

Asian Pacific Centre for Agricultural Engineering and Machinery

Country Report – Sri Lanka

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Country Report – Sri Lanka

1. General information about Sri Lanka

Area: 65,610 km²

Population: 19,252,000 with 1.3 % annual growth rate

Human Development Index: 0.740 (Min 0.0, Max. 1.0)

Life expectancy: 72.4 years

Literacy rate: 91 %

1.1 Average Temperature

Lowlands: Average between 22°C - 33°C

Central Highlands: Average between 7°C - 21°C

1.2 Average Annual Rainfall – 1900 millimeters

1.3 Production of main crops (values in Rupees (0,000) and Land utilization in ha)

| Crop | Value in SL Rupees (0,000) | Land utilization (ha) |
|------------|----------------------------|-----------------------|
| Paddy crop | 42897 | 790,000 |
| Tea | 46283 | 211,000 |
| Rubber | 6327 | 115,000 |
| Coconuts | 28534 | 443,000 |

1.4 Economic & social importance of Agriculture

- Higher GDP contribution (20.1%)
- Land utilization – 1.4 mil.ha
- Employments- 33%
- Food security
- Source of calories

1.5 Institutions involved in Agriculture Research & Development

- Department of Agriculture (Includes Mechanization, FMRC)
- Tea Research Institute
- Rubber Research Institute
- Coconut Research Institute
- Export Agriculture Department
- Sugarcane Research Institute
- IPHT (Includes Mechanization)
- National Engineering Research and Development Centre.

1.6 Private sector involvement in Sri Lankan Agriculture

- Supply of inputs- Machinery, Fertilizer, Agro-chemicals, Seeds and Planting materials
- Credit facilities – Private banks
- Purchasing & distribution
- On farm research- few private companies

2. Agricultural Engineering R & D...:

The following institutions and establishments are available for the manufacturers to obtain their required designs, prototypes, technical know-how and testing and certification of the machinery.

1. Farm Mechanization research Centre (FMRC), Maha Illuppallama,
2. Institute of Post Harvest Technology (IPHT), Anuradhapura,
3. National Engineering Research & Development Centre (NERDC), Ekala,
4. Farm Mechanization Training Centre (FMTC), Anuradhapura

Out of the above four institutions FMRC, IPHT and NERDC are involved in research and development of agricultural machinery. The necessities of different kinds of machines are notified to these institutions in accordance with the respective specialties of them. The requirements are originated from farmers at grassroots level, officers involved, NGOs who are assisting farmers, and the provincial technical working groups.

In general a requirement of machinery for a particular operation is indicated to one of the above three institutions the procedure is to look for the availability of such machines else where in the world. In this regard most frequent case is that even promising machines are available the applicability of them to local conditions had always been questionable. The infrastructure, soil conditions, climatic conditions, inherent practices and above all the purchasing power of the farmers had been obstructive factors to introduce the machines brought from abroad. This is the main reason that, except the fuel operated prime-movers including tractors, all other agricultural machinery are produced locally.

The research procedures involved design, prototype production, testing, modifications as needed, final testing, adaptive research and introduction to the farmers. The mass production of the machinery are totally done by the private sector.

There are also instances where individual companies have obtain the designs from their principals abroad and do modifications to suit local requirements as they are the sole agents in Sri Lanka for these machines and equipment. In such cases, assembly or semi manufacture is mostly the arrangement. It must however be noted that, in Sri Lanka there is only a limited capacity for local consumption and therefore large investment on assembly line type continuous production systems may not be economically viable unless otherwise international market is approached. This is the main reason for many manufacturers importing their prime movers.

Few large-scale manufacturers are capable of investing on R & D work on agricultural machinery. The major cause for this situation is the marginal profit made by the manufacturing industry and seasonal sales of equipment requiring large investment on stocking manufactured goods.

