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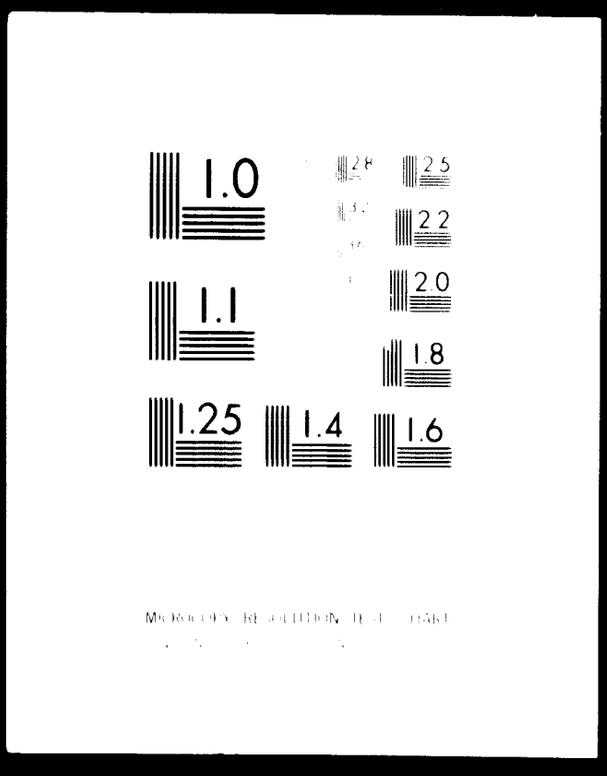

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United Nations Industrial
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Vienna, Austria.

Distribution: Limited.
Language : English
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Proposal for manufacturing promotion of agricultural tools, improved animal drawn implements, hand-operated machines and sample power equipment in the selected least developed countries.

Report prepared by the Government of India
(Council of Scientific and Industrial Research)
Rafi Marg, New Delhi-110001, India

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1. INTRODUCTION

Agricultural tools and implements form an important input for increasing agaicultural production. It was, therefore, considered by many developing countries especially the least developed ones to initiate programme aimed at manufacture of some of the tools and implements locally, to save foreign exchange from their imports and also for developing local industrialization and employment potential. To do this it was necessary to identify the implements and tools that are likely to be useful in the developing and the least developed countries of the world. Therefore, with a view to explore ways and means of promoting the local manufacturing of appropriate agricultural machinery, tools and implements in these countries, United National Industrial Development Organization (UNIDO) in association [1] with the Government of India (GOI) organized a 'manufacturing development clinic on animal-drawn agricultural implements, hand operated machines and simple power equipment in the Least Developed and other Developing Countries' at New Delhi (India) in October 1974[2].

1.1 The clinic made certain recommendations and those relevant to this study were that the Governments of the least developed countries will:

i) give priority in their national plans to allocate funds for promoting design development and testing - specifically, hand tools, animal-drawn implements, simple hand-operated agricultural machines and simple power equipment and the local manufacture of agriculture tools and implements, since such implements are suitable for manufacture in rural areas;

ii) explore the possibility of obtaining assistance from India, through UNIDO; and

iii) consider implementation of the project within the framework of the programme of cooperation among developing countries (CDC).

1.2 The participants also recognized the importance of taking necessary steps in their own countries to secure UNIDO assistance through inclusion of these activities in the UNDP countries planning for 1977-1981.

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1. This was one of the few projects undertaken jointly by UNIDO and Government of India (Council of Scientific and Industrial Research, India) within the framework of the UNIDO-India Agreement on the Transfer of Technology signed on 12 Dec. 1972.

2. Refer UNIDO report ID/148 (ID/WG. 193/3) UNIDO, Vienna, March 1975.

1.3 Each participant identified specific areas in which assistance from United Nations agencies and in particular from UNDP/UNIDO was urgently required. These areas included pilot programme in design and development, local manufacture, maintenance and repair, training, and investment promotion for local manufacture of agricultural implements and tools.

1.4 UNIDO agreed to provide assistance to the Governments of selected Least Development Countries (LDC), namely Bangla Desh, Bhutan, Haiti, Laos, Nepal, Ethiopia, Lesotho, Sudan, Tanzania, Uganda and Upper Volta.

1.5 In order to conduct an analysis and prepare a detailed project report for proposal for manufacturing promotion of agricultural tools and implements in these selected countries, UNIDO contracted the Government of India (Council of Scientific and Industrial Research, India) to prepare such a report[3].

1.6 The contract was expected to highlight following points:

i) indicate possible avenues of technology transfer from India for establishing pilot demonstration plants for agricultural implements in each of the above mentioned 11 LDCs on the basis of the recommendations of the New Delhi Clinic;

ii) elaborate the details of implements that could be supplied by India, its drawings /'photographs' and other relevant information and workout the cost of prototype implements, manufacturing drawings and spare parts supply;

iii) define the machine tools necessary for establishing a simple pilot plant (workshop) with relevant specifications and costs;

iv) assess expert personnel requirements and prepare appropriate job description; and

v) elaborate a programme for the training in India, for technicians from LDCs.

1.7 The Government of India (CSIR) signed the contract on 16th January 1976. Due to various physical constraints, diversity of implements and tools and their requirements by the Least Developed Countries, the scope of the study had to be reduced in consultation with UNIDO.

3. This document has been reproduced without formal editing.

2. THE STUDY

This study is on the "proposals for manufacturing promotion, research and development and transfer of technology in agricu ltural tools, improved animal drawn implements and operated machines and simple power equipment in selected Least Developed Countries", for consideration of the Governments of the selected least developed. It helps to appreciate the need for establishing a practical and direct linkages between the needs of agriculture with agricultural tools and implements which are important inputs for successful agricultural development and rural industrialisation.

2.1 The guidelines are not supposed to solve the problems of the whole country, but to act as a pilot research, development, testing and demonstration project, which will have a manufacturing unit/workshop as nucleus for transformation into a viable commercial plant and which could serve as a model for further establishment of such units in other areas.

2.2 The immediate objective of the project is to indicate to selected Least Developed Countries the required prototypes of agricultural implements available and assist in their supply intensive testing, evaluation and modifications and to organise, the manufacture of a limited number of approved agricultural tools and implements for farmers acceptance keeping in view the existing needs on a priority basis and also within the technical capability of the local people. At a later date this could act as a training centre for local artisans and catalyse rural industrialization and local entrepreneurship. In addition to promotion of establishment of such facilities it will provide training in industrial technology, production techniques, commercialization and management which, are essential for transformation into a commercial venture.

2.3 The studies, therefore, aims at helping the selected LDCs in the

i) establishment of R&D facilities for evolving suitable farm equipment;

ii) manufacture of approved agricultural implements and tools;

iii) development of local technical competence and capabilities;

v) extending repair and maintenance services;

vi) training of local technical personnel in all aspects of farm engineering and production technology;

vii) development of local entrepreneurship and promotion of rural industrialization; and

viii) training of local people in management services, marketing, finance, organization of inventory control, spare parts supply, etc.

2.4 It is hoped that the local Government would help to establish one such unit in a representative rural area and based on the experience and success of the pilot projects in other areas. To achieve this objective, the assistance of UNIDO/UNDP may be secured within the framework of cooperation among developing countries (CDC).

3. THE STRATEGY

The economic development of many of the developing countries is linked basically with their agricultural development. Recent scientific and technological advances coupled with a coordinated extension services and new inputs promise manifold increase in agricultural production. These developments consequently brought a visible awakening and change in outlook of the farming community today to expeditious exploitation of the results of research and use of appropriate technology in agriculture. Farmers are now looking forward to the application of ways and means to produce abundant crop easier and faster.

3.1 A number of factors play in boosting agricultural production and the important ones among them are:

i) improved and hybrid seeds,

ii) fertilizers and pesticides,

iii) package of improved practices,

iv) irrigation and scientific management of water,

v) improved farm machines and implements,

vi) credit facilities and cooperatives, and

vii) organised marketing.

While fertilizers, pesticides, irrigation and other like inputs are important for raising productivity, there is an over growing need for efficient implements for applying the above inputs into the soil or on the crop precisely as per scientific recommendations to increase productivity and economise on cost of inputs and their application.

3.2 Agricultural technology reckons to a wide variety of equipment, viz. hand tools, animal drawn implements and machines and irrigation, crop protection, harvesting, threshing, hand processing and other farm power units, the production and popularization of which would mean the involvement of small scale industries and also larger ones depending upon the complexities of the basic designs. In addition to the above, the increasing sophistication in agricultural sciences may demand attention and use of implements like multi-row seed drills, fertilizer distributors, row crop planters and equipment for beet, sugarcane, potato processing, groundnut decoricators, seed treaters, dryers, cane crushers storage and grain handling equipment etc. In irrigated areas under rice production, emphasis is given to improved puddlers, rotavators, transplanters, broadcasters and threshers.

3.3 Capital intensive assembly plants usually confine to engines, power tillers and tractors where the method of production and organisation are similar to those in automobile manufacture. The operations associated with these units are usually concerned with casting, forging and machining of the major parts, followed by final assembly and distribution. However, the technology of manufacture depends on the donor agency for many components. The other major material need of the agricultural machinery and equipment industries is metallurgical one. These include various grades of steel, copper, plastics, long staple asbestos, alloys of different types and specifications to suit design requirements.

3.4 During the past few years, changing agricultural patterns of farming has created a demand for industrial inputs for agriculture. Agricultural machinery and implements are an important industrial input and offer scope for a wide range of technologies appropriate to the level of farm mechanisation and industrialization in the developing countries. Consequently the development of the industrial sector, particularly the engineering and metal working sector, including the metallurgical sector, also stands to benefit to a large extent from agricultural machinery industry.

Like any other engineering industry, agricultural machinery manufacture involves components of technology pertaining to:

i) design and development

ii) metals, metallurgy and materials for construction,

iii) forging, heat/treatment and foundry,

iv) automotive,

v) electricals,

vi) fabrication of prototypes and testing,

vii) modification and manufacture of improved machines

viii) standardisation and quality control,

ix) repair and maintenance services, and

x) management services.

3.5 In the transfer to technology in agriculture, the factors which influence the decision regarding the appropriateness of a particular agricultural machinery and equipment are:

i) size of farm or holding,

ii) climatic condition,

iii) soil condition,

iv) corpping pattern and policy,

v) nature of irrigation, and

vi) type of power available.

3.5.1 Temperature variations, dust level, corosive environment and other climatological characteristics demand special attention for protection, modification and use of material and design of these machines, while soil conditions determine the quality of soil working components.

3.5.2 The policy in respect of agricultural development, with reference to cropping targets, cropping pattern, dry farming, small and marginal farms, tenancy and land reforms will also influence the activities of industries engaged in the manufacture of farm machinery and equipment.

3.6 The Least Developed Countries will have to take the above mentioned factors into consideration before deciding upon the development of agro-engineering industry or transferring technology from other countries. In the countries where some R&D infrastructure by way of agricultural engineers and scientists already exist, the R&D activities should correlate to the country's industrial development policy, import of technology and the problems faced by the local manufacturing units towards production, raw material supply, product diversification, design engineering, imports, foreign exchange investment, quality control and standards.

3.7 The overall commercialisation programme includes market research, demand analysis, product specification, modification in national import policies, assistance to manufactures in product development and diversification, sales, services, spare parts supply, demonstration, extension, product popularisation, training, credit and financing. It may also involve the establishment of national marketing organisations, dearlership and programme to assist the farmers.

3.8 Considerable importance is attached to pre-investment/feasibility studies which

i) determine the economic feasibility,

ii) establish practical technical viability, and

iii) pre investment needs in terms of finances, land, manpower, etc,

These studies also guide regarding

i) availability of raw materials,

ii) assessment of the problems associated with the production of the agricultural machines, implements and equipment best suited to the needs of the country,

iii) market evaluation to determine product demand, and

iv) optimum manufacturing approach and practical concept of the project.

3.9 Repair and maintenance activities, supported by workshops and mobile units, spare parts store, qualified and skilled persons in the organisation, management and operation of these activities, constitute another major need.

3.10 While considering the requirements for industrial development of the countries of the third world, the "technology gap" among the developing countries has to be taken into account. Accordingly these countries could be divided into three categories viz. least developed, intermediate developed and the more developed.

3.11 A number of least developed and intermediate developing countries have evinced interest in establishing small and medium scale manufacturing units of improved implements and simple machines which could be manufactured locally. However, the main problem before them is the lack of knowlege about appropriate products, adaptation techniques and methods of manufacture. Therefore, there is an urge to secure the cooperation of other countries who have successfully acquired such knowledge and are capable of transferring such technology.

4. NEEDS OF THE LEAST DEVELOPED COUNTRIES

During the Clinic held at New Delhi (India), an exhibition and field demonstration of various implements and tools was arranged and the participants also got the opportunity of seeing the workshop and the manufacturing processes for some of them at the factories which were visited. The participants accordingly identified the agricultural machines, implements and tools, suitable for their country.

This was followed by a joint discussion and interaction individually between the representatives of the participating countries and UNIDO experts, experts and specialist in the field of agricultural engineering and machinery. The needs and requirements of these countries were included in the project proposal prepared by UNIDO. Based on above experience a consolidated data of the needs and interest of the selected Least Developed Countries, (Bangla Desh, Bhutan, Ethopia, Fizi, Laos, Lasotha, Haiti, Nepal, Tanzania, Uganda and upper Volta) was prepared.

The status of agriculture and agricultural equipment in the participating countries are summerized in this chapter, which would form the basis of current proposal.

4.1 Bangla Desh

1) Population engaged in Agriculture — 85%

2) Power used:
   1. Pair of medium powered bullocks & buffaloes
   2. 1100-Power tillers
   3. 1000-Tractors

3) Size of holdings - Very small

4) Implements in use - Wooden wedge plough

5) Main crop - Rice

6) Manufacturing facilities available

i) Drum Metals Ltd.	6000 Hand sprayers
ii) Atlas Honda	Seed drill & Hand Hoe on order
iii) Marshall	Paddy thresher (to order)
iv) Saw Mill & Engg. Works	Spades
v) Machine Tools Factory	i) 2 Causec Low lift tools and centrifugal pump
	ii) YANMAR-Power Sprayer (Japanese)

vi) Rotos & Engg: & Ship	Deep well turbine pump
vii) Village Blacksmiths	Wooden ploughs and hand tools

7) Future Production Plans - Deep well pump, Centrifugal, Sewerage, Fractions pump & trolly, Rice huller, Plough, Spades, Iron rake, Hand operated pumps, Rice weeder, Seed-drill for jute and paddy, Pedal thresher, Winnower, Hand operated sprayer, Rice dryer.

8) Technical know-how - available for the 4 items above.

9) Recommendations of the clinic

i) assistance to diversify production in agricultural machinery to machine tools factory.

ii) assistance for the strengthening design development, prototype fabrication, testing, industrial liason, etc. for animal drawn implements and hand tools.

10) Implements recommended

1) Wah-Wah, 2) Bihar Junior, 3) Three tyne cultivator with seeding and fertilising attachments, 4) Power-tiller, 5) Rotary paddy weeder, 6) Winnower, 7) Pedal thresher, 8) Seed-drill for jute and paddy, 9) Rice weeder, 10) Plough (light), 11) Spades, and 12) Iron rake.

4.2 Bhutan

1)	Population engaged in Agriculture	90%
2)	i) Holdings	-barren land, virgin forests, scattered holdings
	ii) Main crops	-Paddy, Wheat, Maize
3)	Implements in use	-Animal drawn implements like hand tools Kodali (Hoe), wooden plough share, threshing by hand beating trampling.
4)	Scope	i) Hand and manual equipment like small power tiller, sprayers, duster, shellers, etc.
		ii) Power operated machinery in flat valley, tractors, power threshers, etc padel threshers
5)	Problem faced	-Getting spares, and existing workshops not well equipped.

6)	Recommendations of Clinic	i) a central workshop ii) prototype production and popularisation, and iii) manufacture of components

4.3 Ethopia

1)	Population engaged in Agriculture	87%
2)	Average size of holdings	5 hectares
3)	Implements in use	i) hand and animal powered tools (primitive types) ii) tractors and power operated equipment iii) seed-fertilizer technology being intensified
4)	Main Crops	Cotton, Sugercane, Coffee
5)	Organisations engaged in a agricultural implements extension	1) Chilalo Agri. Dev. Unit 2) Wolamo Agri. Dev. Unit 3) ADA Agri. Dev. Unit 4) Ministry of Community Development (produce implements at AWASSA)
6)	Manufacturing items	1) Mould board ploughs 2) Spike tooth harrows 3) OX carts 4) Threshers

7) Recommendations of Clinic

1. Design and development centre
2. Repair centres at selected rural centres
3. Training
4. Implements: Thresher, SFE, Tool bar with tools sprayers and dusters, Biogas plants

   Bund farmers, ridgers and disc harrow

4.4 Fiji

Rainfall - High 150", Med. 100", low -60-80"

2)	Main Crops	- 1. Sugarcane on Western side
		2. Copra
		3. Others -Maize, Cassava, Bananas, Cocoa Citrus, Rice
3)	Power	
		Manual, Cattle, Horse
	- Tractors	250 (1973)

4) Proposal for manufacture of Animal drawn implements - ploughs, harrow, carts, rice cultivators, water pumps, preasant shellers, chaff-cutters, ridgers, tillers, hand tools.

5) Recommendation of the clinic

Propsal for manufacture
i) technical centres in BA for Agricultural implements
ii) implements-seed drills & planters
iii) training facilities

4.5 Laos

1)	Total area	236,000 kms
2)	Arable land	7%
3)	Population	3 million
4)	Density	13 km
5)	Implements in use	Sickles, spades produced by blacksmiths
6)	Facilities available	i) UNIDO Expert
		ii) Power presses (Japanese assistance)
7)	Recommendations of the clinic	1. Infrastructure -Strengthening of existing prototypes production, design and development of new implements.
		2. Spare parts manufacture
		3. Implements recommended-wheel hoe with attachments, seed drills, dusters, single handhoe, three tyne hoe, soil scope, levelling blade, light mouldboard plouge and blo-gas plants
		4. Extension of foundry
		5. Training

4.6 Lesotho

1)	Zones	Low lands -5000-6000' Foot hits -6000-7000' Mountain zone -above 7000'
2)	Cultivated area	9,00,000 hectares
3)	Farm households	1,87,421
4)	Average holding size	2-5 hectares
5)	Main crops	Maize, Sorghum, Wheat
6)	Implements in use	Plough, Harrow, Planters, Cultivators Yokes, sledges, Over 60% in working condition
7)	Requirements	1. Threshers and shellers 2. Walking tractors 3. New implements and tool-bar.
8.	Recommendations of clinic	1. Infrastructure i) Training facilities ii) Strengthening tractor service centre for repair and maintenance iii) Pilot workshops for design development, prototypes fabrication, spares parts manufacture, etc. 2. Implements i) Multi row wheat drill ii) 6 disc-harrow iii) Powertillers iv) Power threshers - wheat and paddy

4.7 Haiti

1	Population	5 million
2.	Topography	mountainous
3.	Holding size	1 hectare
4	Implements in use	Small hand - hoes

5	Recommendations of the clinic	1. Workshop facilities for design development, prototype evaluation, repair and maintenance 2. Training facilities 3. Implements Ploughs, harrows, cultivators, levellers, storage bins, plant protection devices, shellers for maize and biogas plant

4.8 Nepal

1	Population	12 million (in agriculture - 93%)
2.	Total area	13 m. ha.
3	Agricultural area	1.82 mha.
4	Size of holdings in mountainous area	0.5 ha. Tarai region 1.2 ha.
5	Main Crop	Wheat
6	Implements in use	i) Indigenous hand tools - wooden plough, levelling planks, yoke, hoes, khurpis, sickles ii) Improved implements: plough, harrows, threshers iii) Mechanised cultivation - 2000 tractor (1975)
7.	Manufacture	1. Agri Tools Factory - Birganj (processing capacity - 100 tons of steel and 150 tons of castings)
	Implements manufactured	(1973-74) Malbourd plough (2392), Pedal thresher (195), Hoes (8214), Garden rakes (1928), Shovels (4920), Wheel barrow (540), Tractor trailers (79)
8.	Recommendations of the Clinic	1. Assistance to Birganj factory to produce new products like threshers pumps etc. 2. Strengthening of R&D facilities 3. Power wheat thresher (UT 90), Tractor Draw Implements, Disc harrow cultivator, Power sprayer centrifugal pumps.

