centre for research into feed formulation by 2009</p> <p>Ongoing collaboration on feed formulation</p>



OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
<b>3 Infrastructure</b>		
3.1 Naduruloulou research station developed as National and Regional Centre for Freshwater Aquaculture Development	<p>Upgrade all existing facilities and equipment to meet the national and regional needs of freshwater aquaculture development</p> <p>Establish and construct new facilities as follows:</p> <p>Regional/national quarantine facilities</p> <p>Regional/national training hostel</p> <p>Staff quarters</p> <p>Procure machinery for pond construction</p>	<p>Existing facilities progressively upgraded within the next 5 years starting in 2005</p> <p>Quarantine facilities established by 2006</p> <p>Training hostel and facilities progressively established starting in 2005</p> <p>Two institutional quarters constructed by end of 2005</p> <p>Machinery progressively procured starting 2005</p>
3.2 Extension centres throughout the country strengthened and upgraded	<p>Assess the current hatchery situation to establish the need for expansion and improvement</p> <p>Improve existing facilities for field officers at Sigatoka, Ba, Rakiraki, Nabouwalu, Savusavu and Navua</p> <p>Establish additional hatcheries at strategic locations</p> <p>Provide support to the development of market infrastructure in major national market outlets (Nausori, Makoi, Valelevu, Laucala Beach Estate, Kinoya, Lautoka, Rakiraki and Sigatoka)</p> <p>Establish marketing centres to promote aquaculture products</p> <p>Promote aquaculture products in existing market centres and processors</p> <p>Provide support for the establishment of private hatcheries in satellite farm areas</p>	<p>Expanded hatchery capacity to cater for the projected tilapia and freshwater prawn seed stock requirements planned by end of 2005</p> <p>Infrastructure and facilities and technical equipment for field officers expanded by 2005</p> <p>Fully equipped and self-sufficient hatchery constructed in Rakiraki and Sigatoka by 2005 and Dreketi by 2006</p> <p>Permanent marketing facilities capable of catering for one tonne of live fish per week established, starting in 2005: Valelevu and Makoi 2005, Nausori and Sigatoka 2006, Rakiraki and Laucala Beach Estate 2007</p> <p>Marketing facilities progressively established starting in 2006</p> <p>Existing market centres and processors sell and promote aquaculture products, progressively from 2006 onwards</p> <p>Advisory services, facilities and breeders provided to private hatcheries to facilitate consistent, sufficient and quality seed stock supply starting in 2005</p>
3.3 Rural electrification, water and road works developed to cater for farmer needs	Provide logistic support for infrastructure development to cater for pond management and operation	Ongoing provision of logistic support to satellite farms starting in 2006



OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
<b>4</b>	<b>Market Research &amp; Development</b>	
4.1	Undertake assessment of market potential and constraints for all aquaculture target species	Assessment of market potential and constraints started in 2006 in collaboration with regional institution or consultancy
4.2	Undertake vigorous promotional drives for aquaculture products as healthy foods  Establish market intelligence systems for all aquaculture target species  Establish trade access agreement for marketing of aquaculture products  Establish HACCP certified processors and aquaculture products	Aquaculture product promotion work with private sector and regional institution started in 2005  Market intelligence systems started in 2006  Consultation with ministries of Foreign Affairs and Trade and Commerce started in 2005, and ongoing  HACCAP accreditation started from 2006
4.3	Establish a Product Development Unit at Naduruloulou to undertake product development and value adding research on freshwater aquaculture products  Establish product development and value adding facilities  Undertake product profiling for all freshwater aquaculture products	Product Development Unit established and staffed progressively, starting in 2006  Value adding facilities progressively developed, starting in 2006  Collaboration work with regional institution and private sector started in 2005

OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
<p><b>5 Extension Support Services</b></p> <p>5.1 Efficient and effective extension support services provided to farmers</p>	<p>Establish a Farm Management Support Unit to specifically look after the farm development aspects of freshwater aquaculture</p> <p>Collaborate with NGOs or other agencies (US Peace Corps, JICA) in support of farm extension activities</p> <p>Identify farmer training needs and facilitate field training programs</p> <p>Monitor and evaluate farmer performance and facilitate provision of technical support input</p> <p>Establish farm development database and geographical information system (GIS)</p> <p>Facilitate information-sharing among satellite farms</p> <p>Provide logistical support to extension officers</p>	<p>Farm Management Support Unit established by early 2005 and fully in place by 2006</p> <p>Collaboration with NGOs or other agencies started in 2005, ongoing</p> <p>Farmer training need analysis begun in 2005 and field training program ongoing</p> <p>Monitoring and evaluation of farmer performance ongoing</p> <p>Technical support ongoing</p> <p>Farm development database in place by early 2005</p> <p>Facilitation of information sharing started by 2005</p> <p>Provision of logistical support to extension officers begun in 2005 and progressively developed</p>

OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
<b>6</b>	<b>Human Resource</b>	
6.1	<p>Management skills of farmers improved</p> <p>Develop training manuals and curriculum for farmers on best farming practice</p> <p>Enhance staff skills for the delivery of training to farmers</p> <p>Provide training for farmers on best farm management practices and new farming technology</p> <p>Monitor and evaluate the effectiveness of training</p> <p>Collaborate with NGOs and private sectors on the training needs analysis and delivery of training to farmers</p>	<p>Training manuals and curriculum completed by 2005</p> <p>Staff skills in training delivery progressively developed in collaboration with USP and other institutions (ongoing)</p> <p>Farmer training begun in 2005</p> <p>Monitoring started in 2006, ongoing</p> <p>Collaboration with NGOs and private sectors on farmer training needs ongoing</p>
6.2	<p>Staff technical skills developed (MFF extension staff, research officers)</p> <p>Undertake staff training needs analysis on the various activities</p> <p>Address technical skill requirements in product development, feed research formulation, genetics, quarantine, marketing, research and extension</p>	<p>Staff training needs analysis completed in 2005 in collaboration with USP (priority for 2005)</p> <p>Staff technical training begun in 2005 (priority for 2005)</p>
6.3	<p>Staff provision for freshwater aquaculture industry strengthened</p> <p>Assess the staff requirement in terms of skill level and number of personnel</p> <p>Submit documentation of proposal for upgrading staff human resources for Cabinet and Public Service Commissioners consideration</p> <p>Restructure activities at Naduruloulou to provide better organizational structure</p> <p>Recruit the required personnel</p>	<p>Assessment of required staff provision completed by first quarter 2005</p> <p>Staffing proposal submitted for approval by first quarter 2005</p> <p>Revised organizational structure in place by first quarter 2005</p> <p>Recruitment started in 2006</p>

OBJECTIVES	STRATEGIES	PERFORMANCE INDICATORS
<b>7 Industry Support</b>		
7.1 Freshwater Aquaculture Association (FAA) established	Facilitate consultation with all stakeholders involved in freshwater aquaculture	FAA Constitution completed by 2005
	Facilitate the formal establishment of the Freshwater Aquaculture Association	FAA fully functional by mid 2005
7.2 Holding company to provide strategic partners to accelerate the industrialization of freshwater aquaculture established	Provide support for initial operation of the association	Support to FAA started from early 2005
	Establish National Fisheries Co-operative (NFC) and provide initial funding and technical support	Co-operative established by beginning of 2005
	Identify freshwater commodities that can be moved to commercialization and taken up by NFC	Commercialization process started in 2004
	Identify strategic partners and facilitate formation of strategic commercial commodity business unit	Facilitation process begun early 2005