3. Testing and certification procedures of Agricultural Machinery

Agricultural machinery, mainly tractors, are imported from various countries all over the world or locally manufactured in different categories of workshops. Generally the machines are designed to satisfy a certain specified range of conditions. A machine produced in a country may or may not suit another country because of the prevailing agronomic, climatic and ecological conditions. Similarly the locally made machines for instance may fail to satisfy the conditions in some regions within the country. The physical outlook alone definitely is not sufficient to judge and select a machine designed for a certain operation. A thorough testing and evaluation, taking into account performance, quality, durability and safety is necessary for a testing engineer to come to a decision on suitability.

Sri Lanka especially being a developing country requires additional emphasis on an economic evaluation with regard to machine cost, maintenance cost and import duty to allow a judgement. Under the system of competitive free enterprise the manufacturer will further improve and develop his product in various aspects, if a test done at a recognised institution is required by the government.

DEFINITION OF TESTING

Testing has to fulfil a variety of functions in the national economy. These would include:

- providing of information to the farmer on performance, safety, economic benefits of agricultural machines.
- it should reveal to the manufacturer, importer and exporter the positive and negative aspects on design, performance, quality, durability and comparability to its competitors on a national and international level.

Testing for local conditions means not only to have technical data on performance, quality and durability, but includes social, economic and cultural aspects.

TESTING PROCEDURE

To be possible to come to the above judgement a test should include:

- general criteria applicable to all types of machinery
- special criteria applicable to a range of a certain implement

We may consider the general criteria such as:

1. Technical data
(Specification given by manufacturer; performance)
2. Checking of specifications given by the manufacturer
3. Durability wear & tear (coating)
4. Safety
5. Maintenance
6. Repairability
7. Transport
8. Price

Under special criteria we understand as mentioned earlier that for each range of machinery a frame- work of criteria has to be established to analyse the single multiple functions of machinery under various conditions.

Single tests can only produce a certain quantity of readings and are not complete in itself. It is therefore necessary for checking, proving and comparing criteria and data to carry out a number of different tests. These types of tests are briefly discussed in the following paragraphs.

TYPE OF TESTS

(a). Laboratory

A laboratory test may be a very simple test to prove one function or one technical aspect or it may require large laboratory equipment and set-up.

e.g. A simple set-up may be to measure the speed of a tractor or a draught-animal with a tape and a stop watch, where as for a laboratory test of an engine, it may require a large amount of instruments and equipment

The main advantages of a laboratory test are:

- Season or time is immaterial
- Repetition of the test is easier
- Accelerated durability tests can be conducted 24 hours per day, if necessary.

The main disadvantages in some cases are that the results may differ from the actual field situation.

(b). Performance

Each performance test gives quantitative data about the operations and functions of the machine checked against manufacturer's specifications and can be carried out either in the laboratory or in the field under various conditions.

Quantitative data may in the form of capacity readings, efficiency readings in relation to input and further important reading is the ability to record damages or losses, if any, in the involved processes.

(c). Practical

As laboratory tests do not reveal all advantages or disadvantages of farm machinery, tests are necessary as close to reality as possible. This reality is found in farmer's fields. Here we have conditions which are heavily varying due to climate, geography, weather, soil and cultural practices that can influence the performance and efficiency of an implement in a positive or negative aspect. The handling and transport of implements which may not have been analysed thoroughly in the previous tests will definitely come to light and show the ease or difficulty in operating the implement.

(d). Durability

A durability test which can be carried out either in the laboratory or in the field is most important to the farmer to make an investment decision and to the manufacturer to judge if he is able to keep-up with the requirements of the implement and if the implement can complete with other competitor's products on a national and international level. Additionally the durability test will highlight the question of supply and exchange of parts as well as the general repairability of the implement.