4.9 Uganda

1	Agriculture	Main industry
2.	Holdings	Small holdings with 80% engaged in agriculture.
3	Main Crops	Maize, Groundnut, millets
4.	Research	Deptt. of Ag. Engineering, Markerere University, Kampala Machin s developed: Small tractor, grass slashers, tractor sprayers, hand thresher, winnowers, plough weeder.
5.	Manufacture	1. One factory produces hoes 2. Another factory produces Jaggery mill, shovels, pickaxes and tool frame 3. 30 Cooperative workshops producing Ox plough, Ox-seed rs, Ox-carts, coffee pulpers, shellers, planter, etc.
6	Recommendations of the clinic	1. Strengthening of existing workshop facilities 2. Strenthening R&D&F and prototype production - reparis and maintenance. 3. Implements: SFD Knapsack sprayers, rotary dusters, paddy thresher and winnowers, G.N. decorticators, shellers.

4.10 Upper Volta

1	Irrigation by 3 rivers and 5 lakes	
2.	Population	6 million
3.	Villages	7000
4.	Main crops	Peanuts, rice, millets, sorghum, cotton and maize.

5.	**Implements in use**	Imported animal ploughs and power driven cultivators
6.	**UNDP programme**	Training and development of rural handicrafts
7.	**Recommendations of the Clinic**	1. Pilot workshop for R & F & E. Protoype product; 2. Implements sheliers, thresher sprayers, hand pumps, animal ploughs, shovels, pick axes, etc.

4.11 Tanzania

List of Implements selected by the Republic of Tanzania during the International Agricultural Machinery Manufacturing Development Clinic held in October 1974 in New Delhi, India.

i) Power wheat thresher
ii) Seed-cum-fertilizer drill (IARI type)
iii) Tool bar (Krishi Seva)
iv) Mould board plough (IARI type)
v) Sprayers (manually operated)
vi) Dusters (manually operated)
vii) Bund formers
viii) Bio-gas plant
ix) Disc harrow
x) Ridgerplough

5. INDIA'S COMPETENCE

India, with an area of about 140 mha under cultivation has a wide variety of climate, soils and crops. The climate varies from uniform temperate climate of South India to the hot summer and very cold wintry weather of North India. Rainfall also varies widely with South West and North East part of the country getting a very heavy precipitation with medium rainfall in the Gangetic plains and eastern coastal areas. However, over 70 percent of area falls under low rainfall and droughty conditions with low agricultural productivity.

5.1 Soils

Soils fall under 4 different classes:

i) Gangetic aluvium,

ii) Black soil,

iii) Red soil, and

iv) laterites.

Each of these have their own physical properties and their characteristics have a direct bearing on the efficient working of agricultural implements.

5.2 Crops

Crops raised fall under the principal categories like cereals, pulses, oilseeds, fibres, spices and vegetables. The package of practices required for each crop under each of these categories also vary and this brings in the imperative need for designing multi-crop machines which can economically fit into the cropping system throughout the year.

5.3 Water management

Of the total cultivated area of about 140 million hactare, about 30% is under irrigation, and efforts are being made to raise 2-3 crops in such areas. Water management becomes extremely important and increasing irrigation efficiency means use of efficient improved implements for special preparation operations.

5.4 Size of holdings

The size of holdings are also small with an average of 2 ha. The distribution of holdings and the percentage area covered under each is shown in statement below:

Area of holding in acres. (2.7 acres = 1 hectare)	Number in 1000's	Percentage to total holdings	Percentage to Total area
0 - 1	8696	17.2	1.3
1 - 5	22624	44.5	17.9
5-12.5	12614	24.8	29.0
12. 5-25	4538	8.9	22.2
25 - 50	1772	3.5	17.3
Over -50	521	1.1	12.3
Total	50765	100	100

5.5 Animal power

Power for agricultural operations is provided by animal power to a large extent and by humans in small holdings. Animal sizes vary. Haryana, Punjab, Andhra Pradesh and Tamil Nadu have good animals and the smaller ones in eastern states have low draft capacity.

5.6 Timely operation

Agriculture unlike many other enterprises is governed by critical periods, and has to constantly fuse the vagaries of weather. It is necessary to sow crops in time, when soil conditions, soil moisture and temperatures are favourable. Operations should be completed within a limited time before expected or unexpected rainfalls, and crops should be harvested when they are in physiologically matur conditions. Several such problems confront the agriculturists. Thus the problem consists of doing the right operation at right time, and cooperating with nature for maximum benefits. A universal implement like the wooden wedge plough passed on to us from time immorial can not profitably or economically do all that a farmer wishes to do in the limited time available. Therefore, to increase production, more efficient work could be done which can be accomplished by the implements which are specially designed for each operation.

5.7 The above background clearly brings out the challenging role of agricultural engineers engaged in the development of farm implements and machinery in India. In the last 10 to 15 years, planners and administrators realisin the importance of implements and other engineering aspects, have provided for development of capability and competence in the different aspects of agricultural engineering such as research, manufacture, extension and education.

5.8 Research and development

During the Third plan, Government of India sanctioned the establishment of seventeen research and testing centres one for each principal state of the country. The aim of these centres are:

i) to test improved implements available in different states and manufactured under different soil and agro-climatic conditions and to modify the same if necessary,

ii) to test imported prototypes as and when they were available,

iii) to design new implements for operation for which there was no suitable implements, and

iv) to popularise those implements found suitable.

5.8.1 A standard pattern of staff with a research engineer and an assistant research engineer supported by a complement of engineers, craftsmen and other administrative staff were sanctioned. Appropriate provision for workshop buildings with machinery, laboratory and field testing instruments were also provided for each centre, Standard test proformas were finalised and adopted at different centres which are now being standardized by the Indian Standards Institution (ISI). The entire work is being coordinated by ADG (Engineering) at the Indian Council of Agriculture Research (ICAR) Head quarters, New Delhi, and each project comes under a project coordinator, located at one of the oprating centres.

5.8.2 Since the establishment of Agricultural Engineering Colleges in Agriculture Universities, these centres were merged with those colleges for more effective R&D operations.

5.8.3 A variety of implements were tested and approved and also a large number of new implements were evolved, and released for manufacture and popularization.

After an implement is successfully developed by the research engineers, a few prototypes are made for independent evaluation and trials, preferably in batches so that each succeeding batch can incorporate the suggestions made in the evaluation of the proceeding batch. These are got fabricated and manufactured by the local small scale industrial units.

5.9 Extension

Besides prototype; evaluation, which are done under actual farming cond tions in private farms, a large number of national demonstrations and operational research schemes, have also been laid in every state where improved implements are being demonstrated to farmers. Besides, these agricultural extension officers with the help of village level workers also conduct such demonstrations in their respective block areas.

5.10 Manufacture

Large scale manufacture of agricultural implements is done by both Government factories owned by either Government or by Agro Industries Corporation. Such units are located at Lucknow, Jaipur, Trichy, Bhubaneswar. Other ones is privately owned small scale manufacturers and they number over 100. Power operated equipment requiring high capital investiment such as tractors, power tillers, engines are being produced in heavy industrial units. Less complex implements and machines are made at State level by several private small scale production units. For manufacturing very simple hand tools like sickles, Khurpi etc., a number of fabrications have been approved by different State Governments. Thus adequate production capacities have been developed in India for the manufacture of farm implements.

5.11 Education and Training

Training to farmers and entrepreneurs are provided at the Tractor Training Centres located at Budhni and Hissar. Six months course on operation and servicing of agri-machinery are provided at these Centres. Manufacturers of tractor have their own servicing schools, for giving training on their own products. There are a number of industrial training institutions which give training to craftsmen in industrial manufacturing operations, such as turning, welding, etc.

5.11.1 Degree courses in agricultural engineering are being given in the Agricultural Engineering Colleges and in Agriculture Universities at Pantnagar, Ludhiana, Jabalpore, Bhuvaneshwar, Rahuri, Akola, Udaipur, Coimbatore and Indian Institute of Technology, Kharagpur, diploma course in agriculture engineering is available at the Agricultural Engineering Institute, Raichur.

5.11.2 Training facilities of any kind can, therefore, be made available in any of the above institutions and also in various engineering workshops manufacturing agricultural equipment.

5.12 Expertise

It would be possible for India to make available the required expertise in any of the specialisation concerned with farm machinery and engineering.

5.13 Standardisation

Agricultural machinery industry has been rapidly growing in India. With a wide variety of implements being produced, standardisation has assumed considerable importance and with the help of the expertise available in the country Indian Standards Institution (ISI) has taken up the standardisation of implements, their components and also the testing methods and proformas. The following standards have been published:

1.	General	2
2.	Tillage and inter-cultivation	30
3.	Seeding and fertilizing	10
4.	Pest control equipment	13
5.	Pumps	2
6.	Harvesting and threshing	7
7.	Processing and handling	9
8.	Horticultural equipment	11
9	Agricultural Tractors and other prime movers.	14

5.13.1 It would thus be possible for the country to assist the least developed countries with the Indian standards & specifications and also in the formulation of their own standard specifications at a later stage after the initial phase of Research, Development and Training (R & D & T) are completed.

6. AGRICULTURAL IMPLEMENTS AND TOOLS SUITABLE FOR LDCs

Crop production comprises of the following important basic operations all the world over:

1) Seed bed preparation,

2) Sowing and fertilzing,

3) Interculture,

4) Sprinkler irrigation

5) Plant protection and seed treatment,

6) Harvesting and threshing,

7) Processing, and

Agricultural implements and machinery are produced in different sizes for the above operations having different outputs and an appropriate choice of the set of implements required will have to be made, giving careful considerations to the crop, soil, size of holding and the source of motive power available. From a review of the agricultural situations in different developing and least developed countries as presented at the Farm Machinery Clinic held in 1974 and discussed elsewhere in this report, these factors are more or less akin to what they are in India and therefore, the Indian implements to a large extent may prove useful to many of the countries, now included under this project. Hence a brief description of such implements available in India are given below to facilitate selection to meet individual country's requirements, by their experts.

6.1 Seedbed implements

A number of them are available for primary tillage and secondary tillage. With an appropriate set, the time and cost for seed beed preparation can be reduced to 30-40 percent.

6.1.1 Mould board plough

It is used as a primary tillage tool to cut a neat furrow of soil to predetermined depths, and invert the same along with the surface vegetal cover. The inversion and coverage would depend upon the curvature of mouldbard. It helps to destroy weeds and leaves the soil surface cloddy for better absorption of water and air.

There are two main types i) long beam type, and ii) short beam type. In the case of former, the beam is tied on to the animal yoke directly, whereas in the latter the clevis of the plough is tied to the animal yoke through a long rope or chain. These are made in different sizes to give varying depths 7-25 cms and width 10-30 cms. The appropriate size required for an area would depend upon the size of animal available.

The mouldboard is made of mild steel or cast iron. Share is of high carbon steel. The frog is made of cast iron. Beam is of sal wood. These ploughs give an out-turn varying from 0.3-0.4 ha/8 hours depending upon the width of cut. 1.

Maintenance is simple. As bolts and nuts are standardized, only a set of two spanners would be enough. The advantage of using a good mouldboard plough is that it gives a good neat cut of required depth and ploughing becomes an once-over operation.

6.1.2. Three-tyne cultivator

This is a simple and useful secondary tillage tool for breaking the clods left after plouging, stirring the soil and removing the dry weeds. It can be used as an inter-cultural tool, between lines of a crop till it grows to some height. It can also be fitted with a seeding and fertilizing funnel attachment for sowing and fertilizing. The tubing has an internal diameter of 2.5-3.5 cms. Rate of seeding is controlled by hand. The width of cut is 60-70 cms. Without beam its weight is about 15 kgs.

The frame the handle and the tyne standards are of mild steel Reversible high carbon steel shovels are fitted on the standards. Shovels and tynes can be made to different specifications to obtain different kinds of soil surface. Adjustment for depth has been provided at the clevis with different holes for yoking to different animal heights.

About a hectare can be covered with it.

6.1.3 Expanding cultivator

This is a shallow working implement suitable for a pair of animals. There are three M.S. flats each containing 2 shovels. The angles of the side flats carrying the shovels can be changed by a simple adjusting lever so as to get different working widths, varying from 25-75 cms. There is a cast iron wheel at the front which provides stability in working. There are two handles and a clevis for yoking the animals. The shovels are made of high carbon steel and all other parts are of mild steel.

It has a coverage of about 2 ha.a day.

6.1.4 Triangular harrow

It is a light working implement and produces a fine soil structure. It can also remove weeds from the fields.

It consists of a triangular frame made of three hard wood pieces of 54"x3"x2. Two cross pieces are also provided. To this frame are fixed rigidly several sharp steel pegs starting with one tyne at front and with 2, 5 and 7 numbers in the next three

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* A day-mean A day of 8 working hours.

rows, staggered for effective stirring. There is a yoking hook at the front and it can be worked by a normal pair of animals.

It has an out-turn of 2 ha. and a day.

6.1.5 Patela

This is a useful tillage tool which collects dry weeds lying on surface of soil, breaks the clods and the land fit for sowing.

It consists of a hardwood plank (Sal) of about 250 cms x 40 cms x 5 cms. The length can be varied to suit animal power available and a 125 cms 4 length would be suitable for a single bullock yoke and is suitable for hill areas. At the front there ars two hooks for hitch ropes. At the rear is the tyne plate. Two sizes of tynes are alternatively welded on to the M.S. plate which is then firmly fitted on to the main plank. In the fixed type, the tyne flat is firmly bolted on to the rear of plank. In the second adjustable type a rack and lever arrangement facilitates the lifting of the tynes, as and when necessary to free the weeds. It has a coverage of about 4 ha. a day.

6.1.6 Disc-harrow

This is a useful tillage implement used for preparing a seedbed. In light soils however this can be used even for primary tillage. The bullock drawn models normally have 6 discs, 3 on either side. Discs are of high carbon steel though mild steel with hardened edges can also be used. The discs are 30, 35 and 40 cms in diameter. The disc shafts 2 in numbers are fitted on to a sturdy mild steel frame in such a way that the angle of gauge can be increased or decreased, for getting increased or decreased depths respectively. A gang angling mechanism is provided for this pruposs. The disc are spaced uniformly and a cast iron spacer is provided between each of them. Bean is of sal wood. A seat is provided for plowman to sit on. A set of 2 transport wheels is provided which will be at the top when the implement is in working position. When the implements is turned over to the transport, wheels rest an ground. Disc shafts are mounted in ball bearings or bronze or cast iron bush bearings in well protected housings.

It can cover 2 ha. a day.

6.1.7 Bund former

Elther to retaln rain water, or to reduce erosion or to achieve uniform lrrigation, fields are provided with temporary small bunds (levers) to form square check-basins. Constructing the same manually is a very time consuming operation. Bullock-drawn bund former ls a useful implement for constructing such bunds.

The lmplement consists of two divergent soil gathering boards made of mild steel plates of 1.5-2 mm thickness. These are connected to the front fixing U-brackets fixed to the beam and to handle support at the rear. Based on the size of bunds to be formed, these are made in 3 sizes 22.5 cms, 22.5-30 cms and over 30 cms and above suitable for different sizes of animals. The forming blades are bent at the bottom edge for effective gathering.

It can cover about 2-3 ha. a day on an average, depending upon the size of check-basins.

6.1.8 Ridger

This is similar to a mouldboard plough, but there are two mouldboards on either side with the result the soil is formed into well-defined ridge for sugarcane or potato cultivation. The trough of the ridges can also be used for distribution of water for irrigation. The share is of high carbon steel, the mouldboards of steel and the body of cast iron. Two mild steel handles are provided for guiding in the field. A cast iron wheel provided at front end of the short beam gives stability in operation to the implement. The distance between the moldboards is adjustable from

distance between the moldboards is adjustable from (30-60 cms). It can cover about 1.5 ha. a day.

6.1.9 Wheel hoe

This is a manually operated implement used for weeding between rows of plants. The wheel fixed in a frame made of cast iron helps to maintain the uniformity of cut and also stability of operation. To the frame different kinds of shovels and tynes or blades can be fixed. The total weight of this is about 12 kgs. It is a very useful implement for hilly areas.

6.1.10 Leveller

Particularly in irrigated agriculture for uniform flow of water, the land has to be properly levelled. The leveller is a very useful implement for this. There are two planks; the rear back one is a riding plate while the front one is the cutting plate. At the requires of the cutting plate an L shaped pipe is firmly fixed and by raising and lowering this handle the cutting angle can be changed. Use of this implement on the field leaves the surface level. This requires a pair of bullocks.

6.1.11 Weltand Puddler

This is a bullock-drawn implement used for puddling the soil for transplanting paddy. It has a mild-steel frame, at the Centre which is fixed over a mild steel axle. The axle carries a number of sleeves to which are fitted a set of 3 or 4 angular blades. It has a working width of 60-70 cms. It is drawn by a pair of animals on the field ploughed and applied with standing water. The angular blades as they revolve, churn the soil and leaves the same level. A seat is provided for the worker. It can on an average cm 1.5-2 ha per day.

6.1.12 Disc-Trampler

In rice cultivation, green manure applied on the puddled surface has to be pressed into the soil. This is accomplished by the use of a disc-trampler. The trampler has a fr frame fitted with a draft beam. To the Centre of the frame a mild steel axle is fitted. This axle carries 3 or 4 discs. A seat is provided for the worker. As it is moved over the field, the green manure is pressed into the puddle. It has an outturn of 1.5-2 ha/day.

6.2 Sowing devices

These are used to drill different seeds at specified spacings in line and rows, with some precision in the prepared seed-bed.

