AGRICULTURAL MECHANIZATION IN FIJI

1. Introduction

Fiji is an island nation 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 775,000 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.

Agriculture has been the backbone for Fiji’s economy over the past decade. However, its contribution to the national GDP has declined from 20% to around 16% recently. This has been mainly due to shift of labour force from farming to other sectors such as tourism, manufacturing and the garment industries.
Due to the tedious nature of work involved in the agricultural sector, agricultural mechanization plays a pivotal role in sustaining this industry.

2. **Mechanization in Agricultural Sector**

During the colonial era, mechanized farming was centred in sugarcane belts of Western and Northern Divisions of the country where animal and machine powers were extensively used. In other areas, farmers were reliant on hand tools and animal power.

In the beginning of post independent Fiji, large farm-machines and associated equipment were introduced to meet the new challenges in sustainable development of the sector. Introduction of large four-wheel drive tractors and associated machineries and equipments in the sugar industry has been seen as major challengers for the benefit of the industry. Large scale mechanization activities were also undertaken by the Native Land Development Corporation (NLDC) and Ministry of Agriculture, Sugar and Land Resettlement.

Towards the end the last century, more sophisticated and appropriate agricultural farm machineries and equipments were introduced to meet the demands of the modern agricultural farming. A wide range of farm machines and associated equipments were available in the in the country from various dealer to choose from, but without much emphasis to applied research and evaluation of the appropriateness of these machines to suit our local conditions.

With the down-fall of NLDC operations, and deregulation of the rice industry in the early nineties, the mechanization priorities within the ministry also had a setback.

Although the ministry made efforts to revive farm mechanization proposal under the Commodity Development Framework (CDF) programme, but due to the funding constraints the proposal has been shelved. The potential of the farm mechanization would have been realised should the Government pursue to support the proposal in near future.

3. **Need for Mechanization**

Farm mechanization continues to play pivotal role as part of the agronomical practices to ensure economic viability of the agriculture sector.

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 export earnings and as food security.
The various advantages of mechanization are as follows:

- Reduction in dependency on labourers
- Reduced physical power
- Increased output
- Maximising profitability
- Draught animals eliminated from larger-farms

- Indirect employment opportunities increased vide additional spare part dealers, machinery dealers, repair workshops etc.

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 significant in the agricultural engineering needs.

4. **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
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- Machine power – motorized blower, boom sprayers, ridgers, rotovator, disc harrow, seed driller, jab planter, transplanter, weeder, etc

iii. Irrigation

- Flood
- 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

5. **Mechanisation the Way Forward**

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:-

i. Land preparation can be done more thoroughly and in less time

ii. Heavy and difficult soils can be prepared quite satisfactorily and quite independent of weather and season

iii. Operations can be timelier in order to meet optimum planting dates.

iv. Better weed and pest control measures.

v. Engine power may be used efficiently for stationary operations of threshing and processing.

vi. Multiple cropping becomes more feasible through crop diversification / inter-cropping to optimise production, and sustainably utilizing the scare land and water resources.

vii. Avoid harvesting and post harvesting losses such as threshing, handling, drying, storage and processing.

viii. Increased economic returns to the farmers

ix. Reduces drudgery and hard work

x. 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.

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.

6. 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 Fiji Development Bank 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. Deposit for obtaining credit

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.

tax. 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 irrigation projects in Lakena and Navua are too large for small mechanisation and water management. For effective small
7. **Level of Mechanisation Needed**

(a) **Short-term – Farm Machinery Contractors**

**Government Machinery Pool**

All machines cannot be operated by the contractors. There are remote rural areas where government need to assist the farmers in providing the farm machinery services. Surveys have shown that farms with tractors represent fewer than 10% of all the farms. Government machinery pool should address the problems associated with unavailability of labour in rural and give incentives to school leavers to leave a decent living from the farm.

**Setting up of Machinery Contractor**

Improved technology implies improved productivity resulting in improved income for the producer. It must be realised that any increase in agricultural production has to be related directly to the levels of mechanisation. The mechanisation policy should incorporate appropriate technology suited to local conditions. Taking into consideration that a substantial portion of the farms units are too small to own and operate tractors or other machinery service, it is advisable to promote the setting up of machinery contractors to service the needs of the farmers. The contractors as far as practical could be from the farming community within the location or area and should be capable of operating a farm machinery contracting service to provide timely operations in order to avoid unnecessary delays in crop establishment. A typical package of farm machinery owned by a contractor or well established farmers.