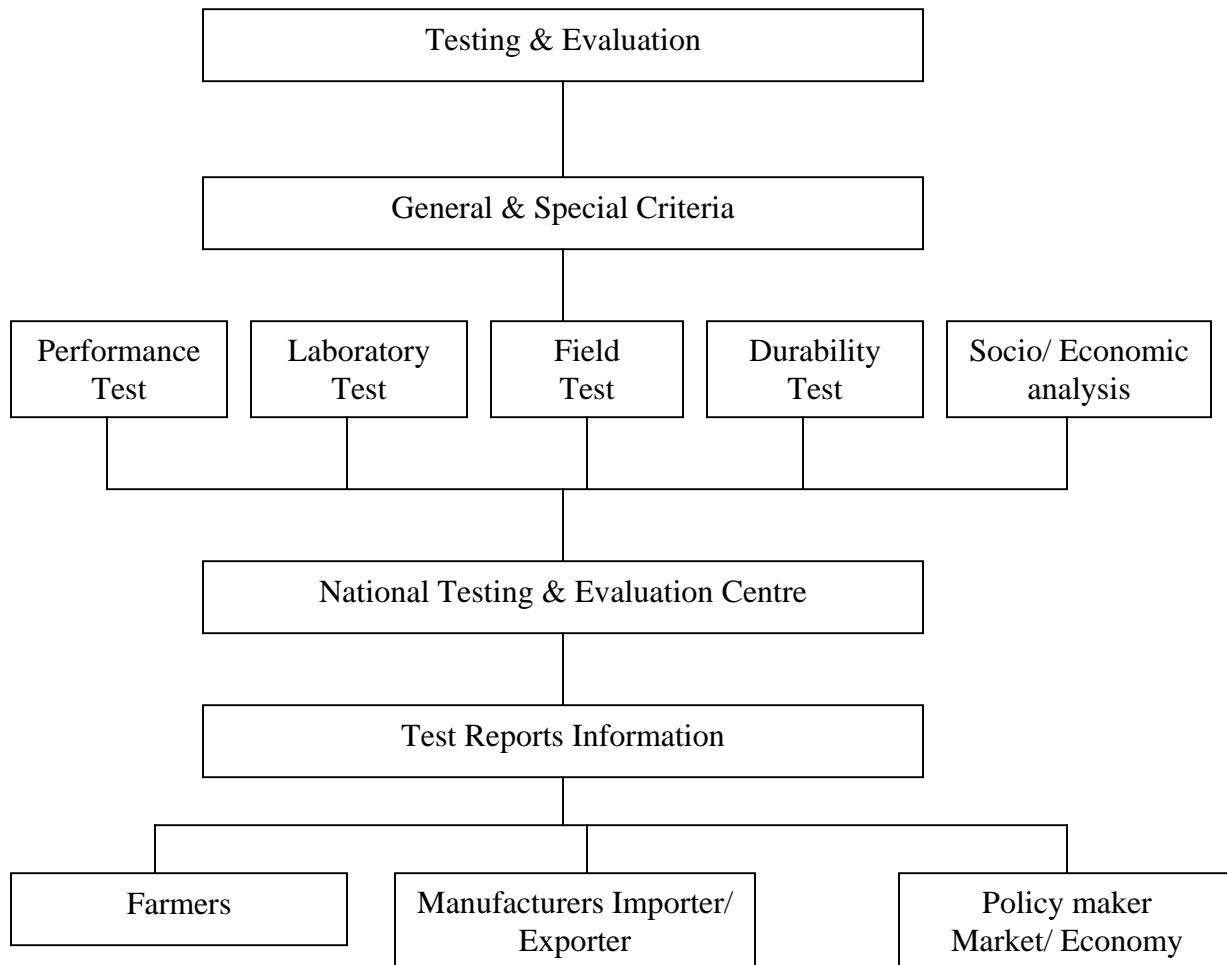
(e). Socio- economic analysis

This has to be done on a basis which gives the farmer a clear picture about the benefits of purchasing the implement, but at the same time it should make the policy maker aware of the consequences of the mechanization process. The consequences may be partly.

- Labour displacement
- Change of cultural patterns & habits
- Uprooting of existences
- Large foreign exchange flow- out

All these factors are not so important to a single farmer, but may rise to an importance of first priority to the policy maker. However, it is acknowledged that these factors differ from region to region, as well as from nation to nation, but it can be said therefore that a social-economic analysis is definitely necessary and of greater importance in a developing country.

This proves that testing and evaluation of agricultural implements to suit local conditions is a complex task and an important link in the mechanization process of a developing nation.