6.2.1 Multi-row drills require a pair of animals whereas some single row drills can be operated manually. Multi-row drills consists of a seed box which is fitted our the axle by means of brackets. Seed-metering mechanism are of different types-fluted roller, circular plate type, flat plate type, cup feed, and internal force feed. Fluted roller has proved to be the most efficient. Metered seeds fall through transparent plastic tubes into the furrows opened by furrow openers. These are of different designs like knife, boot shovel disc, etc. Their spacing can be adjusted. The drill frame is mounted on two wheels and drive to the seed-metering-shaft is taken from the wheel shaft, through a clutch mechanism. Covering arrangements are also provided to cover the seeds. A threerow machine has an outturn of 1.5 ha/a day.

6.2.2 In the combined seed cum-fertilizer drill, a separate box has been provided for fertilizer, with a separate set of tubes. Furrow openers may be separated or combined depending upon where fertilizer is to be placed in relation to seed. When they are separate, the size of the drill normally should be two rows for bullocks. In case of combined furrow opener, the machine can have three rows. To maintain uniform flow, fertilizer should be absolutely dry.

In certain designs, the three row seeding attachment is a seperate unit which can be fitted on to a local wooden wedge plough.

6.2.3 In single-row models, the matering devise is operated through a single wheel. This is mostly for seed only though in one or two units, provision has also been made for fertilizer. Coverage with a single row machine is about 1 ha. a day.

6.2.4 Some of the useful machines recommended for study under the project are:

1) 3-row multi grain drill, IARI, New Delhi.

2) 3-row Maharashtra Toka Yantra, Maharashtra.

3) 3-row seed cum fertilizer drill, Haryana Agros, Hissar.

4) 3-row seeding attachment for wooden plough, IARI, New Delhi.

5) 4-row mechanical Drill, Coimbatore.

6) Single-row drill, American Springs and Pressing Works.

7) 3 tyne cultivator with seed and fert-funnels, Cossul and Co., Kanpur.

8) Cup feed drill-Rajendranagar.

6.3 Intercultural tools

6.3.1 Paddy weeder

It has two drums. Each drum has rows of prongs, fixed on the periphery. At the front is a float plate. The frame is firmly fixed to two handles. By moving this backward and forward all weeds can be removed in wet lands. This is a manually operated impiement and can cover about 0.2 ha a day.

6.3.2 Rake-cum-blade weeder (CRRI)

This is a combination type with rake on one side and the blade at the other. The position of the handles can be adjusted so that either rake or blade comes into working position. Rake is used under wet land conditions while blade under dry conditions. It covers about 0.2 ha a day.

6.3.3 Star-weeder

This is also similar to the first one but a number of star shaped discs are provided for weeding.

6.3.4 Wheel hoe

Wheel hoe is a very effective tool for inter-row weeding operations. The frame is fixed to the wheel axle. At the other end, it is fixed to a pair of handles. The frame has to take in different kinds of soil working tools. It has greater stability for work and higher output of about 0.3 ha a day.

Approximate cost estimate of Standard set of Sprinkler Irrigation Equipment for covering 2 hectar square plot

Mainline	
10 nos. - 75 mm nom dia x 6 metre long Aluminium pipes	Rs. 933.00
10 nos. - 75 mm dia Mainline Coupler 1 no. - 75 mm dia Screwed Coupler 1 no. - 75 mm x 90° Bend 1 no. - 75 mm x 50 mm Reducer Coupler	Rs. 567.00
Sprinkler Line	
10 nos. - 50 mm nom dia x 6 metre long Aluminium Pipes	Rs. 624.00
5 nos. - 50 mm Mainline Coupler 5 nos. - 50 mm Sprinkler Coupler 5 nos. - Sprinklers Model 100 BST with Nozzle size 3/16" x 1/8" Nozzle 5 nos. - 3/4" x 36" Riser Pipe with Tripod 5 nos. - Ball Joint Riser Coupler 1 no. - 50 mm End Stop	Rs. 1,193.00
Total cost F.O.B. Calcutta (Indian Currency)	**Rs. 3,317.00**
Total cost F.O.B. Calcutta (U.S. Dollars)	**$ 378.14**

6.4 Sprinkler-irrigation

Water is the key to plant growth. The best seeds, cultivation, fertilizers and plant protection will be wasted if water is not available in sufficient quantity and at the right time. This can only be assured by irrigation and for maximum yield and profitability the most effective and efficient methodof irrigation must be used. This is sprinkler irrigation..

Sprinklers conserve water and irrigate much more land. With the usual surface irrigation methods more than half of the water is wasted through seepag- in channels, over-irrigation and seepage below the roots, by evaporation and by drainage off the field. With a sprinkler system the crop gets a life-giving rain. Practically all the water is saved and as a result at least 50% more land can be irrigated. In fact in most cases the area that can be irrigated is doubled and even trebled. Apart from this even undulating lands and hilly areas can be irrigated efficiently and effectively with sprinkler irrigation system. Thus not only the land levelling cost is saved, but also the top fertile soil is used for cultivation. The installation of sprinkler irrigation system very often coasts much less than the total expenditure on land levelling. Through the sprinkler system, solution of chemical fertilizers can also be applied over the crop which not only saves labour, but also saves fertilizer upto 40%. It has been observed that the growth of the crop is better when fertilizer is applied through the sprinkler system.

6.4.1 Super duty pipes

The portable pipes that carry the water are made from tough corrosion resistant alumlnium alloy (similar to that used in aircraft construction) in sizes 5, 7, 10, 12 and 15 cms. (outside diameters). These pipes are so light and easy to carry that very little labour is required and acts almost as automatic irrigation.

Performance Specification of Standard set of Sprinkler Irrigation Equipment to cover 2 hectare square plot.

Area to be irrigated	:	2 hectare
Application and cycle	:	2" net rain in every 12 days
Hours of operation per day	:	10 hours per day
No. of sprinklers	:	5 Nos.
Discharge per sprinkler	:	6.3 gpm.
System capacity	:	31.5 gpm
Application rate	:	.44" per hour
Sprinkler spacing	:	40' x 40' (12 Mtr x 12 Mtr)
Sprinkler Operation Pressure	:	27 psi
Pressure loss (friction loss) in Maniline and Sprinkler Line	:	11.54
Pumpset Duty	:	31.5 gpm at 89 ft head
Time required for one application	:	5 hours (2 applications per day)
Area covered by one application	:	0.08 hectare (i.e. 0.16 ha. per day)

The pipes are instantly coupled or uncoupled by a special coupler. The couplers are very flexible so that pipes can be laid over rough land. Sealing of the coupler against water leakage is automatic as soon as the pump develops pressure. When the pump is stopped the pipes drain automatically so that they are immediately ready for moving to a new position. No tool or skill is required to couple the pipes. The couplers are designed to take a total angularity of 22 degree which is sufficient to lay the pipes even on hills.

The continuous and automatic operation of the sprinklers is the secret of profitable sprinkler irrigation. The sprinklers distribute water evenly, slowly and automatically and they last for years. They are made only from brass, stainless steel and other strong metals and can not rust. Special rubber and plastic seals at the top and bottom of the bearing exclude dirts and keep the sprinklers turning smoothly. The sealed bearing resists wear and the seals can be easily and in-expensively replaced after giving long service.

6.4.2 Perfo spray irrigation

This is another type of sprinkler irrigation system, but it does not have sprinklers. In this system the same aluminium pipes and couplings are used, but instead of using sprinklers performations are made on the aluminium pipes in a particular pattern and when water is flown through the pipes with some pressure the water starts coming out of the perforations like gentle rain. The rain in this system is very uniform and it applies water at the rate of approximately 0.5" per hour. This system is most suitable for small vegetable fields, gardens and lawns and other short crops. The most important advantage of this system is that it works on low pressure (between 10 to 20 psi as well.

6.4.3 Gated pipe system

This system of irrigation comes under the category of flow irrigation, but this is the most efficient system among all other flow irrigation systems. Here also portable aluminium pipes and quick action simple couplings are used and each pipe has holes of nearly 1.5" diameter. Over these holes plastic gates are fitted which can slide backward and forward and thus can completely close the hole or open it as per requirement.

The water flow thus is regulated by these gates. In this sytem there are no channel losses and water is applied exactly in the field where it is required. This does not need any extra energy for creating pressure in water flow. This system can be directly used with the lift pump installed on the tubewell, well, river or the lake. This system being extremely portable comes out to be cheaper than any other pipeline irrigation and irrigates nearly 20% to 30% more land with the same quantity of water.

6.4.4 Performance specification of standard set of sprinkler irrigation equipment to cover 2 hectare square plot

Area to be irrigated	2 hectare
Application and cycle	2" net rain in every 12 days
Hours of operation per day	10 hours per day
No. of sprinklers	5 Nos.
Discharge per sprinkler	6.3 gpm.
System capacity	31.5 gpm
Application rate	.44" per hour
Sprinkler spacing	40' x 40' (12 Mtr x 12 Mtr)
Sprinkler Operation Pressure	27 psi
Pressure loss (friction loss) in Mainline and Sprinkler Line	11.54
Pumpset Duty	31.5 gpm at 89 ft head
Time required for one application	5 hours (2 application per day)
Area covered by one application	0.08 hectare (i.e. 0.16 ha. per day)

6.4.5 Approximate cost estimate of standard set of sprinkler irrigation equipment for covering 2 hectare square plot

Mainline

10 nos. - 75 mm nom dia x 6 metre long Aluminium pipes		Rs. 933.00
10 nos. - 75 mm dia Mainline Coupler 1 no. - 75 mm dia Screwed Coupler 1 no. - 75 mm x 90° Bend 1 no. - 75 mm x 50 mm Reducer Coupler	)	Rs. 567.00

Sprinkler Line

10 nos. - 50 mm nom dia x 6 metre long Aluminium Pipes		Rs. 624.00
5 nos. - 50 mm Mainline Coupler 5 nos. - 50 mm Sprinkler Coupler 5 nos. - Sprinklers Model 100 BST with Nozzle size 3/16" x 1/8" Nozzle 5 nos. - 3/4" x 36" Riser Pipe with Tripod 5 nos. - Ball Joint Riser Coupler 1 no. - 50 mm End Stop	)	Rs. 1,193.00
Total cost F.O.B. Calcutta (Indian Currency)		Rs. 3,317.00
Total cost F.O.B. Calcutta (U.S. Dollars)		$ 378.14

6.5. Sprayers and dusters

The basic aim of spraying is to apply a thin film of the chemical uniformly over the foliages and with sufficient force to cover as large an area of the plant as possible. The equipment should, therefore, develop the pressure necessary on the chemical fluid and then force the same forward through the hose and then deliver the same through the nozzle, in the form of a spray on the crops. Some sprayers are carried by the man at the shoulder or on the back and spraying is done as he moves on the field. In others the machine is set at a required spot and then spraying is effected by moving the hose and the lance over the field all round the machine.

Hand compression knap sack sprayer

This manually operated type is made in varying sizes from 6 to 18 litres weighing 4 to 10 kgs suitable for different sizes of holdings. The smaller ones are shoulder mounted while the bigger ones are back mounted. It has a cylinderical pressure tank, made of either stainless or galvanished steel or brass or aluminium alloy sheets 18-20 gauge. These are capable of withstanding high pressures. Pressure gauge is also provided on them. An opening is provided for filling the liquid. At the centre is an opening to which is screwed an air pump. After filling the tank to about three fourths height with the fluid and by working the handle up and down, air is forced inside and pressure develops. The outlet fitted with a valve is at the bottom or to the top, to which a short pressure hose is connected. The other end of the hose has a brass lance fitted with trigger valve and the spray nozzle. By pressing on the trigger the liquid is delivered as a spray. When pressure goes down the pump is to be worked again. These sprayers can cover about 0.5 ha. a day.

6.5.2 Knapsack sprayers

The tanks in these are bean-shaped, and are made of brass-sheets or galvanised iron sheets aluminium alloys or plastics. Tanks have capacities varying from 10-16 litres. A double barrel detachable pump made of brass tube is provided at the centre, which can be worked by a steel handle which is conveniently located to operate, when the sprayer is on the back. The second barrel acts as a pressure chamber and makes provision for the delivery tube. The two washers are made of chrome-tanned leather or graphite impregnated leather. These are placed back to back. After filling the tank, it is taken on the back. The operator keeps working at the handle as he moves on the field when spray is delivered. These can cover about 0.5 hectare a day. The total weight when empty is about 10 kgs.

The above types can also be conveniently fitted on a two wheeled frame for ease of movement on the field.

6.5.3 Foot sprayer

The pump barrel made of brass with a cylindrical pressure vessel at its top, is held vertically in a frame work, made of mild steel flats. The piston assembly consisting of a bucket washer, and suction ball-valve is fitted at the bottom end of the barrel and is connected to a foot-pedal. A delivery valve is provided at the top of the barrel. By pressing on the foot-pedal the piston moves pressing the liquid that is above it. There is an automatic spring loaded guide arrangement which automatically brings the piston down. Two delivery outlets are provided to which two delivery hoses with lances are connected and two persons would be required in such cases. Height of spray is 4.5-6 meters and discharge capacity 115 litres per hour. It weigh 15-20 kg. It can cover about 1.5 ha. per day.

6.5.4 Rocker sprayer

The brass pump barrel is fitted to a wooden base plate at an angle. The pump rod is connected to a steel handle. As the handle is pushed to and fro, the liquid is sucked in through the sunction ball valve and discharge through the delivery ball valve under pressure. The brass pressure vessel fitted with pressure gauge maintains a uniform flow. This sprayer is used for higher throws required in case of tall trees. One man is

required to work the pump and another to move about on the field with the lance. Normally there is one hose. Two hoses can also be fixed where necessary. This can cover about 2 ha per day.

6.5.5 Power sprayer

There are two main types of power sprayers. In the knapsack mode, entire unit is designed so light that it can be easily carried on the back and effective spraying is achieved as the operator moves about the field. In the second type, the capacity is more, the unit is heavier and so is kept at central place and the operator moves all round the machine on the field.

In the knapsack type, the spraying mechanism is worked by a light two-storke petrol engine by one man. The spray tank made of high density polyethene has a capacity of about 10-12 litres. Centrifugal impellor made of aluminium sheets having an output of 10 cubic meters of air is provided. Air goes out of the spreader. The discharge capacity is 8-16 litres per minute. The spray fluid fed into this blast is picked up in the form of a fine misty spray. This mist can reach a distance of 30 meters horizontally and to a height of 15 meters. This can cover 6-8 ha a/day. Such machines are called mist blowers.

In the second type, the engine, tank sprayline, etc. are all fitted to a trolley mounted on wheels. Tank has bigger capacity of about 100 litres with an engine of 3.4 H.P. As these are heavy duty machines and plunger pumps are used. A spring loaded pressure release valve is also required. An area of 6 to 8 ha. a day can be covered. It has two spray outlets and two booms of about 3 meters having 5 nozzles.

6.5.6 Hand rotary dusters

This is extensively used for dusting. The main components of a duster are the container, agitator, gear-box and the blower. Various designs are available in front where it could be rotated easily. In other des gns the belt is put around the neck and the duster is supported on the belley.

The containers are made of brass sheet or galvanised sheet. Machine cut-gears are used for stepping up the speed of the blower. Two gears and two pistons are used to raise the speed 40 to 50 times to work the blower. As the handle is rotated, the big gear revolves rotating a pinion. The shaft of the pinion is fitted w th another larger shaft which in turn works another pinion. Thus speed is raised. The second pinion shaft is attached with the aluminium blower. The drive of one of these shafts also revolves a wire brush agitator at the bottom of the housing. Thus dust is uniformly fed into the tube where it is picked up by the high pressure blast. The blower outlet is connected with the discharge spreader nozzle. The whole machine weight 5-8 kgs and the hopper has a capacity of 4 to 5 kgs. It can deliver about 6 kgs. of dust per hour. About 5 ha. can be covered in a day with this.

6.5.7 Power dusters

These are of two kinds. One is a back-mounted model and the other which has to be kept stationary at a place and dusting resorted to. In the former the engines are very light. The air blast from the blower is passed through the container containing chemicals when dust is forced out. This can also be used as a mist-blower with some adjustment. These are used for small areas and has a discharge capacity of 1-2 kg/mt.

In the other model, the whole mechanism is heavy and componenets are mounted on a carrier frame which can either be moved about by two persons or mounted on a trolley. A series of outlets can be provided each one of them having a spoon-type spreader nozzle. The hopper capacity is about 25 litres and the agitation is provided by the air-blast. Discharge rates vary depending upon size. Petrol engines with HP of 1.5-3.0 are used. These are used on large farms and can cover 1-2 ha a day. Dusters are also designed for operation behind the tractor and the power take-off is used for drive.

6.5.8 Seed dressers

Seed material which is to be used for sowing which is treated with suitable chemicals to avert damage by insects or fungus attacks. As the quantity of chemical used is small, to obtain uniformity in the coating, seed dressers are required. Where small quantitites o

quantities of grains are to be treated, a drum with axle passing through the diagnols are mounted on a stand. The shaft is rotated by handle. The grains move to and fro inside the drum and get well coated in about 10-20 revolutions. It has a capacity of 0.8 quintals per hour. Bigger drums can also be made and driven by power with fast and loose pulley arrangement for driving.

In cases where large quantities are to be treated, a power driven machine would be required. These have two drums fitted with sugers. They revolve at slow speed. The bottom one is for grains and the top one for chemical. Grain is fed into the bottom through the hopper. As it revolves the grain moves and get uniformally coated. The capacity of such machines are 6 quintals per hour.

6.6 Threshing machines

In the last decade the introduction of high yielding varieties and other scientific package of practices have increased the per-acre yield of grain so much that threshing has come to be recognised as a critical operation, requiring timely attention. Efforts are, therefore, constantly being made to improve the efficiency of threshing operations.

6.6.1 In wheat growing areas, the bullock-drawn olpad thresher is useful and finding its way into the farming community. The implement consists of three rows of serrated sharp steel discs fitted in a frame. An important feature of this implement is that at the top of the frame there is a seat for the operator, who rides and thus saves himself of the strain anddrudgery which ultimately results in higher outputs. Quality of 'bhusa' is also better because of the better cutting and stirring action.

6.6.2 For threshing of paddy, the pedal drum thresher operated soley by manual power has been imported from Japan and tried out extensively. The looped wooden drum fitted to a frame work has a gear drive arrangement for giving higher R.P.M. They have proved useful for hill and other areas where labour and animal are scare.

6.6.3 In all these devices discussed above, the threshed grain and 'bhusa' remain together. For effectively separating them, a good air blast is necessary. Here again the age-old practice of dropping the mixture from a height and subjecting the same to natural wind action, was improved by the introduction of mechanical winnowing fans. These fans having two-four blades are rotated by manual labour. Some of the improved ones have chain-sprocket driven with rotating pedals in the same way as in cycles.

6.6.4 Several low H.P. threshers have been developed and tested at several research testing centres in the country. These machines have a number of special features. These consist of a feeding conveyor, drum for threshing, sieves and blower for separation of unwanted impurities in grains. There is also a grain elevating arrangement for lifting clean grains and bagging. The performance of these machines was considered to be satisfactory at several places. Specifications of a few selected ones are given below:

6.7 Processing machines

Different grains require different kind of processing techniques, Several machines have been developed in India for this purpose.