# PART 6 • Resources Required

## 6.1 Budget for the Strategic Plan 2005–2010

BUDGET 2005–2010 (\$FJD)						
	2005	2006	2007	2008	2009	2010
Component 1 Policy & Legislation	6,000		4,000		2,000	
Component 2 Research & Development	112,000	112,000	149,000	149,000	149,000	149,000
Component 3 Infrastructure Development						
Upgrade raceways, laboratory; establish hatcheries and market facilities; improve facilities in outer station	200,000					
Upgrade prawn and carp hatcheries, feed mill, main office, stores, mechanical workshop*		162,000	162,000	162,000	162,000	162,000
Establish training hostel*		120,000				
Construct staff quarters			90,000	90,000		
Establish quarantine facilities*		50,000				
Procurement of farm machineries and equipment			62,500	62,500	62,500	62,500
Establish market outlets		16,000	16,000			
Upgrade Dreketi hatchery		5,000				
Upgrade private hatcheries		3,000	3,000	3,000	3,000	3,000
<b>Component 4 Market research &amp; development</b>	10,000	20,000	20,000	20,000	20,000	20,000
<b>Component 5 Extension Support Service</b>	150,000	225,000	360,000	612,000	1,101,600	1,101,600
<b>Component 6 Human Resource Development</b>		157,000	137,000	94,000	75,000	60,000
Training programme						
(Staff requirement - see table)	12,000	12,000	18,000	18,000	24,000	24,000
<b>Component 7 Industrial Support</b>	10,000					
<b>TOTAL</b>	<b>500,000</b>	<b>882,000</b>	<b>1,021,500</b>	<b>1,210,500</b>	<b>1,599,100</b>	<b>1,582,100</b>

\* Seek international funding and technical assistance for the implementation of these activities (e.g. JICA or EU)

## 6.2 Expertise to be developed and acquired

The new staff required to maintain the development of the sector are in the areas of: scientific training in applied genetic and animal husbandry skills for freshwater culture species; extension and communication skills; engineering and land survey skills; project appraisal/monitoring/evaluation skills; and human resource development skills.

HUMAN RESOURCE REQUIREMENT						
	2005	2006	2007	2008	2009	2010
Principal Fisheries Officer		1				
Senior Research Officer		1				
Fisheries Officer		1				
Research Officer			1			
Administration Officer				1		
Senior Technical Officer (TG)		1				
Technical Officer I (TG)			1			
Technical Officer II (TG)				1	1	
Fisheries Technical Officer		2	2	2	2	2
Fisheries Assistant		4	4	4	4	4
Technical Assistant (TG)			1			
Senior Clerical Officer		1				
Stores Officer		1				
Clerical Officer			1			

## 6.3 Land Resource Base

The various land classes with corresponding properties and their acreages are presented below. The table below indicates that land classes 11a, 11b and 12a would be ideal for freshwater culture and land classes 4a, 4b, 5a and 12b are suitable for the culture of marine prawn.

LAND CLASSIFICATION						
Land Class	Properties	Viti Levu	Vanua Levu	Other Island	Total	Comment
<b>A</b>	<b>Lowlands (flat, rolling, hilly)</b>					
3a	Dry season moderate to dry Flat to gently undulating land Poor internal drainage Moderate to high fertility	10,709.61 ha	8,259.48 ha	1,134.4 ha	20,103.58	Freshwater culture
3b	Dry season moderate to dry Flat to gently undulating land Poor internal drainage Low to moderate fertility	13,594.91 ha	14,061.11 ha	106.19 ha	27,762.21 ha	
4a	Dry season moderate to dry Flat to gently undulating land Consistently high water table Water brackish to saline	12,960.36 ha	582.75 ha	38.85 ha	135,81.96 ha	Marine prawn culture
4b	Dry season moderate to dry Flat to gently undulating land Consistently high water table Water saline (This class includes all mangrove and saline swamp in all climatic zones)	25,848.2 ha	22,178.17 ha	2217.04 ha	50,243.41 ha	Marine prawn culture
5a	Moderate to dry zone Undulating to rolling land High fertility (very high lime status)	9,684.01 ha	893.55 ha	9,380.98 ha	19,958.54 ha	Marine prawn culture
7c	Moderate to dry zone Undulating, rolling land and minor flat land Low fertility	7,433.3 ha	2,040.92 ha	3,245.27 ha	12,608.12 ha	
11a	Weak, very weak or no dry season Flat to gently undulating land Poor internal drainage Moderate fertility	9,634.80 ha	1,111.11 ha	82.88 ha	10,828.79 ha	Freshwater prawn culture
11b	Weak, very weak or no dry season Flat to gently undulating land Poor internal drainage Low fertility	11,108.51 ha	113.96 ha	290.08 ha	11,512.58 ha	Freshwater prawn culture
12a	Weak, very weak or no dry season Flat to gently undulating land Consistently high water table Water non saline	202.02 ha	-	-	202.02 ha	Freshwater prawn culture
12b	Weak, very weak or no dry season Flat to gently undulating land Consistently high water table Water brackish to saline	5,475.26 ha	-	-	5,475.26 ha	Marine prawn culture
14c	Weak, very weak or no dry season Undulating to rolling land Moderate to low fertility	1,603.21 ha	1,227.66 ha	2,421.65 ha	5,252.52 ha	