4. Compulsory minimum standards as applicable to chemical spraying and issues involved

Sprayers

- Sprayer manufacturing industry

Types of sprayers mostly used: Spraying is essential in controlling insects, diseases and weeds in paddy, other field crops, plantation industries, horticulture and floriculture. Large scale tractor mounted boom type sprayers are rare and knapsack hand operated sprayers are the most popular, the average annual demand of the latter being between the range 25,000 – 30,000 units. The sprayers available in the field could be categorized as follows:

- Knapsack piston type
- Knapsack diaphragm type
- Knapsack semi-auto type

- Knapsack/Hand carried thornborn type
- Knapsack power sprayers
- Engine/Motor driven high pressure piston type for orchards

The Semi-auto type is usually not recommended for agricultural use for its inability to keep the spray discharge constant throughout the operation. Sri Lanka has a few large scale manufacturers producing best quality standard knapsack hand operated and engine powered sprayers. However, nearly 20% of the sprayers are still imported amidst the high custom tax about which the local manufacturers are still not satisfied claiming that their production cost is higher because of the imported raw material are being highly taxed.

- Standards available and the Authorities for updating standards

Standards for knapsack had operated sprayers have been formulated by the Sri Lanka Institution for Standards (SLS) with the views and suggestions obtained from the relevant Institutions and Universities. With regard to updating the standards the SLS is the sole authority and the testing standards are formulated and updated by the FMRC.

- Testing institutions and their functions

The Farm Mechanization Research Centre (FMRC) is the only Institution available for testing and certification of sprayers of all kinds. Under the open economy system no hard and fast rules to import, manufacture or sell substandard sprayers. But, fortunately, machines that have not received the certification of FMRC have no demand in the market.

- Problems encountered due to substandard spraying equipments

Many problems associated with sprayers are due to inadequate attention on compliance of the different components of the product with the accepted standards as mentioned in the following table.

| Component | Deviation from the standard | Problems encountered |
|----------------------------------|---|--|
| Container material | Substandard material | Can not withstand the reactions with different chemicals |
| Improperly manufactured triggers | Trigger can not be operated with one hand | Inability to closedown the discharge in an emergency |
| Overflow retention area | Lack of overflow retention arrangement | Danger of over flowing |
| Straps | Strength, width and cushion effect not up to the standard | Ergonomically unsuitable and danger of braking |

Proposals for further development of sprayer standardizations and manufacture

- Strengthen FMRC testing and certification activities
- Strict rules to obtain test certificates in order to avert production or import of substandard machines

5. Conservation Agriculture

A good control of weeds before seeding or planting is an essential pre-requisite to successful farming. In this context killing weeds, making minimum damage to the soil and environment, while preserving the precise water for increased cropping intensities is basically expected from no-till or minimum tillage. Cultivating of crops in alliance with this nature is somewhat similar to the traditional practice of chena systems which consists of pre-planting control of weeds by slashing and burning the existing vegetation. This shifting method virtually needs no external input. However, under the severity of tropical rainfalls the bare soil quickly erodes and fertility declines. On the other hand the elimination of well grown forest resulted consequently in lowering down the anticipated rainfalls and hence strict rules have been imposed to control this type of cultivation.

It is therefore encouraged to apply no or minimum tillage practices to the existing cultivable lands. Those lands cultivated under lowland conditions with crops such as rice, that needs soft soils for better growth, anyhow must be well tilled. Then, the highlands used for cultivating pulses, maize, millets and certain types of vegetables could be brought under the no till or minimum tillage Agriculture. In this regards, many small-scale farmers who are growing pulses and maize generally do not till their lands for the purpose of reducing the production cost. They, instead of ploughing, dig shallow holes using hoes and bury the seeds-in without disturbing the soil structure. The weeds are controlled by slashing them with mammoties or hoes.

One of the better solutions to mitigate pollutions from Diesel engines is to encourage use of engines that consumes less fuel per unit area. In this context no sufficient research has been done and as a result it is not leading only for environmental damages but in general for the cost of cultivation to remain at a high level. Sri Lanka being a country with the average land holding of one hectare research must be conducted on both the effective use of small scale tractors and animal power wherever possible. The other important aspects to look into are the proper maintenance and efficient application of machines for optimum field capacity. In order to achieve this, research programmes coupled with effective training and extension methods would have to be introduced. .