6.7.1 Groundnut stripper

Groundnut stripper are used for separating the pods from vines. There are two main types of machine:

i) Drum type: It consists of a drum made of a number of rods fitted to end discs. It is fitted to a stand made of mild steel. The vines with pods are struck against these rods when separation takes place. The rods are rubber covered. The output per person using this machine is 20 kgs/hour at a cost of Indian Rs. 3.80 per quintal of pods as against Indian Rs. 7.50 by conventional methods.

ii) Indian Comb type: Comb like plates are fitted on to flats of a square frame. The vines are pulled against the comb when stripping takes place. 4 persons sitting on four sides of the frame can process 40 kgs per hour at a cost of about Indian Rs. 6 per qunital. The cost of the machine is about Rs. 125.

6.7.2 Groundnut grader

Grading is essential for reducing breakages during decortication. Pods are graded when the kernals are to be used as seed material.

A grader has been developed which has an output of 600 kgs. per hour, and is driven by a 1/2 HP motor. Cost of operation per quintal is Indian Rs. 0.30.

6.7.3 Groundnut decorticator

Both manual and power operated units are available. In the manually operated machine, the drum is rotated by hand or a foot pedal to rotate the drum. The decortification takes places as the pods pass between the concave and rubberised roller.

In the power driven type an oscillating drum gets its drive from the main pulley. Engine power is 1 HP and has an output of 400 kgs per hour.

6.7.4 Maize sheller

The shelling action takes place when the cob is drawn through specially designed discs. The shelled cob is discharged out of the machine. It has an output of 300 kgs/hour, with a cost of operation of Indian Rs. 0.45 per quintal of kernals.

There are simple manually operated shellers also available for small farmers.

Statement showing details of known threshers

Sr. No.	Name of machine	Name of manufacturer	Crops that can be threshed	Power H.P.	R.P.M.	Grain output Qtls/hrs.
1.	Bullock driven pedal thresher	Cossul and Co., Kanpur	Paddy	1 Bullock + 4 Men	-	1.5
2.	Olpad thresher		Wheat	50 kg (Draft)	-	0.2
3.	Karamath	M/s Punch Udyog (P) Ltd., 85/52 Cooperganj, Kanpur (UP)	Wheat	5	-	0.8
4.	Swadeshi	M/s Swadeshi Krishi Yantra Udyog, 80/7 Cooperganj, Kanpur (UP)	Wheat	5	-	1
5.	Cossul	M/s Cossul and Co. (P) Ltd. 123/367 Fewalganj, Factory Area, Kanpur. (UP)	Wheat	5	-	1
6.	Soyabean thresher	UPAU Pant Nagar (UP)	Soyabean	7.5	400	2
7.	Jai Kissan	M/s Best Manufacturers, Krishi Udyog, 70/481, Kuli Bazar, Kanpur(UP)	Wheat	0.5 7.5 10.0 15.0		1.2 2.0 2.5 3.8
8.	Standard thresher	M/s Sabbarwal Metal Industries, 61 Industrial Estate, Kanpur (UP)	Wheat	0.5 7.5 10.0		2.0 2.8 4.0
9.	Drummy type	-do-	Wheat	3 5 7		1.2 3.0 2.8
10.	Power wheat thresher	Deptt. of Agriculture, Engg. Agri. Institute, Allahabad (UP)	Wheat Gram	5	850 750	2.0 2.5
				7.5	800	3
11.	HIRA	International Manufacturing Co. Jagraon, Dist, Ludhiana (Pb)	Wheat Jowar, Gowar	10	550	3
12.	PUSA-40		Wheat	5	840	3
13.	UT 90	Union Tractor Workshop, 8B Phase II, Industrial Area, New Delhi.	Wheat	30	600	10
14.	UT 30	- do -	Wheat	10	---	3
15.	Sherpur	M/s Union Forgings, Sherpur, G.T. Road (near Dhandari Rly. Station) Ludhiana (PB)	Wheat	5 7.5 10 15 20 25	--- --- --- --- --- ---	2 3 4 5 6 10
16.	LTC	LTC Industries, Coimbatore, (TN)	Jowar	5	850	10
17.	Shri Ram Thresher	Sri Ram Industries, Coimbatore (TN)	Paddy	3		4
18.	LDL All Crops thresher	Krishak Industries, 18-14 Boiguda Hyderabad (AP)	All crops Paddy Wheat Jowar Maize	6.5 -- -- -- --	- - -	- 0.6 10 15 25
19.	Aurbindo	Aurbindo, Pondicherry	Paddy	--	1120	8

Note: (specifications of machines shown in the statement are on the basis of available test reports and manufacturers catalogues)

6.7.5 Chaff-cutter

In the power driven type not only fodder is cut into small bits but they are also blown to a height of 2.1-2.4 meters by a pneumatic blower. Sharp well designed blades are fitted to a circular flywheel. It requires a 2 H.P. electric motor to operate and can cut 750 kgs of green fodder per hour. Cost of this machine with motor is Indian Rs. 3300.

In the manually operated machine, an auto-feed worm is provided which feeds to the cutter uniform lengths of fodder. The flywheel to which curved knives are fitted is rotated by a man. The output is about 1.5 quintals/hour.

6.7.6 Sugarcane Crusher

It is operated by an engine of about 5-8 H.P. with a speed reduction mechanism. Three rollers with well designed grooves are fitted into the frame with appropriate clearances. Canes passing through these rollers are crushed and juice flows out of the machine. Machines are also made for bullock power.

6.7.7 Biogas plants

The digester of the biogas plant is made of black steel sheets and of various diameters. For four animals 1.8 meters diameter digester tank is used. This tank is placed invertedly in a masonry tank which is filled by cowdung and other organic wastes. A masonry pit is used to mix water with dung in equal quantities which is then fed into the well. After about 27 days of first charge, biogas collects in the steel tank over the slurry. After this, the process is continuous. The spent slurry flows out through another pipe and is led into pits where it is mixed with other organic wates for use as compost.

6.7.8 Storage bins

These are made of galvanised steel plates in various sizes. They have an opening with a tightly placed lid.

At the bottom there is a spout for easy removal of grain as an when needed. These are made in varying sizes going from 1 quintal to 3 or 4 tons. Before storing the grains,they should be dried and tested properly.

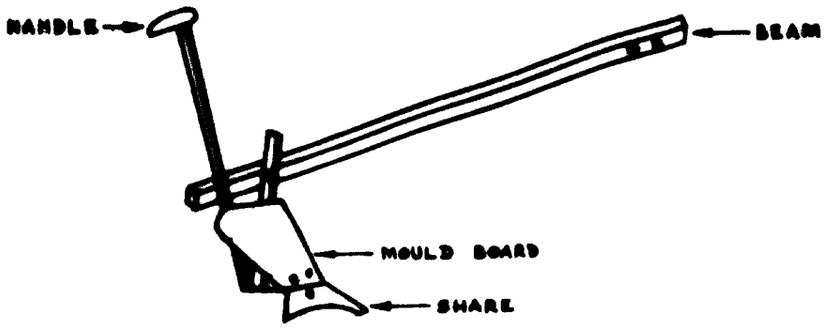
6.7.9 Manually operated rice mills

Small manually operated rice mills have been developed in India. In these , the paddy is thrown with force due to the centrifugal action. The movement of paddy through shelling plates working at different speed produces the shelling action and paddy gets dehusked. Manually operated machines and low power mills are also in production. In the manually operated machines, a gear and pinion mechanism raises the speed.

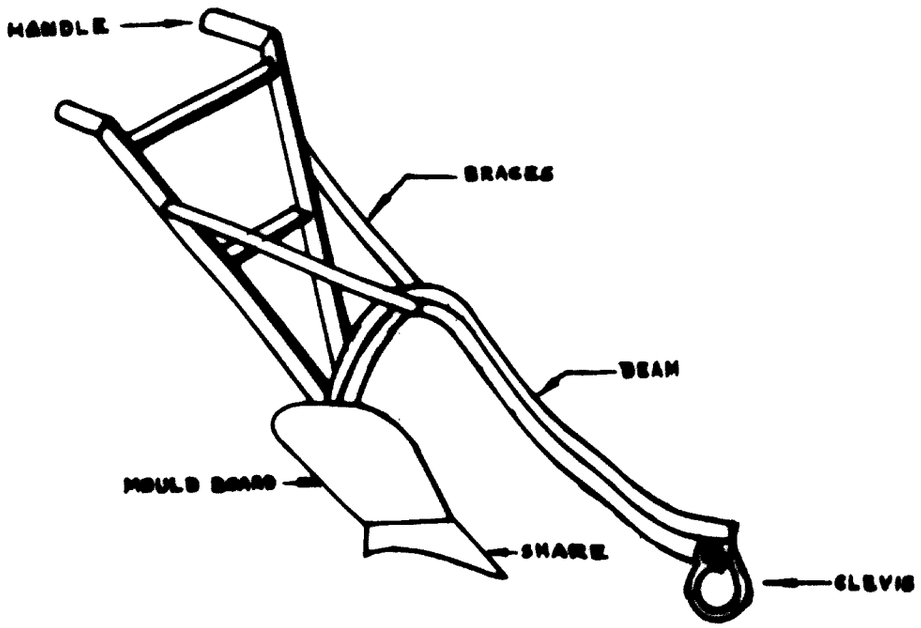
6.7.10 Mini rice mill

CFTRI, Mysore has developed a mini rice mill with a processing capacity of 500 kg/hour.

MOULD BOARD PLOUGH



LONG BEAM TYPE



SHORT BEAM TYPE

FIGURE- 6.1.1

BULLOCK DRAWN SCRAPER

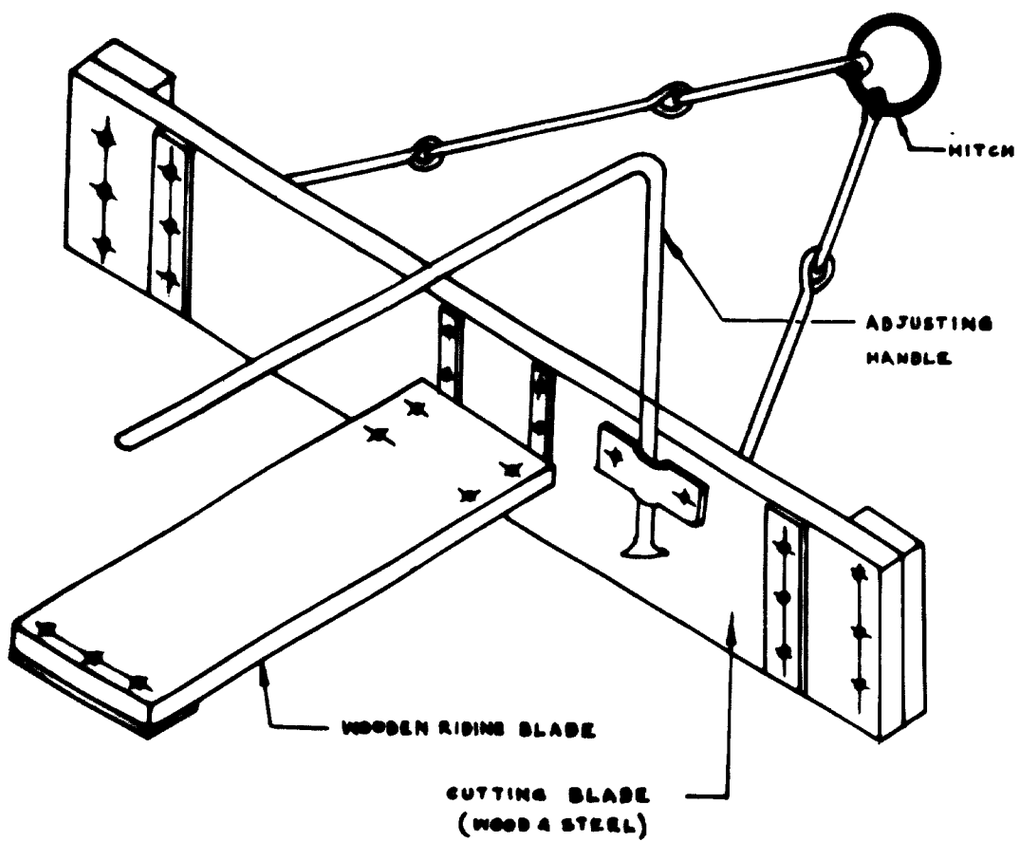


FIGURE – 6.1.1 (a)

POWER TILLER

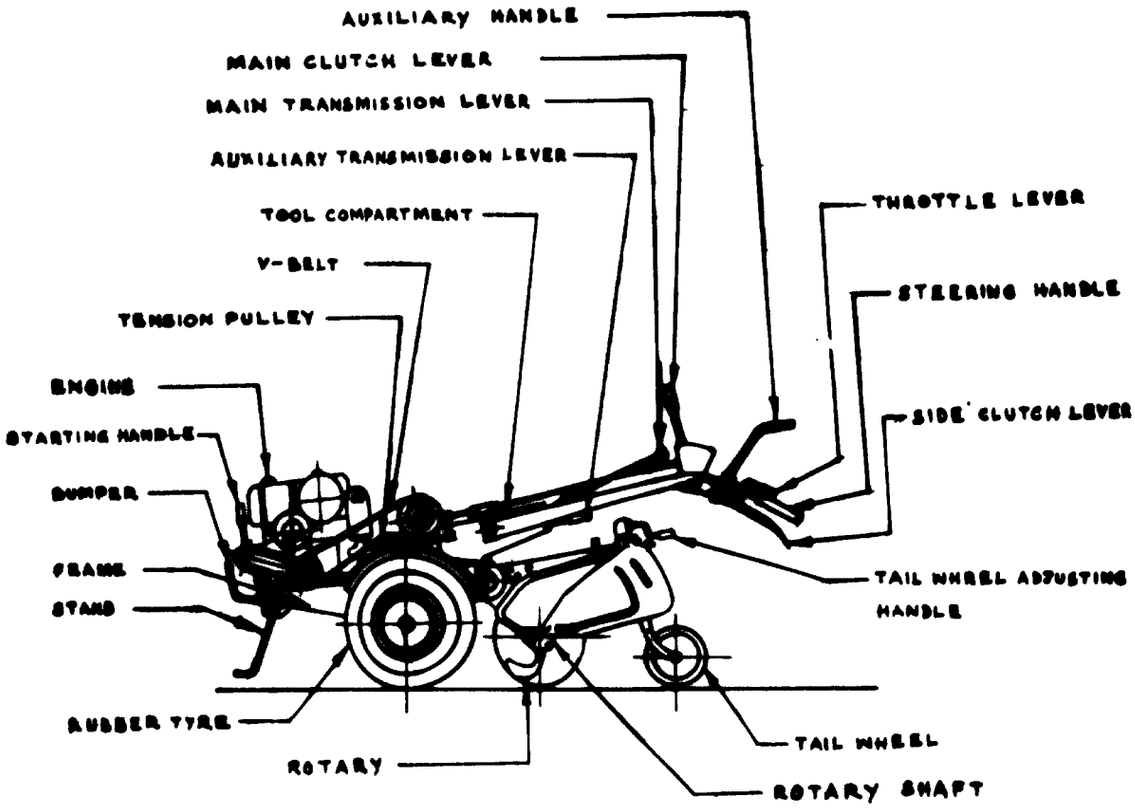


FIGURE- 6.1.1(b)

