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NEED FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN FIJI VIA ENGINEERING TECHNOLOGIES

1. **Introduction**

Fiji is one of the small island nations in the Pacific comprising of over 300 of which 109 islands still remain to be habited. The two main islands (Vanua Levu and Viti Levu) support majority of the total population of just over 800,000 with sizeable percentage being in the urban centres of Suva (168,000), Lautoka (43,300), Labasa (24,100) and Nadi (30,884). The islands are predominantly volcanic and rise to an elevation of around 1,000m above the mean sea level with rivers and streams supporting the tropical rainforest on the windward side and extensively cultivated sugarcane farms on the leeward side. All major economic activities including tourism are based on these islands. In contrast, outer islands vary considerably geologically and topographically from slighter coralline islands to larger volcanic edifices, which support smaller but significant population.

The total land area of the country is 18,272km² dispersed in the territorial waters of around 141,800km², the proportion of land to water is only 13%, and even smaller when compared to the larger Exclusive Economic Zone.

Fiji enjoys two seasonal climate conditions (hot wet and cool dry) with rainfall averaging 1,500mm to 4,000mm annually. The topographic effect means that much of the rainfall is within the windward side of the islands. Up to 80% of the rainfall is recorded in the wet season and 20% in the dry season.

2. **Agricultural Policies**

Agriculture has been the backbone for Fiji's economy over the past decade. However, its contribution to the national GDP has declined

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from 20% to around 16% recently. Although agriculture was the lead revenue earner in the 20th century, tourism has now replaced it as the front runner. This has been mainly due to shift of labour force from farming to other sectors such as tourism, manufacturing and the garment industries.

Subsistence farming and sugar cane production dominate the Fijian agricultural sector. The structure of the agriculture sector is made up made up from: crops and livestock, 73%; forestry 10%; and fisheries, 17%. Subsistence agriculture provided 38% of the total agricultural GDP in 2004, whilst the contribution from the commercial agriculture were sugar cane 27%, other crops 16% and other sectors 19%.

Sugar production is the most important agribusiness in Fiji, contributing 6 per cent of total GDP, 25 per cent of total domestic exports, and directly employing around 40,500 people. Indirectly, the Government recognizes the need for restructure with the twin concerns of FSC's insolvency and falling sugar prices in-line with the Cotonou Agreement. As a result of the expected fall in sugar prices, many cane farms will diversify into other forms of agriculture.

The diversification will have impacts on the agriculture sector as a whole, such as increasing competition in the domestic market for vegetables, fruit and poultry, and adjustments in agribusiness and agricultural service industries to meet new opportunities.

The relative contribution of the agriculture sector remained unchanged 1999 - 2004, but this disguises some large shifts within the sector¹. The contribution of sugar began to fall after 1999; by 2004 production had declined by 16 percent from the 1999 level (although it is still of major importance to the economy), fisheries now contributes about 15 percent less following poor catches in recent years, while the mahogany forest harvest is just beginning to make a useful contribution to the value of primary production; mahogany production is expected to increase strongly from 2007 as most plantations reach maturity. The major shift in agriculture is the increasing role of cash crops and livestock. This represents a diversification towards more commercial agriculture as some farmers move out of sugar and other farmers develop from subsistence only farming models to increased commercial production. This requires support to develop the necessary farming skills, including farm business management skills.

¹ Source: Ministry of Finance and National Planning

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Imports:

	2006	2005	2004	2003	2002	2001
Total Imports of Fiji (F\$)	3,119,920,431	2,722,800,000	2,501,639,400	2,284,729,715	1,970,000,530	2,017,000,000
Total Agricultural Imports (F\$)	438,752,308	339,761,474	327,502,542	301,142,661	272,764,962	274,628,184
% Agricultural contribution to imports	14	12	13	13	14	14

2.6 Exports:

	2006	2005	2004	2003	2002	2001
Total Exports of Fiji (F\$)	1,201,574,027	1,187,786,000	1,200,497,000	1,265,934,000	1,232,348,000	1,217,793,000
Total Agricultural Exports (F\$)	526,349,554	419,660,284	357,262,910	329,358,120	247,395,213	369,775,037
% Agricultural contribution to exports	43	35	30	26	20	30

ECONOMIC RECOVERY

Import Substitution

Policies of import substitution and direct government investment in agricultural development projects were vigorously pursued during the two decades following Independence in 1970. The import substitution policy focused on growing local food to directly replace products that were imported - rice, beef, dairy, poultry and feed grains.