Sri Lanka is blessed with a satisfactory average annual rainfall of 1900mm with that of about 3000 mm at the hill areas in the mid country and average of 1050 mm in the low country including the dry zone. A very little amount of this water is being utilized for generating electricity and for feeding agricultural crops. The ancient cascaded tank irrigation systems could not be coupled with the direct use of rain water, as yet, to achieve at increased cropping intensity due to following reasons.

- Poor organizations among farmers and authorities concerned to achieve timely crop establishments
- Lack of sufficient power and machinery for timely completion of different farming operations

Wastage of water remains at high level due to the carelessness of the users and none availability of modern micro-irrigation systems including drips and sprinklers.

6. Food Chain Issues

The importance of post harvest technology and food processing is dictated by several factors, among which are high post harvest losses of commodities with a short self-life, advent of fast developing processing industry and the need for the country to enter foreign market with novel products.

The losses incurred in rice from pre-harvest to the consumption table is around 25% and that of vegetable and fruits stand at about 40%. Thus the proper attention on reducing post harvest losses itself brings a vast achievement in self sufficiency in food.

The value addition in food is essential as a measure of reducing poverty. In this regard the new food products have to be convenient to the consumer, attractive enough to be noticed by potential buyers, possess high quality and taste. To be able to successfully capture foreign markets, the method of shipment has to be sufficiently cost effective and products have to conform to high quality standards on arrival at the country of destination. Thus it is vital to involve in a wide range of activities that include supporting commodity and machinery researchers by quality evaluation, technology development for harvesting, processing, handling, grading, packaging, transport and technology transfer.

7. Renewable Energy and Bio-fuels

7.1 Wind energy

Sri Lanka being an island has sufficient potentials for extracting wind energy for both agriculture and electricity generation. The horizontal type wind turbines had a popularity a few years back mainly among vegetable cultivators. In this connection, fossil-fuel driven centrifugal pumps and wind-mill structures fabricated at village level had no significant different in initial investment and the farmers preferred the latter for its advantage of fuel-free operation and cheap maintenance. However, with the increase of imported raw material the cost of fabrication of wind-mills increased extensively resulting in poor demand for the same. The other disadvantage of wind-mills is that the present design can not install away from the fields to face undisturbed wind blow. Therefore, this technology involved with very low running cost and no environmental hazards must be reconsidered and sufficient facilities must be provided for further research and extension.

7.2 Solar power:

Drying of agricultural commodities is not a serious problem as Sri Lanka receives sufficient heat from sunlight for its favourable location in the world map. However, systematic drying technique for dehydration of perishable food items such as vegetable, fruits, fish products etc. needs further attention.

Water pumps driven by solar energy is becoming popular in micro-irrigation systems. The major drawback in this connection is the high initial cost and FMRC is presently studying the methods to reduce production cost of these systems.

7.3 Bio-fuels:

Despite several attempts the popularization of biogas technology still not successful because of the following reasons:

- High initial cost
- Availability of alternative fuel at close proximities.
- Difficulty in performing regular maintenance
- Use of biogas in operating engines is not popular

8. Agribusiness/Agro-based (green) enterprise development

A need to develop agriculture on a commercial basis was identified by the Department of Agriculture (DOA) and separate service for the purpose was established a few years back. This service offers varieties of services including the followings.

- Establishment of linkages between producers, processors, dealers, exporters and government institutions
- Collaborations with provincial councils, NGOs, business community and other relevant interest groups
- Collection of information on crop production, processing and marketing for dissemination to potential users
- Keeping clients informed on services provided by the DOA
- Establishment of a database on commodity prices.

A core group of officers with specialised training covering spheres of agricultural processing, post harvest handling, production systems, seed and planting material production helps potential entrepreneurs to identify new avenues for investment in agriculture. The demand for technological support appears to be particularly high for construction of protective houses for cultivation of high value crops.