THREE-TYNE CULTIVATOR

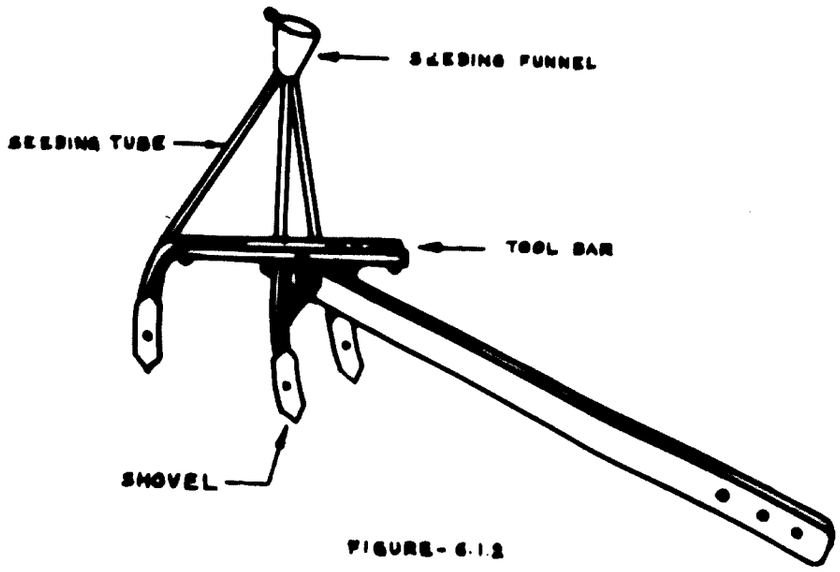


FIGURE- 6.1.2

EXPANDING CULTIVATOR

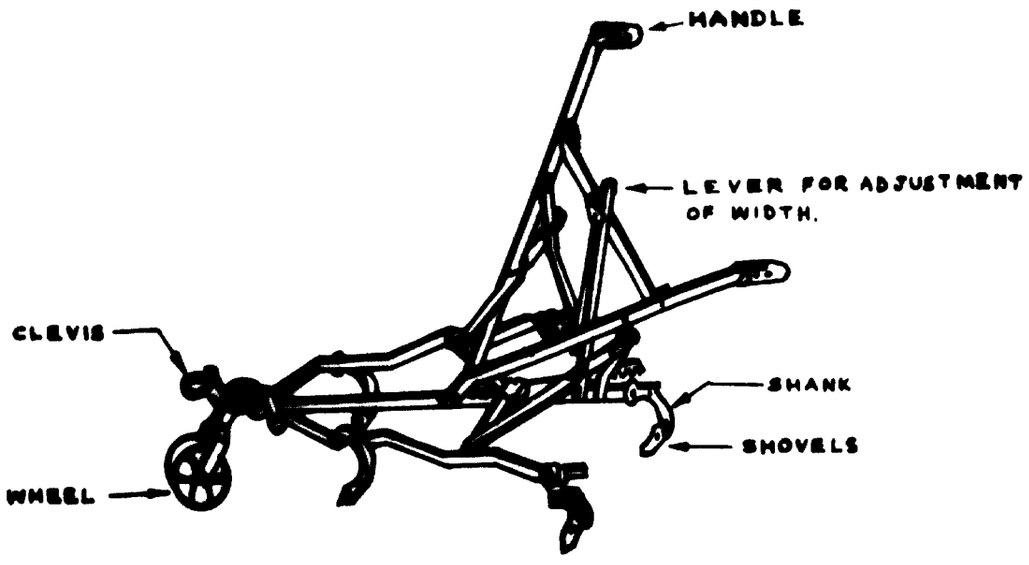


FIGURE- 6.1.3

TRIANGULAR HARROW

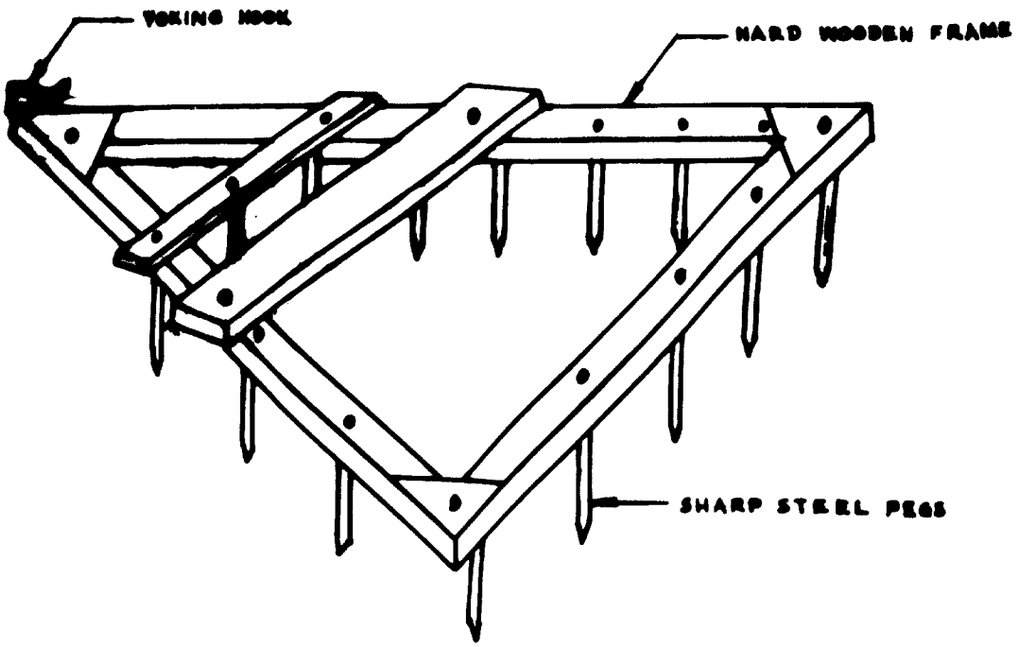


FIGURE - 6.1.4

PETELA

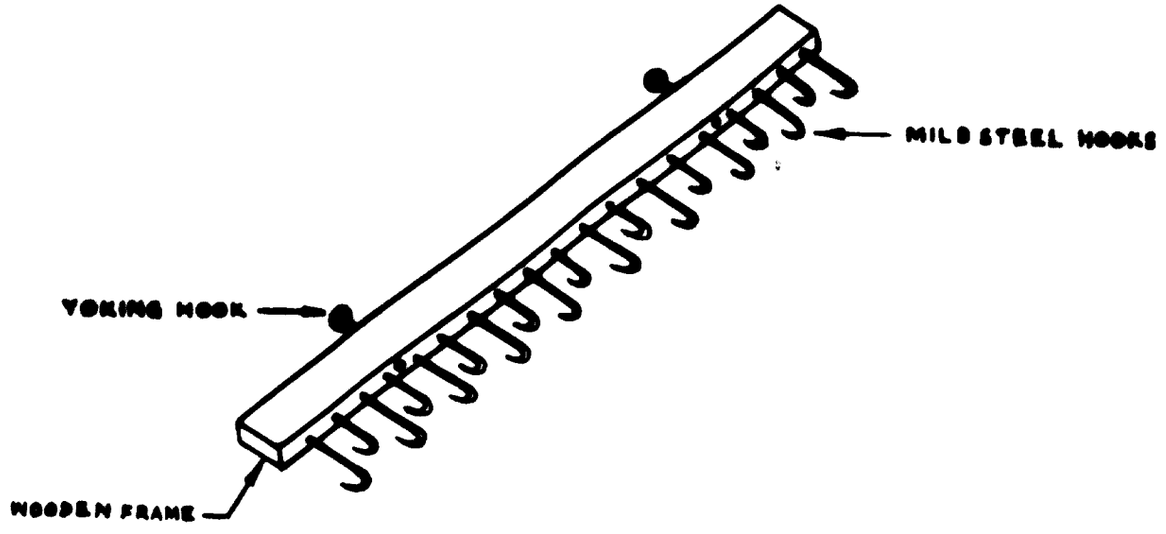


FIGURE - 6.1.5

DISC HARROW

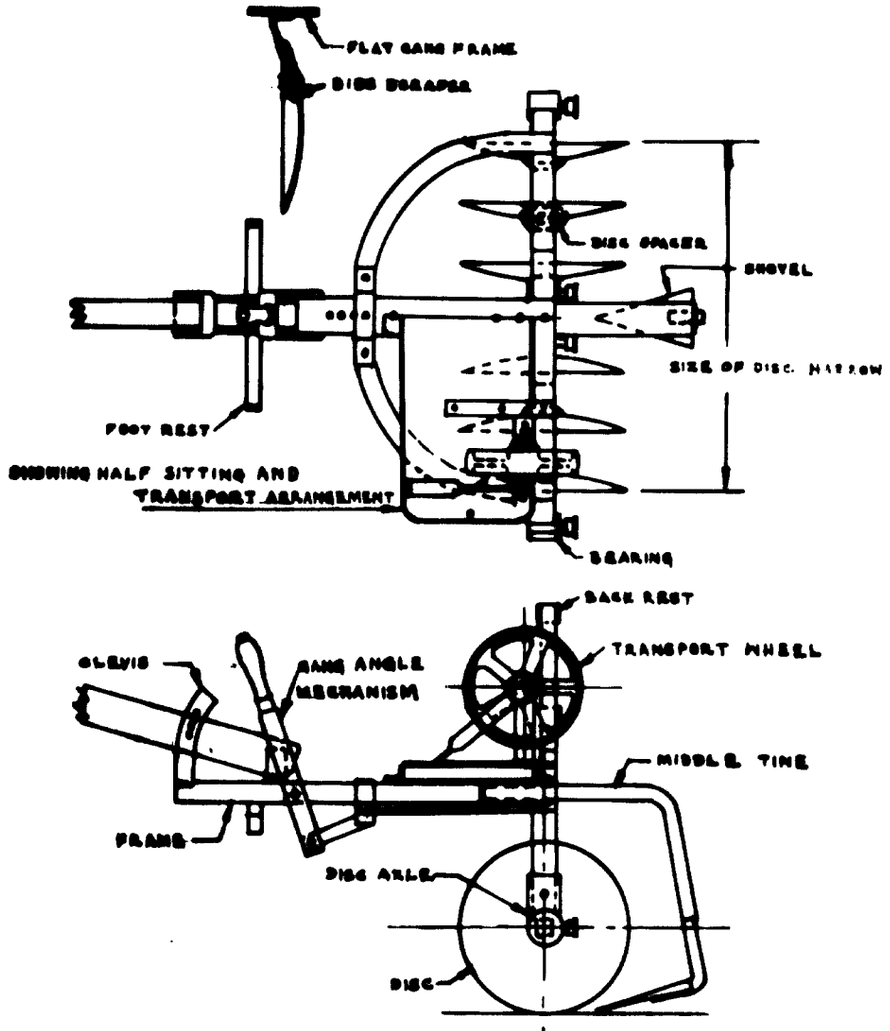


FIGURE-6.1.6

BUND FORMER

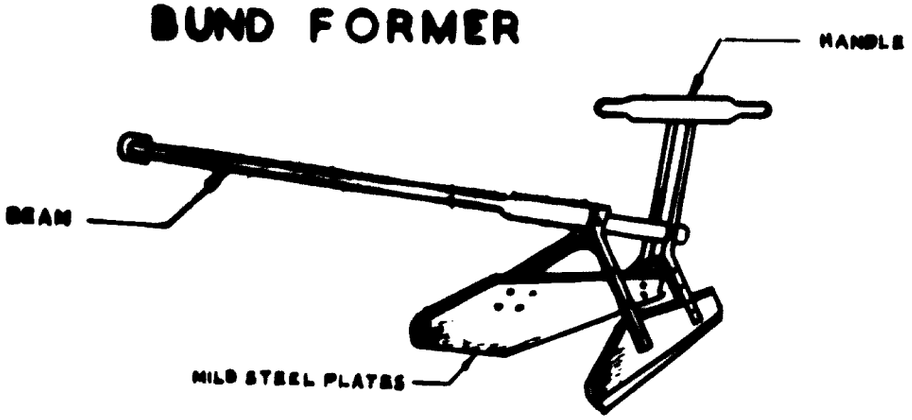


FIGURE-6.1.7

RIDGER

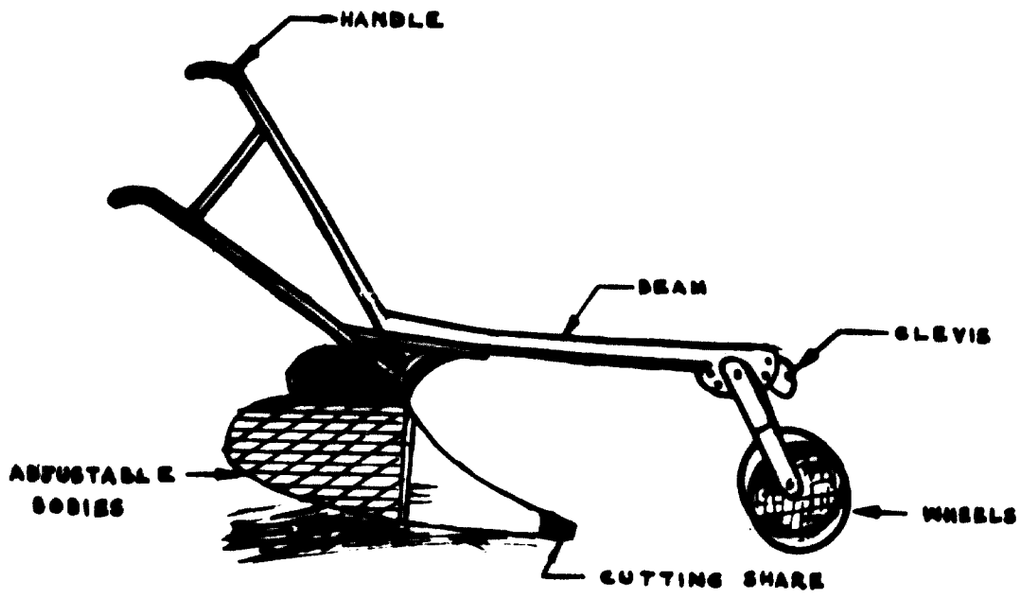
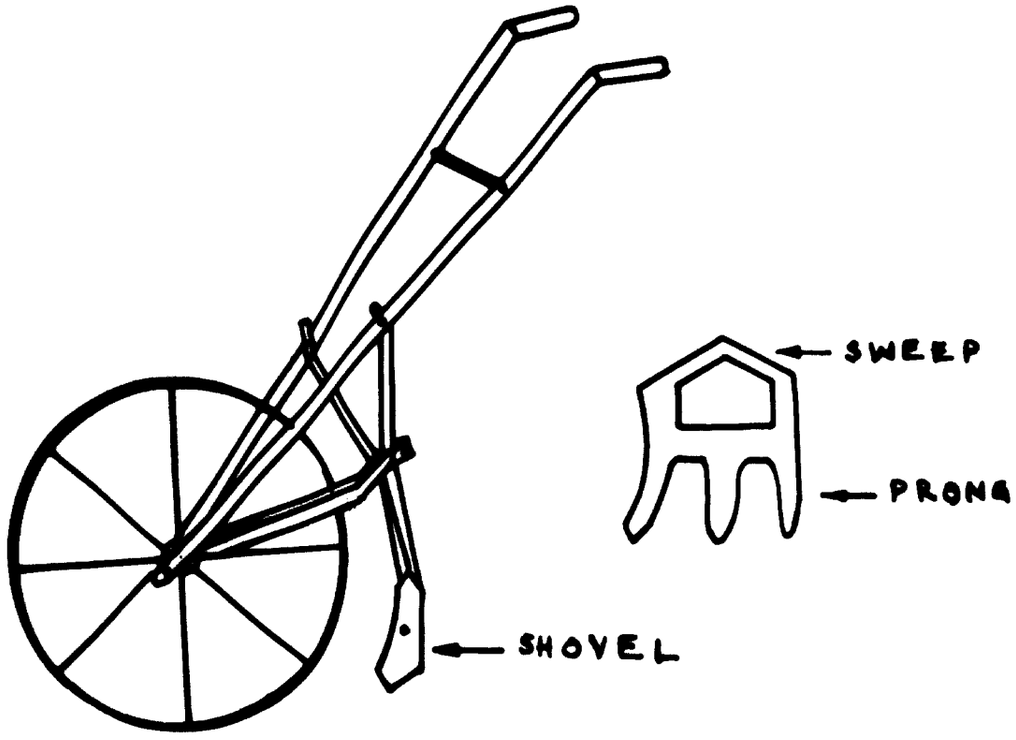


FIGURE – 6.1.6

WHEEL HOE



AKOLA HOE

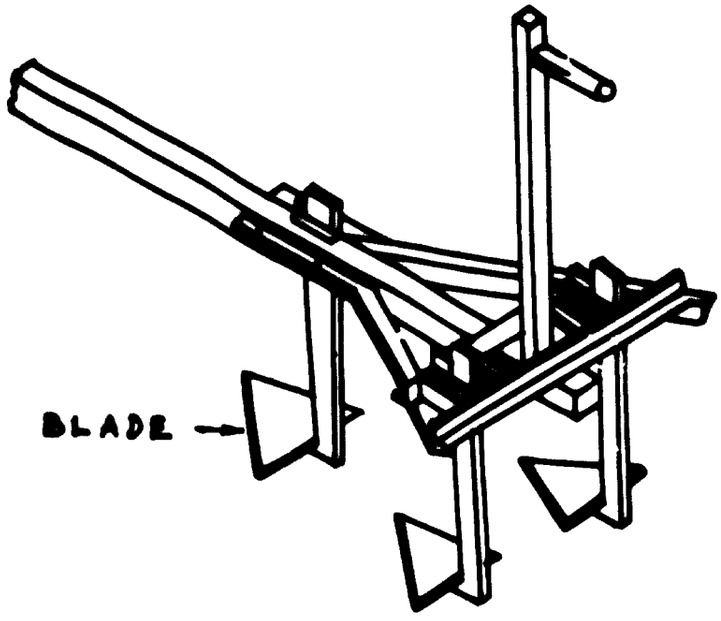


FIGURE- 6.1.9

LEVELLOR

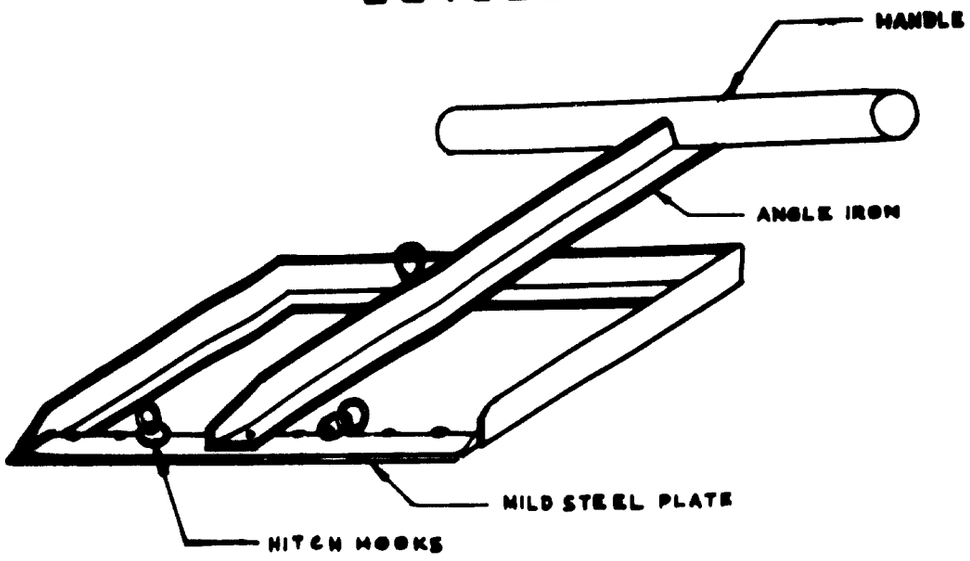


FIGURE - 6.1.10(a)