## LAND CLASSIFICATION

Land Class	Properties	Viti Levu	Vanua Levu	Other Island	Total	Comment
<b>B</b>	<b>Uplands</b>					
16b	Moderate, weak, very weak or no dry season Flat to gently undulating land Poor internal drainage Low fertility	378.14 ha	-	-	378.14 ha	
17a	Moderate, weak, very weak or no dry season Undulating to rolling land Moderate fertility	-	-	124.32 ha	124.32 ha	
17b	Moderate, weak, very weak or no dry season Undulating to rolling land Low and very low fertility	7,995.33 ha	139.86 ha	1,947.68 ha	10,082.87 ha	
<b>C</b>	<b>Steep and mountainous</b>					
21a	Weak, very weak, no dry season Moderately steep or steep slope Moderate to high fertility	36,519.00 ha	38,073.00 ha	13,724.41 ha	88,062.59 ha	



The Land Use Inventories and Capability Maps also assist in identifying land use capability. Under the land use specific classification the soils are zoned into eight different categories (Class I to Class VIII) ranging from “very good multiple use land” (Class I) to “land that is generally unsuitable for productive use in both agriculture and forestry” (Class VIII).

<b>LAND USE CAPABILITY</b>	
<b>LAND CLASS</b>	<b>DESCRIPTION</b>
<b>I</b>	<b>VERY GOOD MULTIPLE USE LAND</b>
Iw1	Flat, deep easily worked alluvial fertile soils with very slight initial wetness
<b>II</b>	<b>GOOD ARABLE LAND WITH SLIGHT LIMITATIONS WHICH MAKE IT MORE DIFFICULT THAN CLASS I</b>
IIw1	Deep fertile alluvial land with slight to moderate wetness after drainage. Suited to a wide range of crops
IIw2	Also deep to moderately deep fertile alluvial land, slightly more poorly drained than the above class with slight to moderate risks of damaging floods
<b>III</b>	<b>FAIR ARABLE LAND WITH MODERATE LIMITATIONS WHICH RESTRICT THE CHOICE OF CROPS GROWN</b>
IIIw1	Slight to moderate fertile land with moderate to severe wetness, normally of gley soils (Navua). Best suited to wetland crops
IIIw2	Very poorly drained gley soils (Tokotoko) of slight fertility. More poorly drained than the above class. Best suited to wetland crops (rice after major improvements)
IIIw3	Moderately fertile lower river terrace subjected to frequent damaging floods, normally used for marginal grazing
IIIs	Coastal flats of low fertility, low moisture holding capacity, of moderate salinity. Could be improved for vegetables but best used for coconut plantation or improved for pasture
<b>IV</b>	<b>MARGINAL ARABLE LAND WITH SEVERE LIMITATIONS, RESTRICTING THE CHOICE OF CROPS GROWN OR NEEDING INTENSIVE CONSERVATION AND CAREFUL MANAGEMENT</b>
IVs	These are saline areas of Soso soils or mangrove swamps not too difficult to reclaim for cropping
<b>VI</b>	<b>MARGINAL PASTORAL LAND WITH MODERATE TO SEVERE LIMITATIONS</b>
VIw	Areas of mangrove swamps which may be too difficult to reclaim for cropping but can be reclaimed for marginal pasture
<b>VIII</b>	<b>GENERALLY UNSUITABLE FOR PRODUCTIVE USE IN BOTH AGRICULTURE AND FORESTRY</b>
VIIIw	These are mangrove swamps that are best left as they are for protecting the foreshore