9. Food security

Both the farmer as well as the type of farming has to change if we are to succeed in our strategies directed towards achieving greater food security. The country has to place agriculture on a commercial footing and develop the farmer as an entrepreneur. With the

view to increase the productivity, reduce the cost of production and improve the quality of produce the government has to take leadership to draw up new plan of action for the coming years.

The basic strategy is to establish field demonstration plots and organize field days to educate farmers and other interested groups on the advantages of adopting recommended technologies for increased productivity. The field days should be carried out with the participation of provincial extension staff, administrators, scientists from universities, NGOs, private sector enterprises and farmer organizations.

Steps have already been taken to collect exhaustive information on varied aspects concerning production of crops (extent cultivated, production, yield, varieties, seed and planting material supply, inputs and their availability, cost of cultivation etc.), their marketing (prices, imports and exports) and other relevant details.

10. Problems in rice cultivation and suggested solutions

From the total of 1,800,000 farmer families 800,000 are directly involved and depends on cultivating rice. Nearly 80% of these families are still in subsistence level and the main problem faced by them is the high production cost that forces a substantial number of farmers withdraw from farming to look for other means living. This situation is continuously being aggravated and there want be sufficient farmers available for rice production in few years to come. It is unfortunate that no sufficient emphases have been made to strengthen the hands of farmers to produce commodities that are supposed to be able to derive high yields at research stations.

10.1 Measures to increase profit margin in rice cultivation

Owing to many reasons the profit margin of rice cultivation is continuously narrowing compared to a number of other crops. This indicates that immediate measures would have to be taken to avert the profit being reduced and to encourage farmers to be persistent with the cultivation of our staple food, rice. Among many ways in which the profit margin could be increased the followings are the tangible solutions.

1. Reduce input cost (labour, machinery, agro-chemicals, fertilizer etc)
2. Increase labour and land productivity
3. Increase cropping intensity
4. Increase yield through timely cultivation, high yielding varieties, proper land preparation, increasing fertilizer efficiency
5. Reduce pre & post harvest losses and increase quality of production
6. Make maximum use of seasonal rain falls

It is obvious that through appropriate mechanization many of those mentioned above could be achieved and the farming operational wise approach as mentioned below was suggested and discussed at the National Farm Mechanization Committee (NFMC) meeting on 29.08.2005.

10.2 The measures that have to be taken to reduce cost of production and increase profit margin in paddy cultivation (Problems identified and solutions)

| Operation | Main problem | Affects owing to the problem | Reasons for the problem | Probable solutions |
|------------------------------|---|--|--|---|
| Land Preparation | Inability to keep timeliness | Late harvest in Maha, resulting in: Less cropping intensity in Yala due to lack of water in tanks (50%) Crop damage and losses due to adverse weather conditions High rate of insect and fungal attacks | Insufficient energy (Should increase to 2.40 hp/ha from present 1.41 hp/ha to advance land preparatory time by one week), High cost of tractors, Unsuitable tractors Lack of labour. | Support more farmers to have their own tractors Tractor lending stations Gov/NGO/Private Ensure that the benefit of no import- tax policy on tractors goes to the farmers Farmers and bankers should be made aware of the importance of FMRC certificate Introduce machinery for labour intensive activities (e.g. for repairing and reforming of bunds need 5–6 man days/ac) |
| Weeding and plant protection | Inability to total control of weeds, insects and diseases | Reduced yield and/or total crop losses | Lack of sprayers (one sprayer/5 ha), Improper use of sprayers, Incorrect selection of nozzles, Low quality sprayers No labour for transplanting, Mechanical weeding still not popular | Support more farmers to have their own sprayers Sprayer lending stations Gov/NGO/Private Encourage sprayer venders to train their customers Farmers and bankers should be made aware of the importance of FMRC certificate Encourage use of Mechanical transplanters Popularize mechanical weeding that also has advantage of increasing fertilizer efficiency |
| Operation | Main problem | Affects owing to the problem | Reasons for the problem | Probable solutions |