SOIL SCOOP

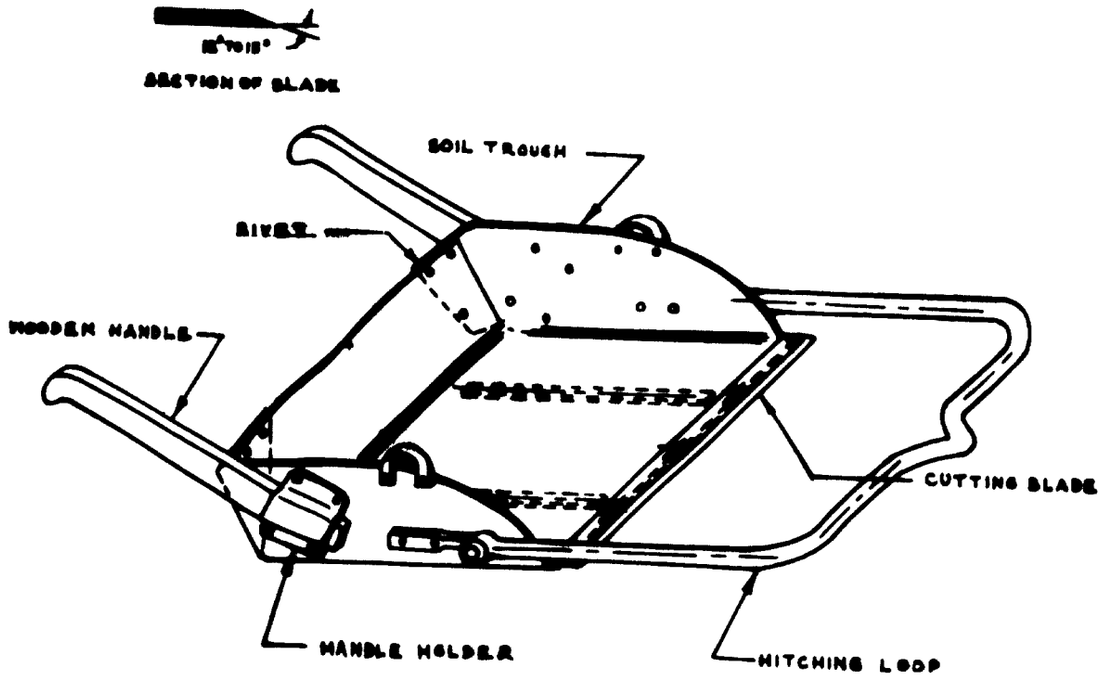
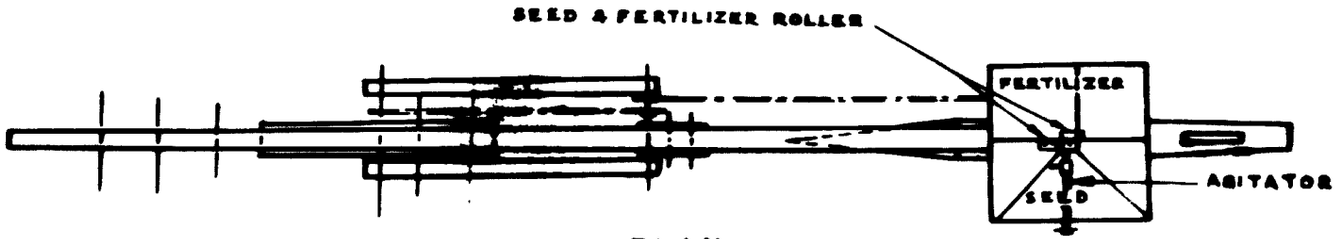
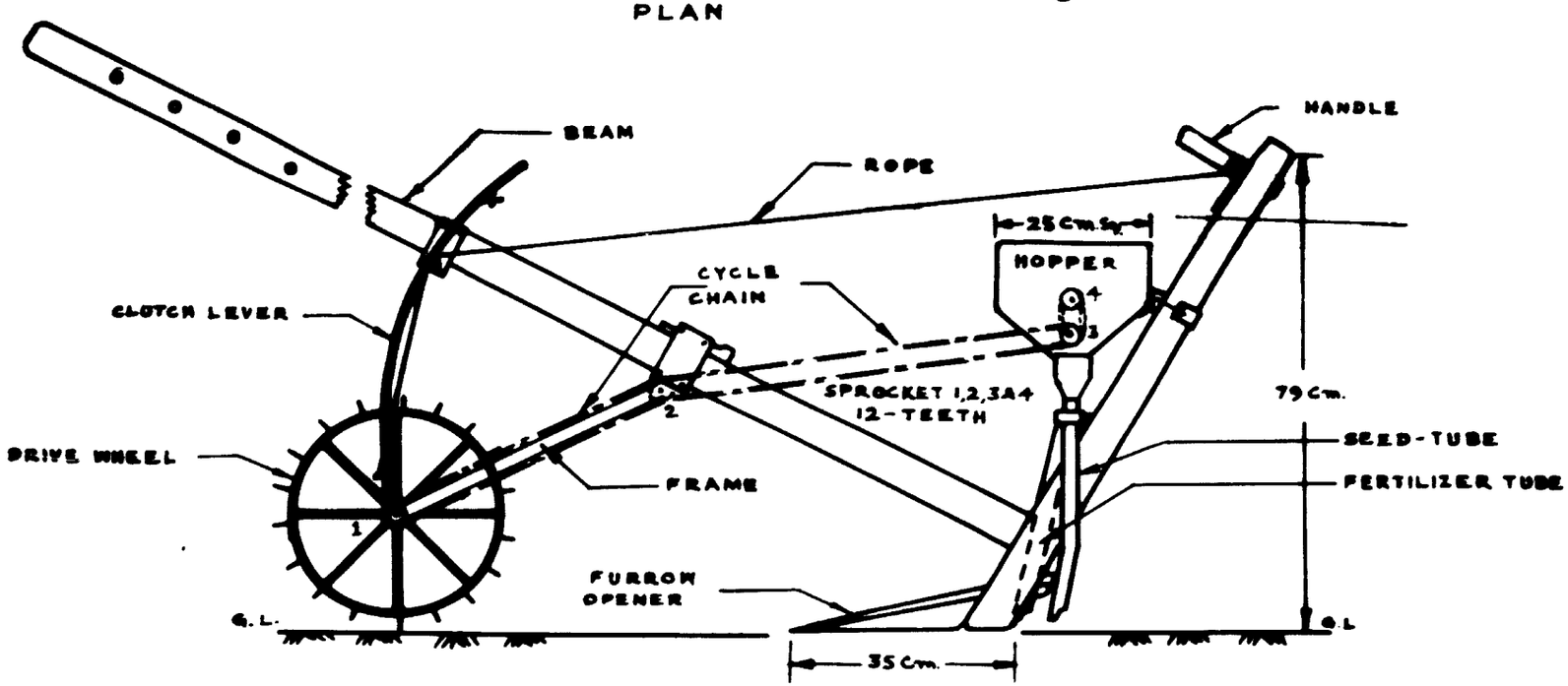


FIGURE - 6.1.10(b)

SINGLE ROW SEED CUM FERTILIZER DRILL



PLAN



SIDE VIEW

FIGURE-6.3.8

THREE ROW SEED-CUM-FERTILIZER DRILL

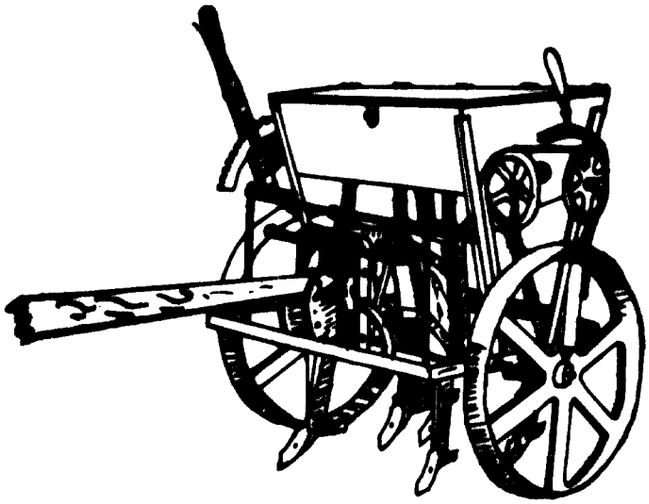


FIGURE- 6.2.4 (iii)

CUP FEED TYPE SEED DRILL

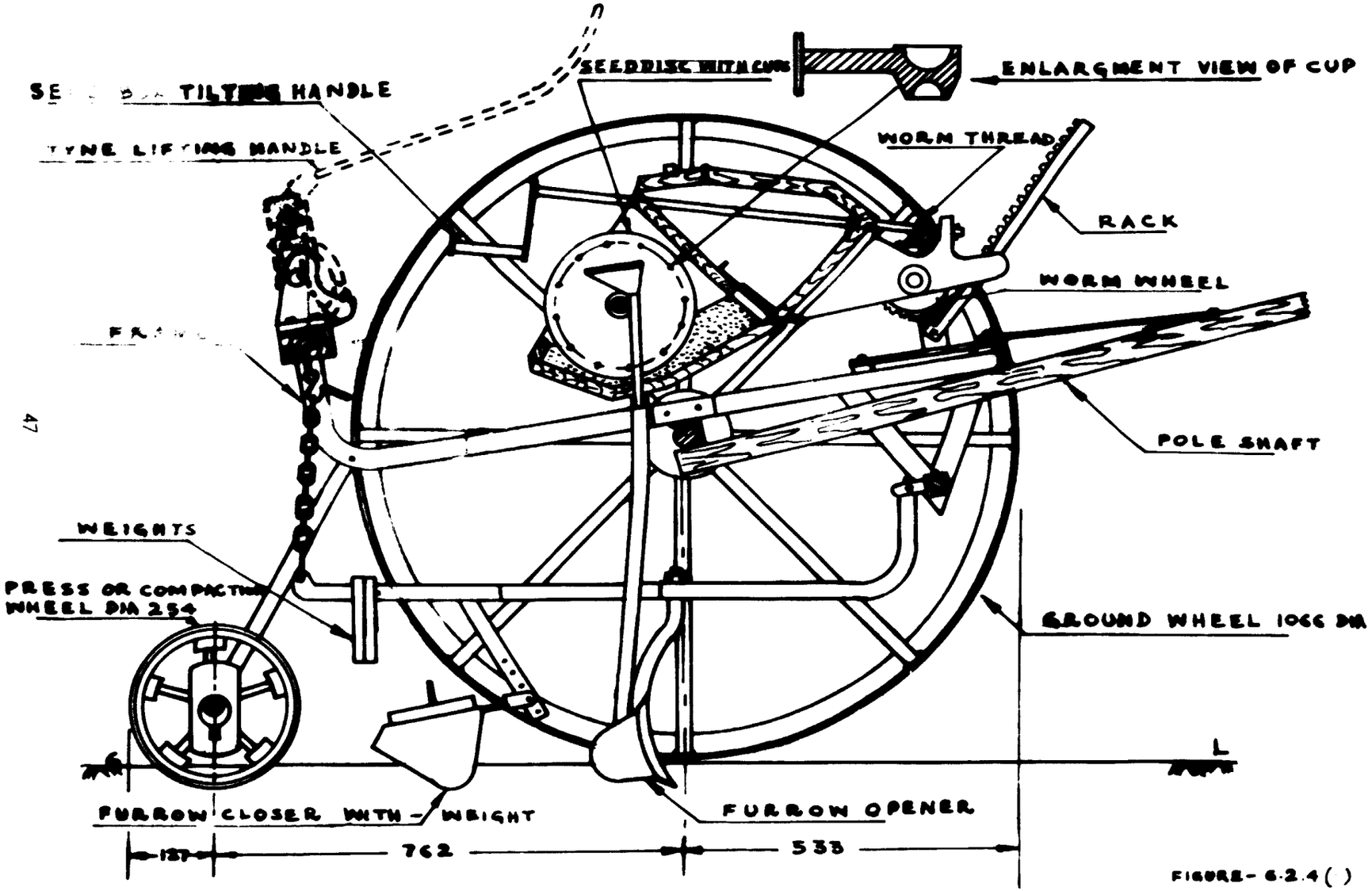


FIGURE- 6.2.4( )

PADDY WEEDER

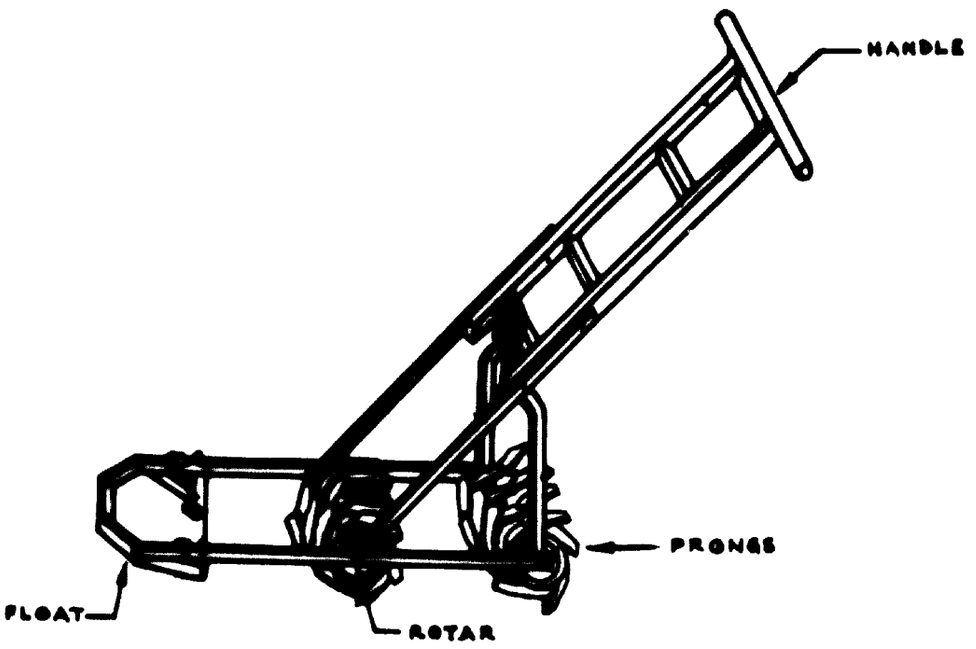


FIGURE-6.3.1

IRON RAKE

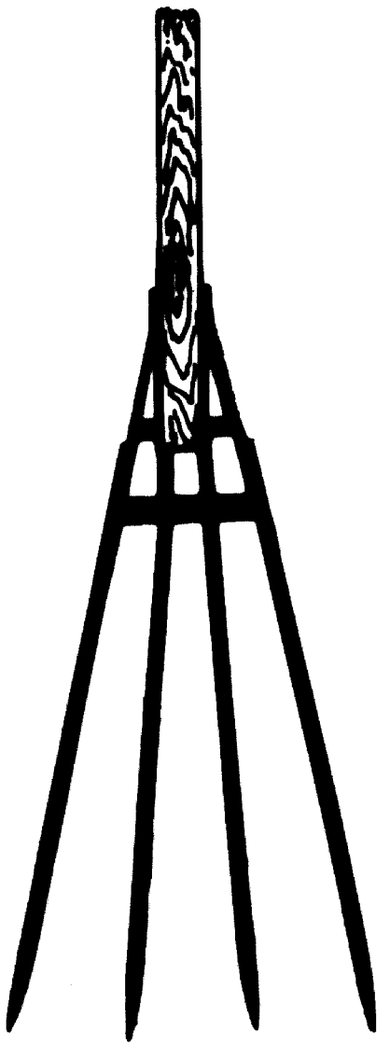


FIGURE-6.3.2

RAKE-CUM-BLADE WEEDER (CRRI)

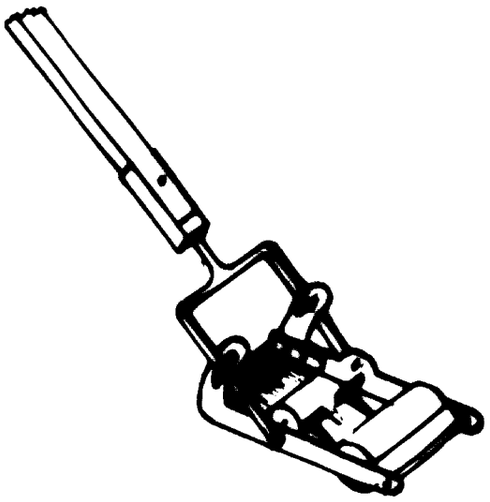


FIGURE-6.3.2

STAR WEEDER

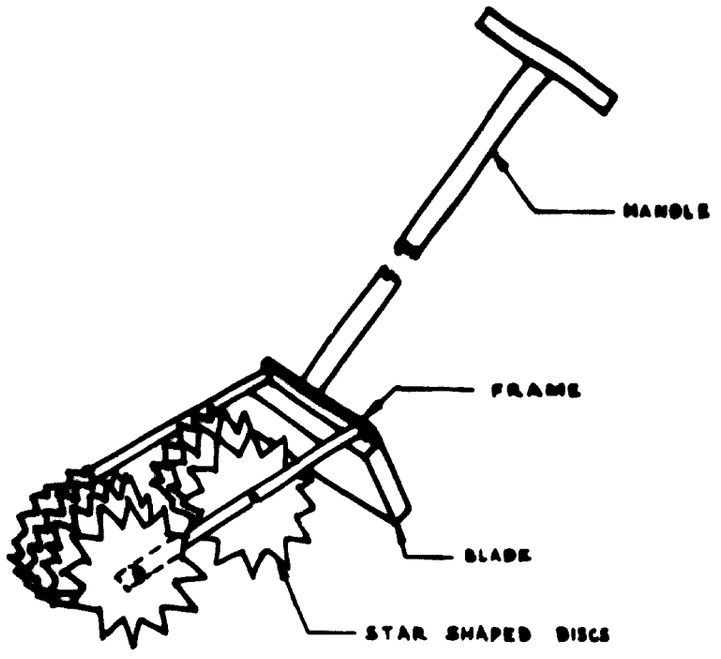


FIGURE-6.3.3

WHEEL HOE

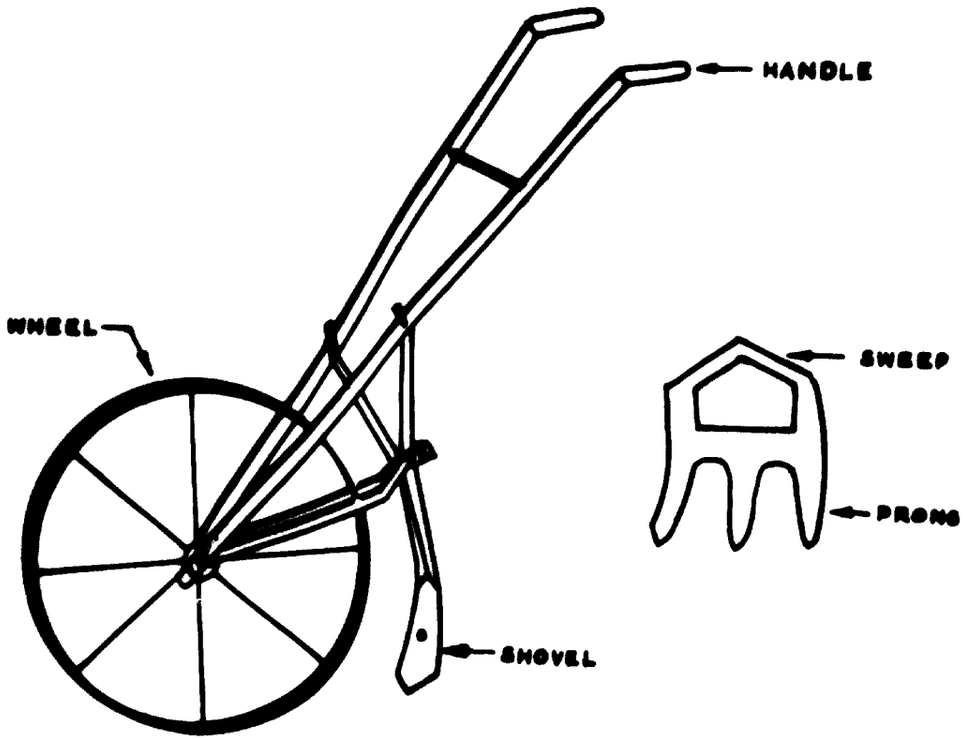
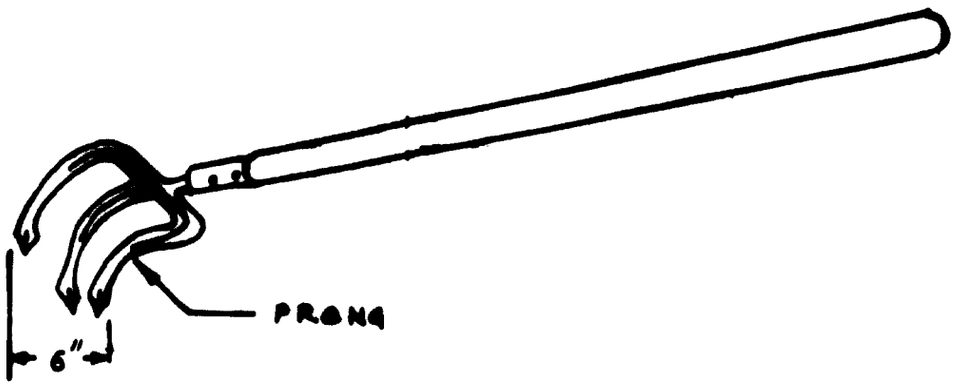