**Strengthen Mechanization Unit**

As modern technology grips the globe today, more and more new machines become available in the market. The mechanization unit within the ministry has no direction or policy that could see it positively contributing towards the rejuvenation of the agricultural sector. A firm policy formulation and Government commitments to mechanize the agricultural industry need to be in place, to provide guidance in developing the sector.
(b) Long Term

Establishment of Farmer Organizations

To form Farmer Associations or Agricultural Cooperatives whereby the members can purchase appropriate agricultural machinery either by loans, self-help projects, overseas aids and grants. The advice and assistance of various Government Departments will ensure that the members actively participate, control collectively and share increased benefits. Pilot Farmer Associations or Agricultural Cooperatives should be established in each district or province and the associated Government Ministries and agencies should act as advisors and ensure that the project does not fail. The success of the pilot project would determine whether the concept of Farmers Association or Agricultural Cooperatives can be extended further. The services of a farm mechanisation consultant or advisor will be needed for guidance and advice.

Research and Development

Currently there is very little research and development of agricultural tools and machines that suit the local environment. The need to design appropriate machines is more than ever demanding now. Water management for various crops to produce quality vegetables, grains and fruits is essential for the agricultural industry. Moreover, implementation of appropriate irrigation system can contribute to the sustenance of the export market for the agricultural produce. We have only tried to copy the glass house technology, without considering its implications on the local environment. Temperature control, water requirement, weed control and harvesting techniques need to be pursued.

8. Implementation and Strategy

The effective mechanisation of agriculture is closely related to the economic growth of a developing country such as Fiji. Many factors must be accounted for during the planning and implementation phase of agricultural mechanisation programme. These include such things as:

- Land productivity
- Labour utilisation
- Machines design and selection
- Costs and returns
- Income distribution
- Machine operations
Effective education and training are an essential part of any agricultural mechanisation programme. Personnel must be trained at all levels from that of machine operators to supervisors and engineers. Short-term and long-term training programme should be developed both local and abroad. Many of the unsuccessful mechanisation programmes were attempts to directly transplant technology from a developed country to a developing country. Often the machinery and power units were not the right types and did not have the capability of doing the task effectively and economically.

At the initial stages, the new strategies could be tried out in the irrigation projects and the agricultural development projects. It could be extended to other extension projects and areas if it is found to be successful.

A periodic or annual evaluation is to be carried out to gauge its effectiveness and shortcomings. The services of an agricultural mechanisation advisor or consultant are also needed for advice and guidance.

9. Current Practice

- Land development and farm mechanisation has been a vital component of all agricultural programmes whereby unused land particularly mataqali land is cleared and levelled by D4 dozers, followed by ploughing and rotovation with wheeled tractors.

The current practice has been that unused and potential land is developed either under partial grant assistance or at a established hire rate, i.e. free land clearing and levelling by D4 dozers, one ploughing and two rotovations, whereby the fields are ready for planting.

The machines could be hired from private contractors or government machinery pool if available. Bringing unused/potential land into cultivation is a costly operation for farmers especially the land owning units, ‘mataqali’, members. These farms are assisted in the initial stages so that they are able to establish themselves and get off the ground. Based pm the above concept the future mechanisation policy should be as follows:

- Used/Cropped land

Land improvement works on existing cropped land by D4 dozers, ploughing and rotovation by wheeled tractors, seed drills and water pumps can be provided to farmers.
The revenue derived from the hire of machinery could be operated as a revolving fund. The running and maintenance costs of the various machines in the pool could be met from this revolving fund. Proper records of machine hire charges, revenue collection and expenditure should be kept which should be subject to periodic audit checks so as to keep a tight control on the efficiency of the operation. The machine hire rates should be periodically reviewed to be in line with prevailing costs of fuel and spare parts.

• **Private Contractors**

Due to the limited number of machines available within government’s jurisdiction to cope with the increasing demands especially tractors for land preparation, it is advisable to encourage the setting up of farm machinery contractors to service the needs of the farmers. The majority of the crop farmers in Fiji apart from sugarcane are small holder units and are therefore not able to own tractors and other appropriate machines. These contractors as far as possible should be from the same farming location or district and should be capable of operating a farm machinery contracting service to provide timely operations especially land preparation (ploughing and rotation), crop planting, harvesting and threshing. A typical package of farm machinery owned by a contractor or well established farmers.

The finance needed to purchase the above machinery and equipment could be made available from the Fiji Development Bank, Merchant Bank of Fiji or other commercial banks. These contractors will provide timely service for the various field operations, and will encourage more areas to be brought into cultivation. The Ministry should act as advisors to these farm machinery contractors on the purchase and use of the most appropriate machines/implements from land preparation to harvesting and processing. Grants and duty-free concessions on machinery should also be given to recognised contractors, so that farmers in turn receive better, efficient and cheaper service.

10. **Research and Development**

Fiji needs to undertake proper Research and Development programs in developing agricultural mechanization 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 such as APCEAM (and also including other donor agencies) to assist Fiji in the following area:

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

- Eradicating poverty among the rural farming communities through improved farming systems and use of appropriate farming machineries and equipment for sustainable livelihood,

- Training in Agricultural Mechanization,

- Priority needs in Agricultural Engineering and Mechanization

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