| | | | | |
|-----------|--|--|---|---|
| Reaping | Excessive delay | Heavy grain losses | Needs heavy labour input Reaping takes place at the labour peaks island wide | Ensure benefits of no tax policy on combine harvesters goes to farmers Encourage local production of two wheel tractor coupled combine harvesters Farmers and bankers should be made aware of the importance of FMRC certificate Strengthen the reaper lending system at Agrarian Services Centers |
| Threshing | Delay in threshing Expensive High losses | Discoloured rice Low quality paddy Less rice recovery at milling | Needs heavy labour input Threshing takes place at the labour peaks island wide Performance of some threshers in the market are not satisfactory | Support more farmers to have their own threshers Thresher lending stations Gov/NGO/Private Make farmers aware of advantages of mechanical threshing over the other methods Make threshers available at affordable prices Farmers and bankers should be made aware of the importance of FMRC certificate |
| Cleaning | Accidents | Injuries and life threat to the farmers | Substandard quality of artisan produced winnowers | Standardize the design Impose strict rules to use standardized winnowers Encourage use of cleaning machines |

Quantity and Price of inputs in rice cultivation

| Input | Unit | Quantity | Unit price (Rs.) |
|-------------------------------|----------------|----------------|------------------|
| SEED | | | |
| Broadcasting | kg | 51.46 | 24.78 |
| LABOUR | | | |
| Hired Labour | md | 17.95 | 282.00 |
| Family Labour | md | 17.67 | |
| Total Labour | md | 35.62 | |
| FERTILIZER % Reporting | | | |
| V1 | 80 kg | 48.24 | 22.99 |
| Urea | 100 kg | 80.13 | 17.05 |
| T.D.M | 57 kg | 45.50 | 20.00 |
| YIELD & RETURNS | | | |
| | per/ Ac | per/Ha. | |
| Average Yield (kg.) | 1857.00 | 4589.00 | |
| Price of Produce (Rs/ Kg) | 13.90 | | |

| Input | Unit | Quantity | Unit price (Rs.) |
|---|-------------|-----------------|-------------------------|
| Gross Income (Rs) | 25812.30 | 63782.19 | |
| Profit Including Input cost(Rs) | 5440.32 | 13443.03 | |
| Profit Excluding Input cost(Rs) | 12567.99 | 31055.50 | |
| Per Unit Cost (Including Input Cost) (Rs/kg) | 10.97 | | |
| Per Unit Cost (Including Input Cost) (Rs/kg) | 7.13 | | |

11. Development of Farm Mechanization with a view to provide Farm Machinery to Farmers at different levels

11.1 Rationale

Even though the farmers are aware of the advantages associated with farm machinery, they are unable to approach them due to various reasons. The main advantages include, increase quality and quantity, timeliness, reduce drudgery, reduce production cost and low labour requirement. Above all, the attraction of present generation to agriculture the machinery has to play a major role. There are two ways in which the farmers could receive the help of machinery for different farming operations. They are, by owning them or by hiring.

11.2 Owning machines by individuals

At present there are a number of limiting factors, as mentioned below, for owning the machines by individuals

- Poor purchasing power
- Seasonal usage of machinery
- Lack of infrastructural facilities
- Difficulty in obtaining financial facilities
- Many machines are single purpose
- Lack of after sales services

11.3 Machines hiring facilities

Hiring of machinery by farmers is rare due to following reasons

- Non availability of machines at close proximity to the farms
- Lack of awareness on available technology
- High and varying hiring charges
- Some machine owners are reluctant to hire their machinery
- Insufficient machinery to cater the demand
- Financial hardships during peak periods
- Expected quality of work can not be achieved

11.4 Project strategies:

The project strategies are to create facilities for owning the suitable machinery by individuals at reasonable prices, possibly with installment paid basis, or providing machines hiring facilities at close proximities to the farms.

11.5 Facilities for owning machinery

At present machine supplying and distribution system is completely handled by the private sector. Since there is no control on pricing, except the competitiveness among the suppliers, farmers have to pay unreasonable charges. Apart from that, there are no sufficiently organized after sales services and the farmers have no easy access for spare parts etc. Further, there are instances where substandard quality machines have gone to the farmers.