FIGURE-6.3.4

SINGH HAND HOE



SHARMA HAND HOE

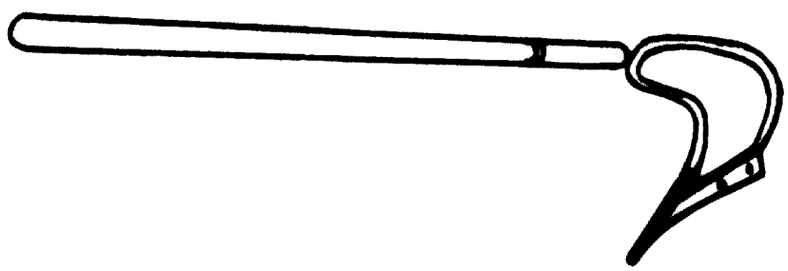


FIGURE- 6.3.4

SHOULDER MOUNTED
POWER SPRAYER-CUM-DUSTER

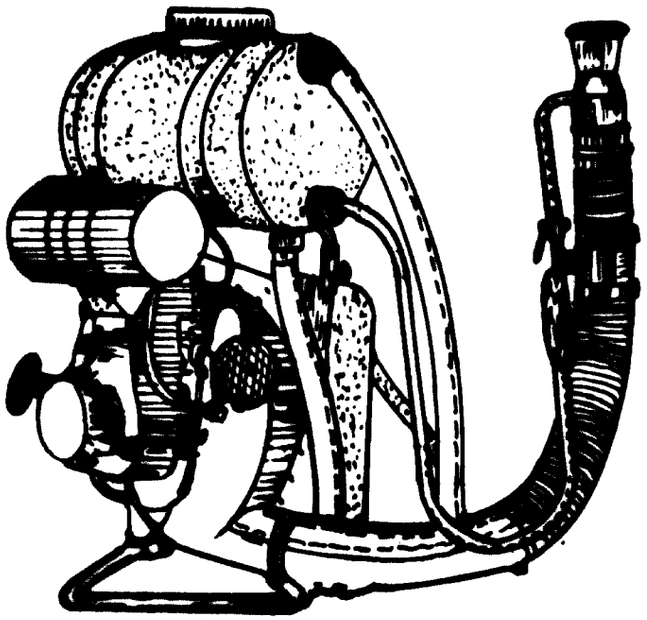


FIGURE- 6.4

HAND-COMPRESSION KNAPSACK SPRAYER

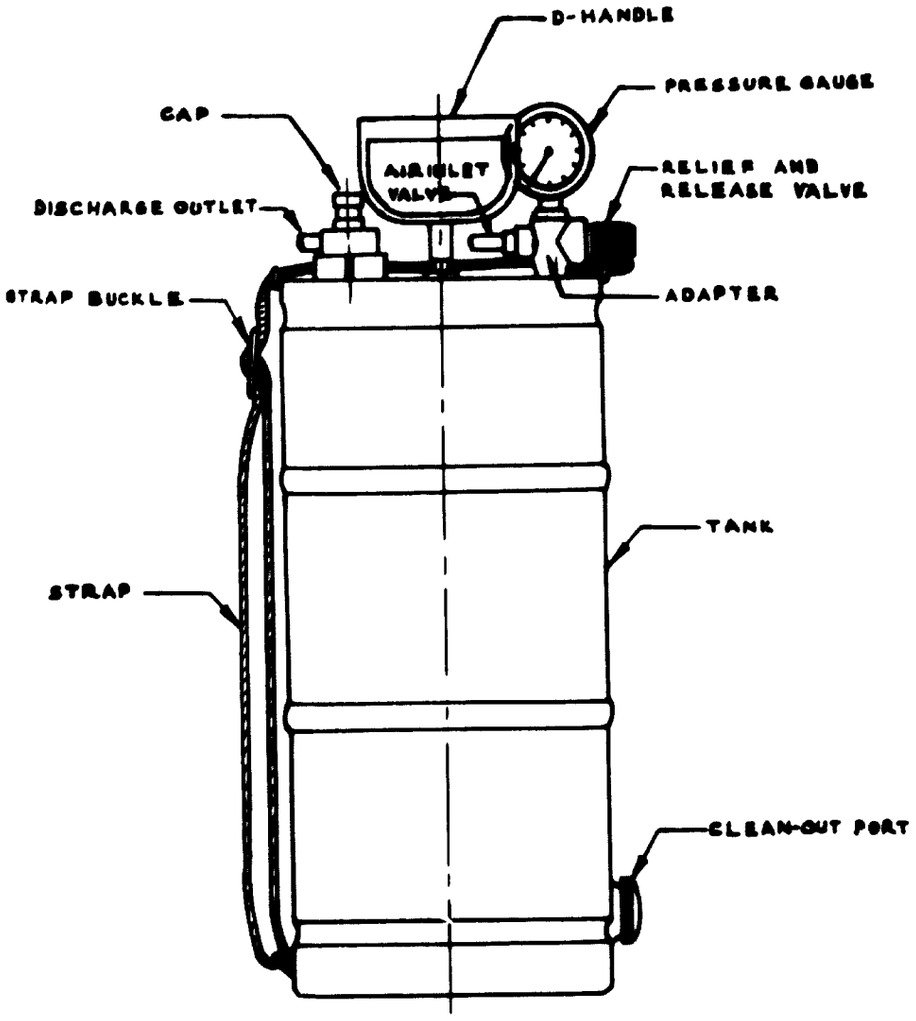


FIGURE-6.4.1

KNAPSACK SPRAYER

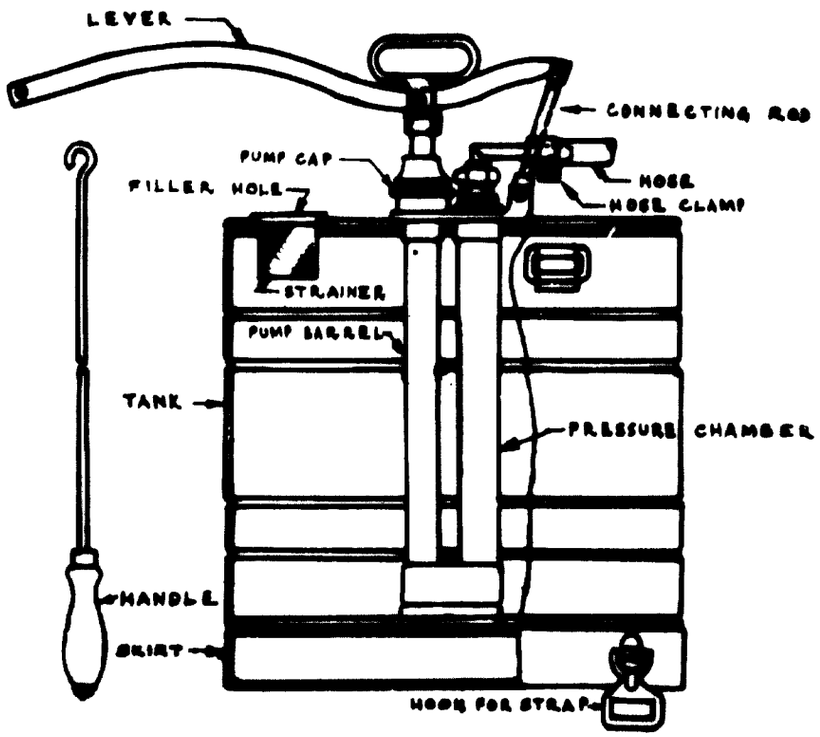


FIGURE-6.4.2

KNAPSACK SPRAYER

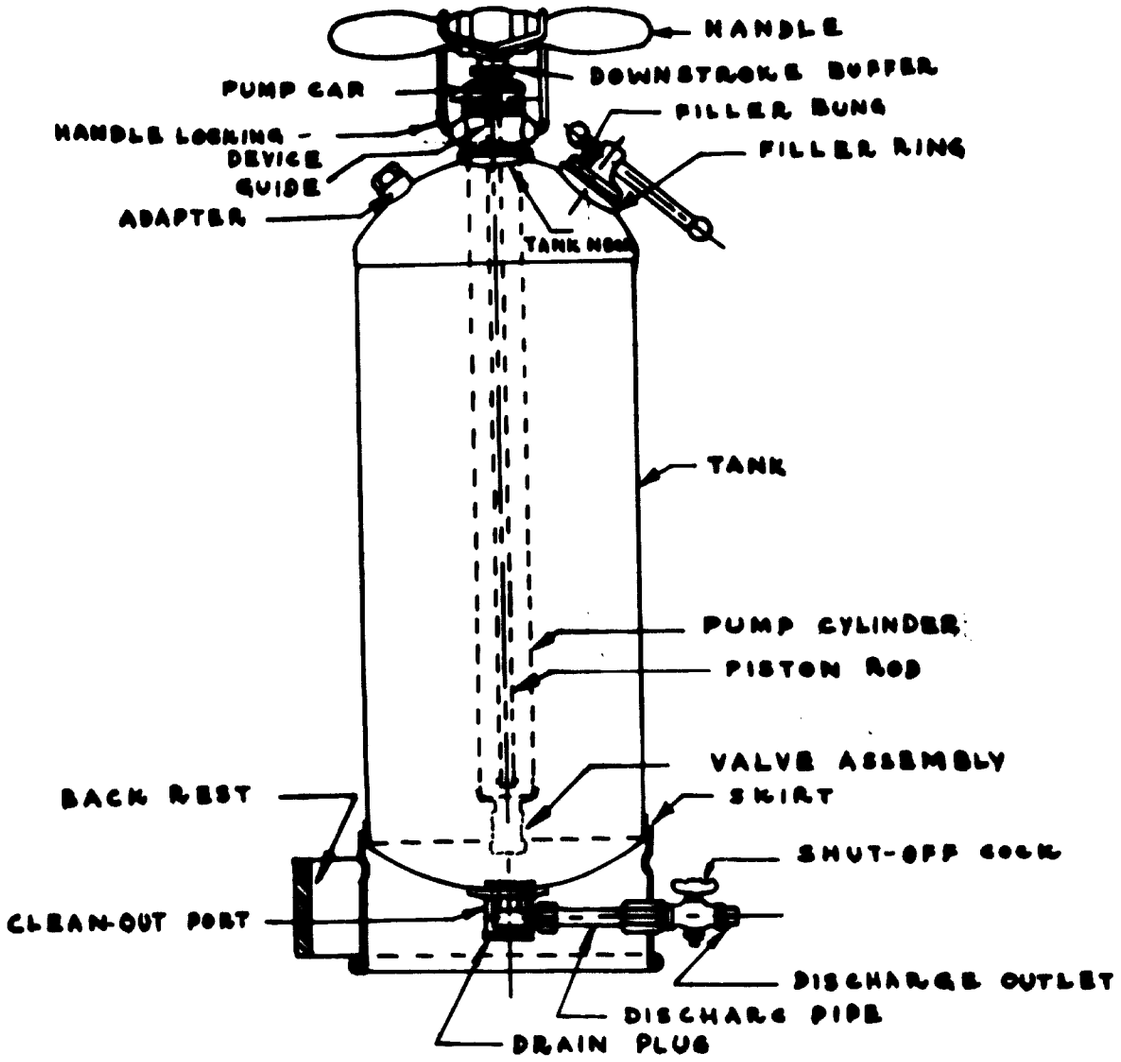


FIGURE- 6.4.2

FOOT SPRAYER

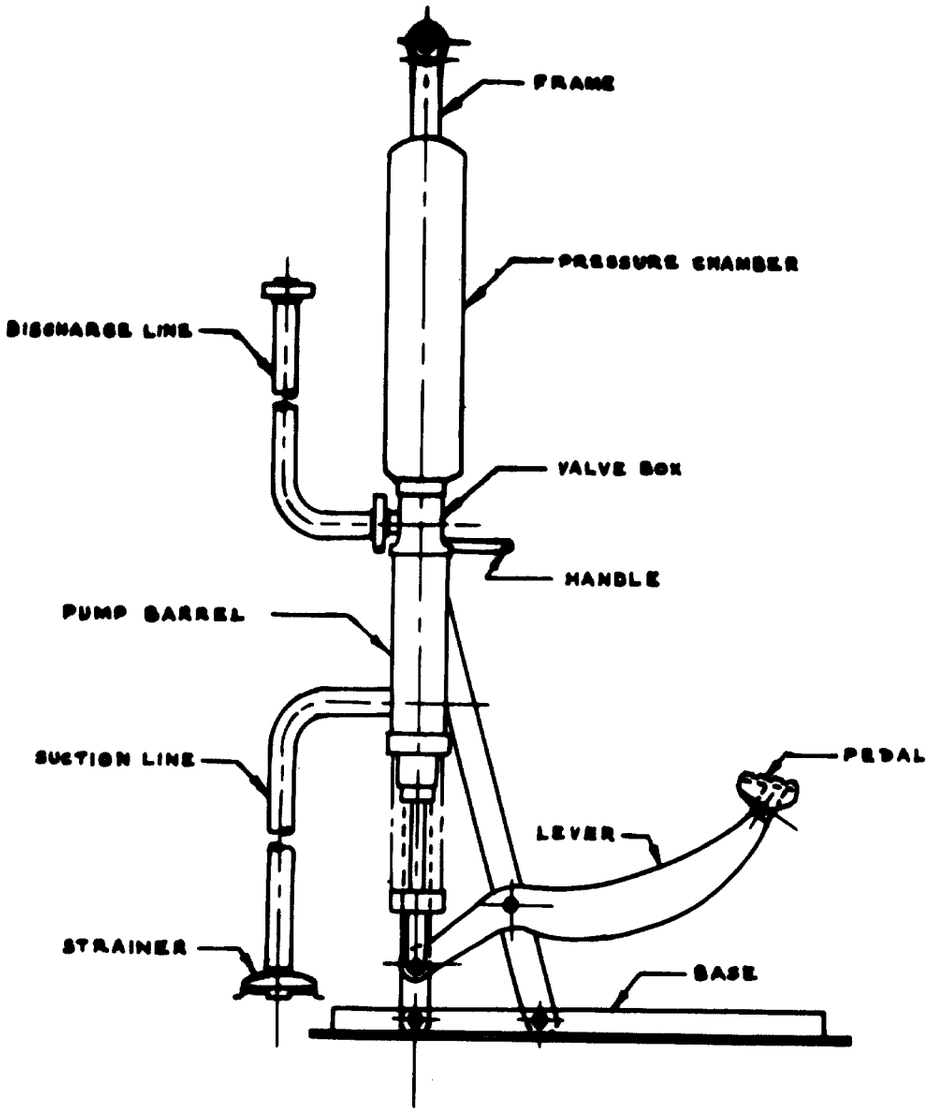
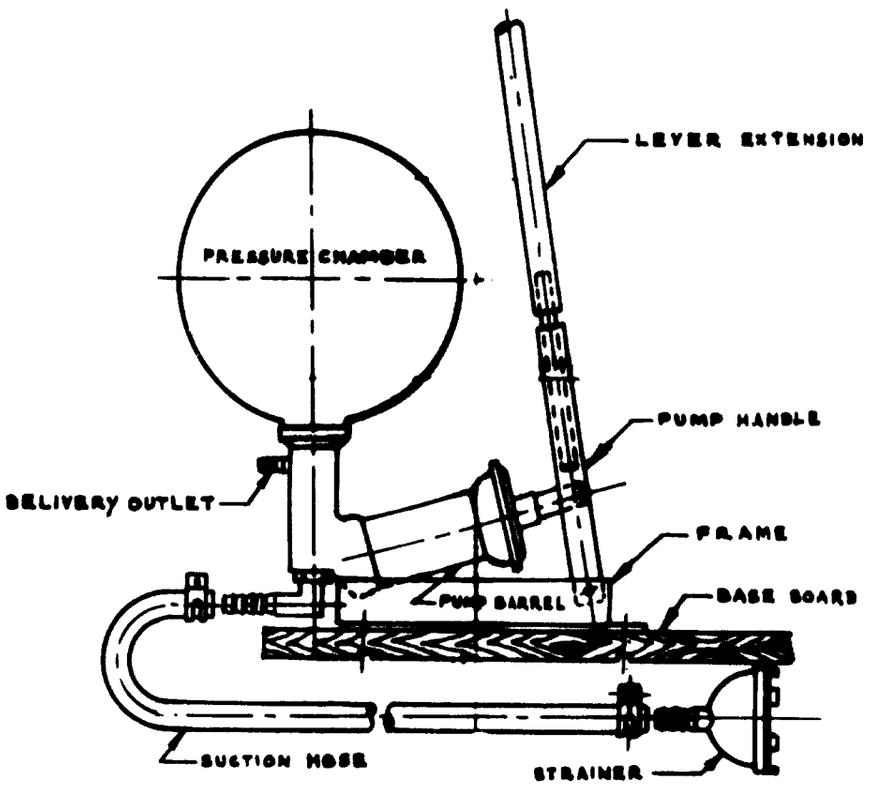
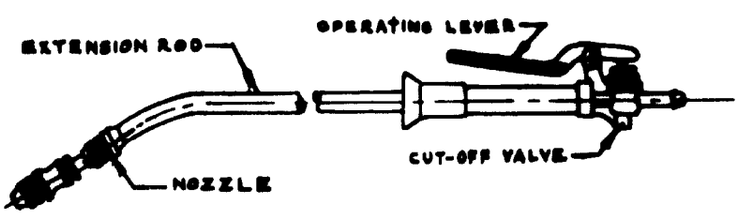


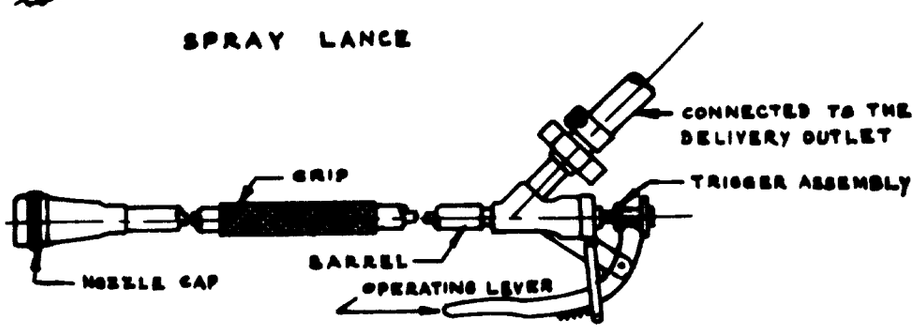
FIGURE - 6.4.3

ROCKER SPRAYER





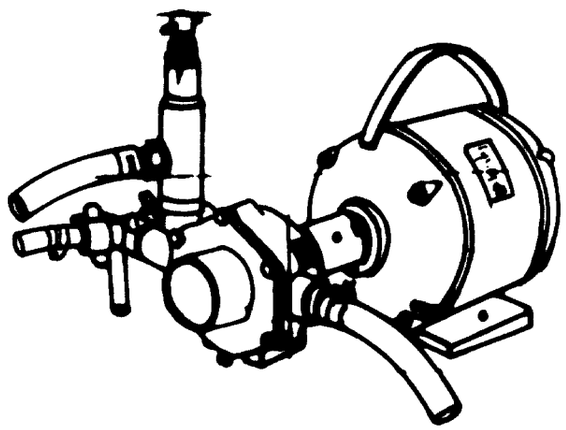
SPRAY LANCE



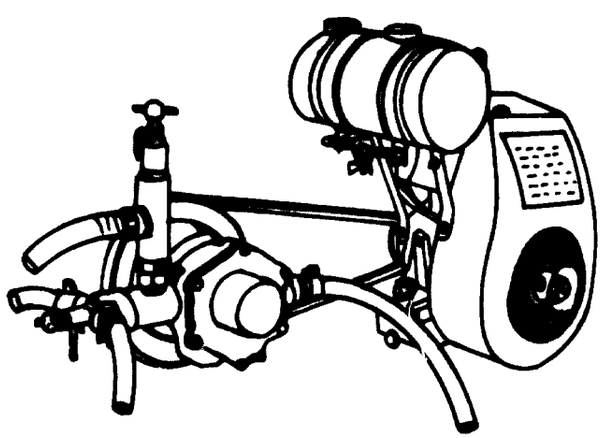
SPRAY GUN

FIGURE- 8.4.4

POWER SPRAYER



(FOR ELECTRIC MOTOR)