## ○ Potential sites for aquaculture

The land classification for aquaculture purposes is derived from the consideration of what factors most affect the potential for land-based aquaculture, with reference to the accompanying environment, for each individual soil type. These factors include the following:

- Climatic zone
- General slope and topography
- Soil drainage (permeability)
- Fertility
- Proximity to adequate water source (water catchment area)

Potential sites for aquaculture should reflect the following characteristics:

- Climate with moderate, weak, very weak dry season
- Flat, gently undulating, low to moderate topography
- Poor internal drainage (good water retention quality)
- Moderate to low fertility
- Close to adequate water source; 1,000 m<sup>2</sup> (0.1 ha) pond area requires 1 megalitre of water

Consultation with other users of the common resource needs to be carried out to facilitate the adoption of efficient and sustainable management practices that would strengthen and harmonize the management of the land resource base in relation to the forms of farming systems and land use involved.

The following are the criteria for selecting areas for aquaculture, in decreasing order of importance:

- 1 Soil largely unsuited to permanent agriculture, or to afforestation for catchment protection, or forestry for continuous timber production and forest preservation, or any other land based economic activity (examples would be waterlogged land, marshland, coastal mudflats)
- 2 Soil suited to permanent agriculture after major improvement (example would be a reclamation area such as Raviravi, Naviyago)
- 3 Soil suited to permanent agriculture after minor improvement (example, rice irrigation area like Lomaivuna pastoral farm, Vunaniu and Deuba rice irrigation scheme)
- 4 Soil suited to permanent agriculture without improvement

## ○ Alternative Land Resource Base Utilization and Management

A possible alternative that may need to be pursued to increase the production base of freshwater aquaculture is to fully utilize certain inoperable rice irrigation areas under a “smart” partnership arrangement involving the government (NFC) and the private sector (indigenous landowners, leaseholders, and foreign investors).

### SOME UNDERUTILIZED LAND-RESOURCE BASES

Location of available land	Area (ha)	Comments
<b>Unused rice land</b>		
Lakena Agricultural Flatland	300	Rice farming revoked
Calia Rice Scheme	450	Underutilized
Vunaniu Rice Project	50	Yavusa/mataqali owned, abandoned
Deuba Rice Scheme	100	Yavusa/mataqali owned, abandoned
Raviravi/Wairiki Rice Project	30	Yavusa/mataqali owned, abandoned
<b>Underdeveloped flat land</b>		
Calia Irrigation Area	200	Surveyed CDF period
Wainadoi Flat Land	100	Former rubber tree farming zone
<b>TOTAL LAND AREA</b>	<b>1,230</b>	

## PART 7 • Production Forecasts

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### Projected Production

The targeted annual production by the end of the five-year period 2006–2010, based on achieving a total area of about 450 hectares by 2010, is 6720 tonnes. The annual production value is projected to be \$60 million by 2010. The other preconditions for increase productivity are: stock improvement and maintenance of quality stocks; incentive packages; and landowners support and participation. Production could be further increased if other support factors are introduced, such as the use of hormones to improve fish growth and productivity.

#### TILAPIA PRODUCTION 2006–2010

	2006	2007	2008	2009	2010
Area (ha)	100	150	200	250	300
No. of fry (million)	10.5	15.5	20.5	25.5	30.5
Production (mt)	2000	3000	4000	5000	6000
Value (\$m)	10.0	15.0	24.0	30.0	42.0

#### PRAWN PRODUCTION 2006–2010

	2006	2007	2008	2009	2010
Area (ha)	50	75	100	125	150
No. of post-larvae (million)	8.64	12.24	15.84	19.44	23.04
Production (mt)	240	360	480	600	720
Value (\$m)	5.0	7.2	10.0	13.2	18.0



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