As a result of the deregulation policies, the current trade policy regime is fairly liberal with generally low tariffs on food and agriculture products. All licensing and quotas have been removed.

The most important crop imports (2006) which can be cultivated locally include the following:

Rice
Vegetables
Yaqona
Potato
Peas/Leguminous Crops

The most important livestock imports (2006) which are available locally include the following:

Dairy products
Beef

Poultry

Constraints:

High costs of production;
Lack of appropriate machineries and technologies;
Low duties concessions on imported agricultural commodities;
Lack of consistent quality and supply throughout the year of domestic produce;
Unavailability of farming land and the issue of land leasing;
Inaccessibility to finance.

The Ministry of Agriculture will promote the following strategies to develop Fiji's import substitution:

Government, to work towards a cohesive import replacement strategy which engages the private sector and builds quality and consistency capacity of farmers, processors and marketing businesses;

Strengthened applied agricultural research particularly on the prioritized commodities such as rice, carrots, tomatoes and potatoes;

Collaborate with Hotels and institutions such as the Fiji Hotel Association in ensuring that hotel demands for food that can be grown locally are met by local farmers;

Strengthen the Business Advisory Unit to promote a more commercial-oriented production to farmers.

Export Promotion

Profitable opportunities have been identified for exporting traditional exports and certain high value niche products. Numerous studies have identified significant potential.

The most important export commodities are:

Dalo
Ginger
Papaya

Reports have also noted that there remains significant untapped export potential in the following:

Cassava
Breadfruit
Copra
Pineapple
Yaqona

Organic produce – especially vegetables

Too frequently, low levels of these exports are partially attributable to poor quality and inconsistency of supply by local producers.

Constraints:

Marketing structure and infrastructure;
Unavailability of farming land and the issue of land leasing;
Insufficient human resource development;
Appropriate marketing strategies;
Quarantine protocols are not sufficiently in-line with trading partners;
High air freight and shipping costs;
High costs of production;
Lack of appropriate machineries and technologies;
Access to finance.

The Ministry of Agriculture will promote the following strategies with regards to the promotion of export:

Improving market access through securing bilateral quarantine agreements for pawpaw, eggplant, chilli, herbs, pineapple, breadfruit and mango, amongst others to New Zealand;

Implementation of the recommendations of the National Export Strategy;
Formation of the Commodity Groups Industry Councils and development of Strategic Plans for these councils;

Ensuring that the Quarantine Division be corporatised to better respond to the needs of its clients;

Undertake Supply Chain studies on potential export commodities to address supply chain constraints;

Strengthen trade facilitation efforts at bilateral as well as multilateral level.

Agro-processing and Value-adding

Significant potential is available for agro-processing and value-adding, particularly for the niche markets. Of importance are:

The production of cassava, dalo, and breadfruit chips. Flour Mills of Fiji, for example, require 1million tonnes of cassava per month.

Confectionary ginger, and ginger-based products, of which F\$280,000 were imported in 2006.

Tropical fruits, such as fruit puree and jam.

Increasing Investment in Agriculture

There is a growing concern of the lack of investment by the private sector given that most of the private sector involvement in agriculture is small, family-based firms and have limited capital to further expand their business. Government has recognized that this is an impediment to further developing the sector.

The Foreign Investment amendment Act 2004 clearly stipulates guidelines for investors to follow when planning to invest in Fiji. Noteworthy are the types of activities that are classified as reserved and restricted activities for investment.

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Requirement that 40 percent of the equity be held by locals have since been amended as they were seen to be restrictive and not practical to implement particularly in cases where total investment costs are into millions of dollars.