In order to overcome those shortcomings it is proposed to establish machinery sales centers island wide with the involvement of the Government (possibility should be discussed). These centers are responsible for the followings:

- Provide quality assured machinery to the farmers
- Provide easy payment facilities
- Provide better after sales facilities
- Function as the coordinator between the farmer and the supplier
- Conduct awareness programmes on the available technology with the help of respective agencies
- Ensure the availability of repair facilities within the area
- Direct the feed back of machinery conditions to decision makers
- Keep strong linkages with Farm Mechanization Research Centre (FMRC) and Farm Mechanization Training Centre (FMTC)

11.6 Facilities for hiring Farm Machinery

At present hiring of farm machinery is done by the individuals and this service is not so effective due to reasons mentioned in 1.2 above. Therefore, Government intervention is essential to provide sustainable, efficient and reasonable hiring facilities. A few years ago the Government controlled tractor-hiring units failed and compelled to be closedown due to inefficient management and especially due to the poor maintenance of the machinery. Therefore, it is suggested that to establish Government controlled machinery hiring units island wide to hire the machines through farmer organizations to the individual farmers. The machines made available in these units for hiring may be preferably of less maintenance types. The machines kept at different hiring centers would have to be decided upon the requirement of respective areas. The hiring centers shall hire the machines to operate by the farmers themselves.

The following machinery could be identified, as those needed minimum attention with regard to maintenance and they are recommended suitable to use at hiring centers. Most probably the income generated by hiring the machines may sufficient to carry out the anticipated minimal amount of maintenance, to cover up the maintenance cost of the

buildings and the monthly wage of the caretaker. That means, once the initial investment is made the Government would have no burdens in connection with smooth functioning of hiring centers.

The machines and implements that are recommended suitable to be made available at hiring centers are:

- Mould board ploughs for two wheel tractors,
- Rotovators for four wheel tractors
- Seed paddy cleaners (Electric motor driven)
- Seed paddy cleaners (Two wheel tractor driven)
- Lowland Seeders and Weeders (manual)
- Highland Seeders and Weeders (manual)
- Paddy trans planters (manual)
- Axial flow water pumps (Two wheel tractor driven)
- Knapsack sprayers (manual)
- High pressure sprayers for orchards
- Paddy threshers (medium size)
- Paddy threshers (high capacity)
- Maize shellers (manual)
- Maize shellers (Two wheel tractor driven)
- Groundnut shellers (manual)
- Groundnut shellers (Electric motor driven)
- Pulse splitting and processing machines (Electric motor driven)
- Fruit harvesting tools
- Grass mover attachments to two wheel tractors

The prime movers such as tractors and engines that are needed to undergo frequent maintenance must have easy accessibility by the farmers to own through the sale centers proposed above. The machines mentioned in the above list could be selected in accordance with the requirements of respective areas.

11.7 The responsibilities of hiring centers

- Fulfilling the machinery requirement of the farmers in time
- Looking after the machines
- Train farmers on operation and maintenance of the machines
- Conduct awareness programmes on available machinery
- Decide reasonable hiring cost in consultation with farmer organizations and FMRC
- Make use of new agricultural technologies
- Maintain direct contacts with Farm Mechanization Research Centre (FMRC) and Farm Mechanization Training Centre (FMTC)

11.8 The responsibilities of farmer organizations

- Inform machinery requirement of the area to the hiring centers in advance
- Ensure that the farmers use the machinery safely, efficiently and effectively
- Ensure that the machines have been returned back to the hiring Centre immediately after the operations
- Inform any malpractices of the hiring centers to the higher authorities

11.9 Expected outcome and benefits

Through proper usage of agricultural machinery the farmers and the Country in turn would have the following benefits.

- The agriculture will become an attractive livelihood for younger generations
- Cost of production will go down and profit will increase
- Quality of agro produce will increase
- Yield and income will increase due to increased cropping intensity and reduced losses
- Water use efficiency will increase
- Would make healthy and happy farming community