New agro development incentive was introduced in 2006 with the main objective of attracting more investment from locals in agriculture given that most current incentives mainly favour overseas investors. Part of this new Agro Development Incentives is a 200 percent deduction in capital expenditure on capital goods and a 100 percent deduction for promoting value-adding processing. It is difficult at this stage to determine the success of these two new initiatives.

It is understandable that many existing farms and small-medium agro-businesses have identified opportunities to improve the productivity of their operations and/or the quality of their products marketed, however that lack the necessary capital to undertake this process. Typical examples are plant and machinery, livestock herd increase, transport, handling and processing equipment. In most cases the capital items are required for expansion or scaling-up of existing agro-businesses to meet existing market demand, or to take existing products into new markets. In some cases capital items may be part of planned diversification into new areas of agro-business or to develop new products. In essence, agro-businesses have limited capital available to meet the 35% equity requirements for an agricultural loan, without exposing the business to liquidity risk. The option available then is to minimize the loan, but this is often inadequate for the required capital items.

The Ministry of Agriculture will promote the following strategies with regards to the promotion of investment in the agriculture sector:

Review and evaluate effectiveness of current incentives and concessions available to the industry;

Promote Agro-Industry Development through Public-Private Partnership in industry proposed projects, including pilot technology; systems and processes; product development and promotion; marketing studies; market access facilitation; adoption of quality standards and certification;

The Ministry to initiate discussions with the Fiji Development Bank to offer more affordable credit and lenient security and also to review and implement new lending policies to cover cropping cycles and criteria including low interest rate to support growth in the agricultural sector;

Identification of suitable sites for agricultural investment by private as well as overseas investors;

Providing targeted fiscal incentives such as tax concessions, cash grants and specific subsidies within the framework of WTO rules;

Improving domestic infrastructure;

Promoting local skills development to meet investor needs and expectations;

Improving regulatory environment and decreasing red tape.

Food/Income Security and Poverty Alleviation

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Food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

It is vital that sustainable produce be available not only for domestic consumption, but as a source of income and foreign revenue. Given the political events over the last two decades, it is important that there is a sustainable, financially viable agricultural sector. In this, agriculture plays an important role in the stability of the balance of payments.

The main challenge facing food security in Fiji is the rapid substitution of the traditional dietary pattern by introduced dietary pattern. This trend will continue into the future and is irreversible and will continue in the future for the following reasons.

Traditional foods have remained more expensive than their imported substitutes ;

Costs of production have continued to increase, due to declining productivity and the increasing demand caused by population growth ;

Additionally, the prices of imported foods, including rice and wheat, have declined as recent global supply shifts have outweighed demand shifts in the world market.

The Ministry of Agriculture will promote the following strategies with regards to enhancing food security:

Develop cost effective appropriate technologies for traditional root crops that will increase yield and reduce production costs;

Improve agricultural productivity and enhance livelihood and food security in poor rural communities;

Develop and conserve Natural Resources;

Expand rural infrastructure (including capacity for food safety, plant and animal health) and broaden market access;

strengthen capacity for knowledge, generation and dissemination (research, extension, education and communication);

Ensure access to food for the most needy through safety nets and other direct assistance.

3. Need for Mechanization in Agriculture

Although, the Governments policies on developing sustainable natural resources including agriculture have been referred on papers, practically, very little have had flow down effect.

Due to the tedious nature of work involved in the agricultural sector, agricultural mechanization can play a pivotal role in sustaining Farm mechanization continues to play pivotal role as part of the agronomical practices to ensure economic viability of the agriculture sector and contribute to the nation's GDP. Soil losses in Fiji's various watersheds range from 30 to 89tonnes per hectare per year, clearly demonstrating that land use and tilling

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practices, coupled with variable frequencies of rainfall are the main causes of depletion in soil fertility. Lack of proper land use policies and regulations are forcing agricultural activities of slope land.

Fiji farmers had been struggling for ages to transform agricultural farming practices from traditional method of production to modern farming technologies. The mechanization technologies are very efficient and thus yields higher farm returns in terms of additional income for farmers and as food security.

However, the adoption rate of mechanization is slow and at a very low-rate. Most of the farms use draught animals for farming activities. In most cases farmers lack basic skill and knowledge or are not aware of new machines, equipment and tools, that could improve the efficiency, thus increase productivity.

Although, all sectors of the agricultural industry are well served with highly educated professionals and scientific expertise, there is significant deficiency of professional expertise in agricultural engineering and machinery profession to assist in the adaptation of the modernization and mechanization within the farming sectors. To prosper in the development of the country's agricultural sector, farm mechanization is seen as the way forward to make remarkable impact in the agricultural engineering needs.

Current Practices of Agricultural Mechanisation

An agricultural mechanization practice in Fiji has been in many different folds from use of small hand tools to machine power. Various practices include the following:-

- i. Land Preparation
 - Hand tools- forks, spade, knives etc
 - Animal power – plough, harrow, tynes etc
 - Machine power – tractors (2wheel/4wheel), plough, harrow, rotovator, tynes, leveller, ridger, trailer etc
- ii. Crop Cultivation
 - Hand tools – forks, spades, knives, hand sprayers hoes, etc
 - Animal power - plough, harrow, tynes, ridger etc
 - Machine power – motorized blower, boom sprayers, ridgers, rotovator, disc harrow, seed driller, jab planter, transplanter, weeder, etc
- iii. Irrigation

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- Sprinklers (vegetables)
 - Drip
 - Hydroponics
- iv. Harvesting
- Hand picking and hand harvesting (sickles)
 - Reapers (portable)
 - Combines (irrigation projects, commercial farms)
- v. Threshing
- Beating by hand
 - Treading by animal
 - Portable threshers (5hp) powered
 - Combine threshers
 - Sheller
- vi. Winnowing
- Hand
 - Machine
- vii. Drying
- Sun drying
 - Machine drying
- viii. Processing
- Hand pounding
 - Mechanical milling
 - Value adding
- ix Storage
- Silos
 - Storage sheds
 - Cooler
- x Preservation
- Traditional methods
 - Modern techniques- coolers, chemicals, canning etc
 - Sun drying/mechanical drying

Mechanisation the Way Forward

Large volume soil losses in Fiji cannot be over emphasized. To motivate the current generation of young farmers into agricultural industry, mechanization is the way forward. Mechanization plays a dynamic and catalytic role in today's modern farming technology benefiting in the following activities:-

- viii. Land preparation can be done more thoroughly and in less time
- ix. Heavy and difficult soils can be prepared quite satisfactorily and quite independent of weather and season
- x. Operations can be timely in order to meet optimum planting dates.
- xi. Better weed and pest control measures.
- xii. Engine power may be used efficiently for stationary operations of threshing and processing.
- xiii. Multiple cropping becomes more feasible through crop diversification / inter-cropping to optimise production, and sustainably utilizing the scare land and water resources.
- xiv. Avoid harvesting and post harvesting losses such as threshing, handling, drying, storage and processing.
- xv. Increased economic returns to the farmers
- xvi. Reduces drudgery and hard work
- xvii. Substitute for farm labour and the low margin of profit by the traditional method of crop production.

b. **Advantage of Animal Power**

- i. Operating costs and depreciation are low and replacement is by home breeding which is inexpensive
- ii. Management is easy and quite well understood
- iii. Animals are multi-purpose, besides being used as draft animals, they also produce manure and ultimately utilised for meat.

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- iv. Little if any foreign exchange needed for procurement or operation.
- c. Disadvantages of Animal Power
 - i. Low performance capability as compared to mechanical power, thus timeliness of operation is diminished
 - ii. Animals cannot always be controlled for rendering precise planting and cultivation operations
 - iii. Difficult to provide enough power for ploughing new land, heavy soils and thick vegetation
 - iv. Draft animals depend on care and provision of adequate food.
- 4. **Inadequacies/constraints/limitations in the present system**

Mechanisation is not the only solution for all the problems of agricultural production and economic development.

Some of the major constraints are:

- i. Lack of appropriate machine and equipment
- ii. Lack of funding
- iii. Rough terrain
- iv. Lack of knowledge and skills in agricultural mechanization
- v. The disparity of profit returns from mechanisation can be a limiting factor for development
- vi. Land tenure

Constraints have been encountered in obtaining agricultural soft loans from the lending agencies to purchase tractors and associated implements by farmers mostly occupying native lands due of insecurity of land tenure.

- vii. Small-scale holding

Small-holder farmers prefer hiring of machinery or use animal power. They are keen to buy or share small machines like knapsack sprayers or motor blowers. Some small holder farmers are part-timers, engaged in other professions to supplement their income. While others just grow one single major crop through out the year such as rice with some vegetables for their subsistence use.

viii. Credit Facilities

The main criteria for obtaining loans to purchase tractors and other farming implements are based on a one-third to half deposit. This amount is quite considerable and this sort of finance is not readily available from farmers.

ix. Recovery of hire charges

Majority of farmers who hire their tractors or machinery often do not pay for charges and a substantial sum of money cannot be recovered and consequently they go under loss. Some farmers only pay 50% of the hire charges and do not pay the balance after their work is done.

x. Spare parts/after sales service

The after sales servicing and spare parts are not readily available by the agents, and parts have to be air-freighted which normally takes one to three months. This results in high cost of repairs and heavy machinery downtime. The agents should strengthen the spare parts and after sales back up service in order to be more effective.

xi. Research and Development

There is virtually no research and development presently being carried out on the most appropriate machines required for the various major field crops. Some of the areas needing major attention and strengthening cannot be pursued due to funding constraints.

xii. Human Resource Development

Expertise in this area is a rare commodity. There is a need to develop training programme before a full fledged mechanization unit can be effectively operational.

xiii. Field Parameters

It has been observed that the present sizes of the fields in the rice irrigation projects too large for small mechanisation and water management. For effective small scale mechanisation, field sizes should be designed to standard size and this includes the design of new irrigation projects.

5 Agricultural Infrastructure Development

Pacific Islands are small atoll nations with small area of flat land which have drainage and irrigation infrastructures that support the farming community for sustainable living. The effect of climate change are taking its toll in low lying Pacific nations and Fiji is no exception.

There are various types of infrastructures constructed to improve land agricultural production. These include sea defence works, floodgates, waterways, riverbank protection, river training, drainage networks, water storage dams and irrigation works.

The agricultural drainage design criteria adopted in Fiji has the capacity to discharge only 100mm of rainfall within 24 hour period. However, with high rainfall intensities now recorded, the frequency of flooding has increased and our current drainage network have not been able manage the flood waters. On the other hand, prolonged droughts have also been recorded on the drier sides of the country restraining the natural water resource.

Most of villages and farm land are located in the deltic areas of the country. The climate change phenomena is affecting the sea level rise and low lying land which had been improved via construction of seawalls are at risk of being infiltrated with sea water again.

In these areas the agricultural engineering technologies need to be re-looked at to address the risk of vulnerability being created by the climate change phenomenon.

The Ministry of Agriculture is looking at an integrated approach in addressing the problems within watersheds.

6. Future Direction

Fiji needs to review its agricultural engineering programs to suit its local conditions. Unfortunately, we lack the expertise in this field.

We therefore, would like to request external assistance from the member countries of **APCEAM** (and also including other donor agencies) to assist Fiji in the following area:

- Technical Assistant - Policy formulation for agricultural engineering programs,
- Short term & Long term mechanization development programs
 - Ensuring capacity building in policy formulation in Farm Mechanization Technologies,
 - Post-harvesting Technologies,
 - Technology Transfer,

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- Revisit the design criteria for the drainage system and other infrastructures to support sustainable use of low lying land
- Develop technologies for water harvesting to mitigate the impacts of drought
- Eradicating poverty among the rural farming communities through improved farming systems and use of appropriate farming machineries and equipment for sustainable livelihood,
- Capacity building in the area of agricultural engineering,

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