(FOR PETROL/KEROSENE ENGINE)

FIGURE-6.4.5

SEED DRESSER

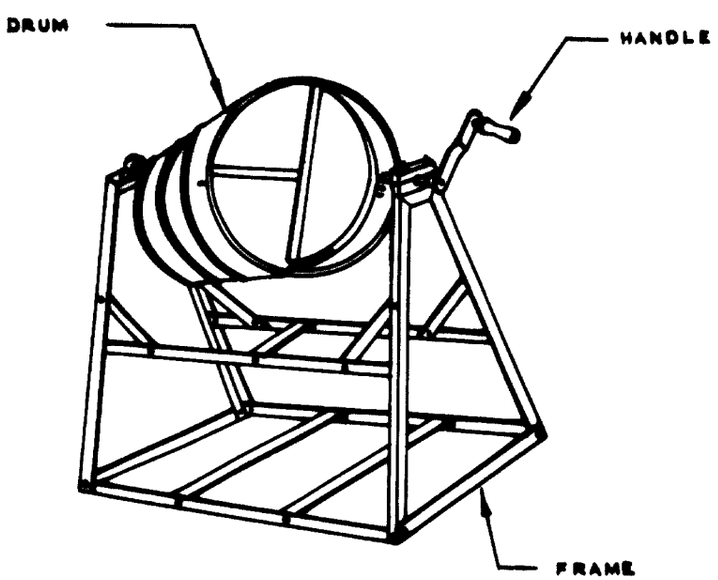
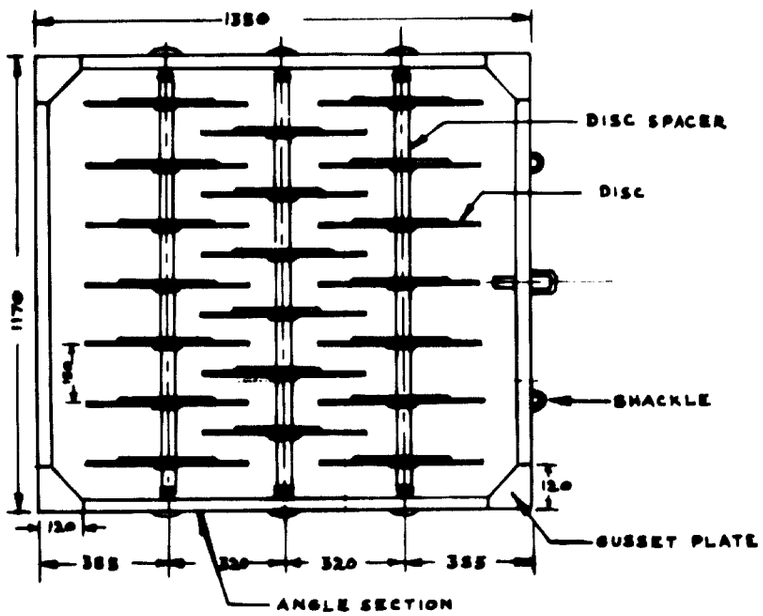
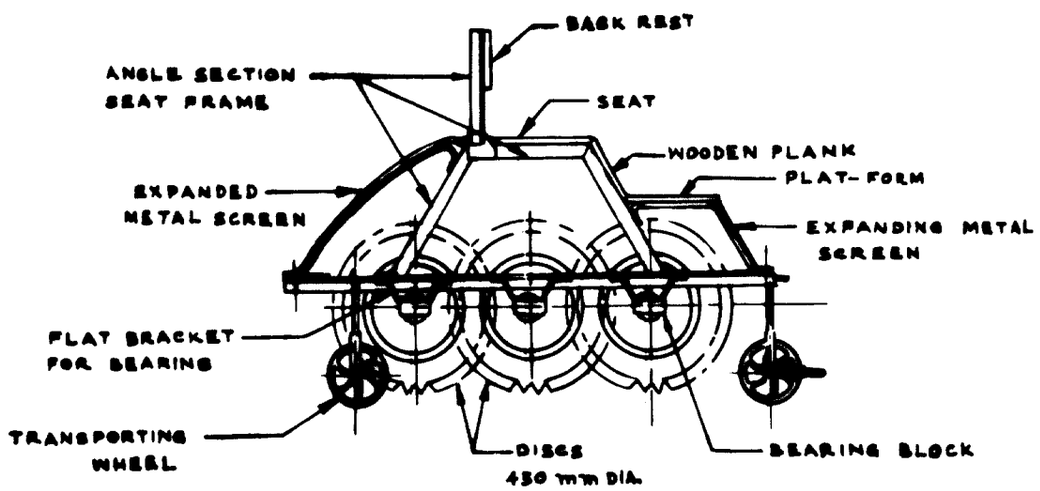


FIGURE- 6.4.8

OLPAD THRESHER



PLAN (WITHOUT SEATING)



ELEVATION

ALL DIMENSIONS IN MILLIMETRES

FIGURE- 6.5.1

PADDY THRESHER

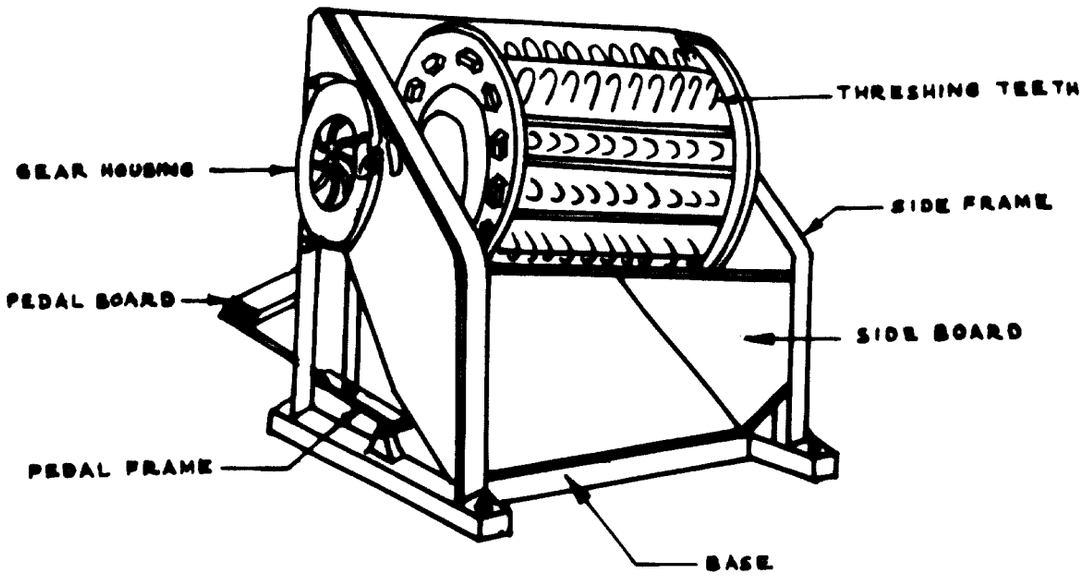


FIGURE-6.5.2

WINNOWER

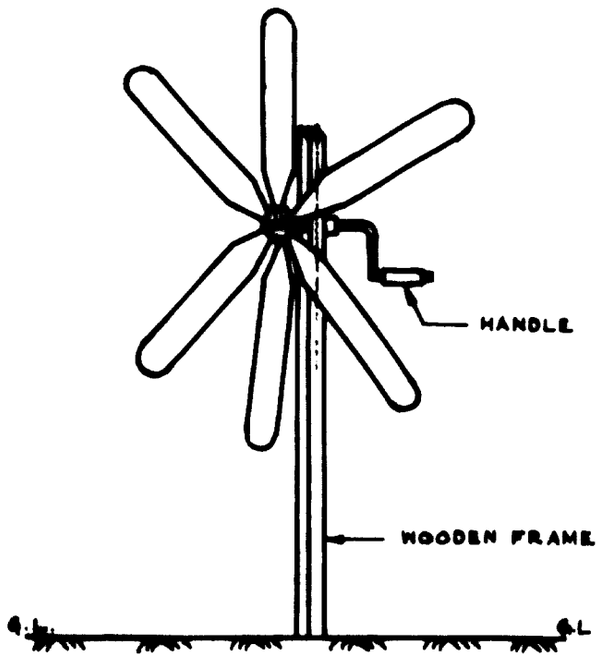


FIGURE-6.5.3(I)

WINNOWING FAN

(CHAIN SPROCKET)

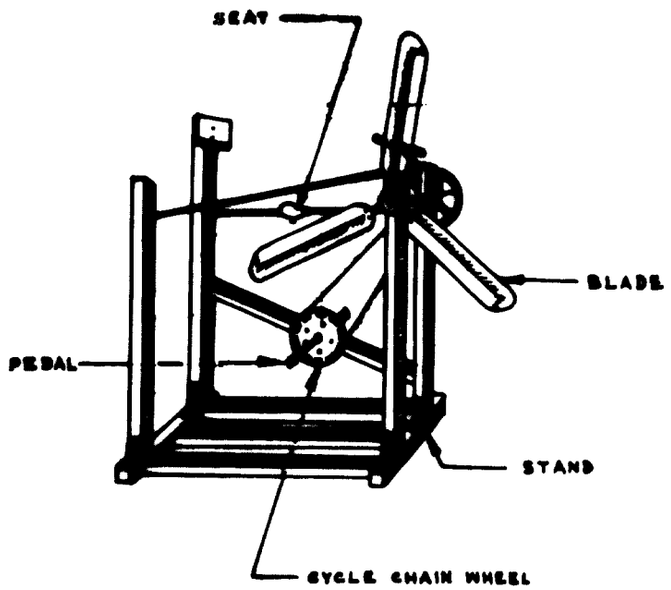
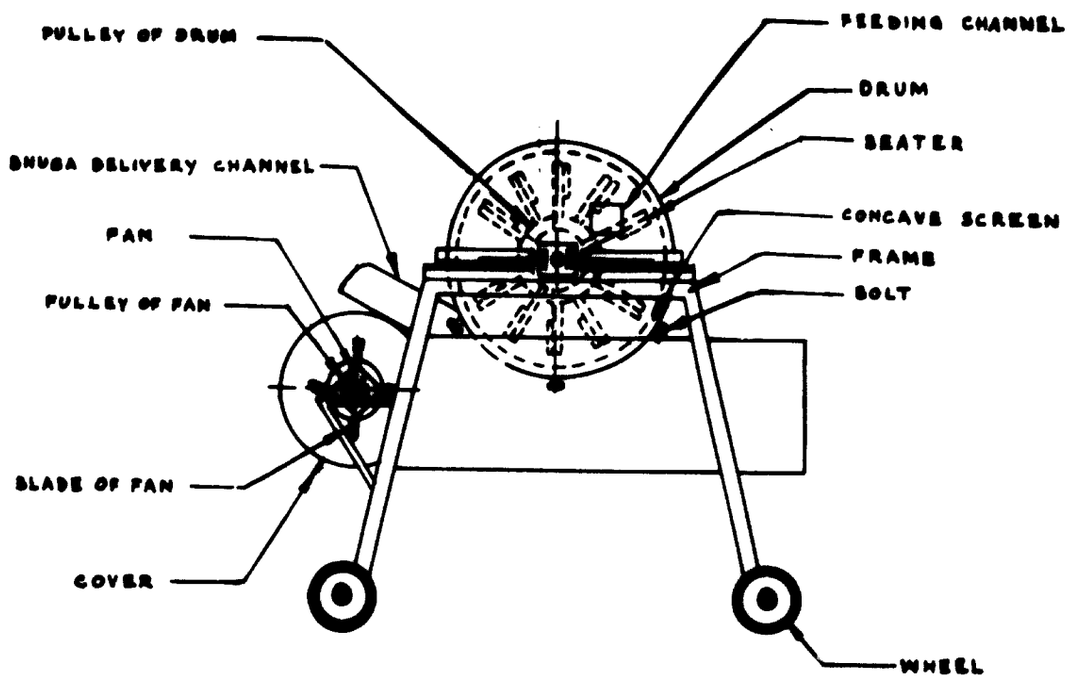


FIGURE-6.5.3(II)

POWER THRESHER

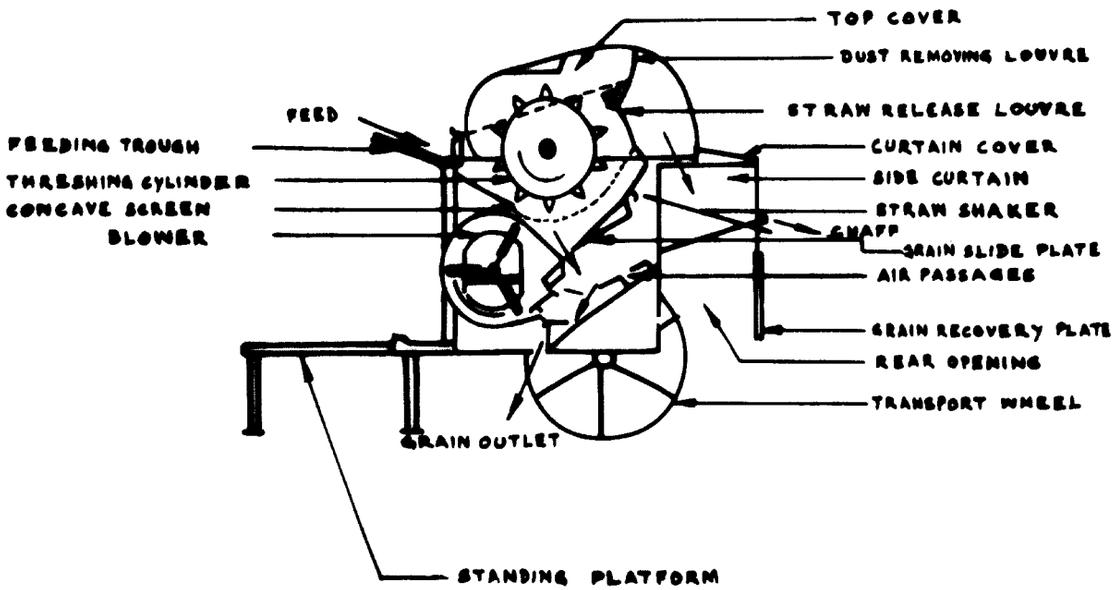


OUTPUT :-

WHEAT ..... 3-4 QUINTALS/ HOUR

FIGURE - 6.5.4

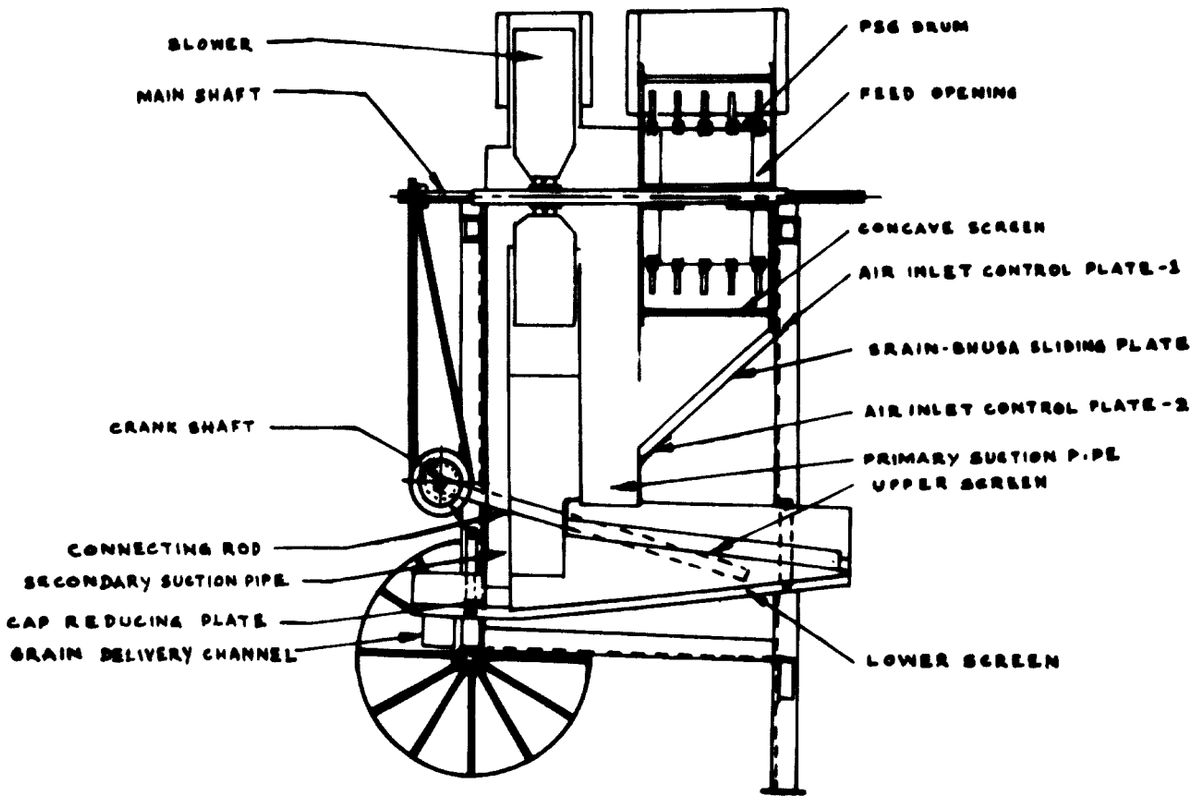
POWER THRESHER
(NAINI JONIOR)



OUTPUT :- 1 QUINTAL / HOUR

FIGURE - 6.3.4

POWER WHEAT THRESHER



OUT PUT :-

WHEAT ..... 175 TO 200 kg/hr.

GRAM ..... 200 TO 250 kg/hr.

FIGURE-6.5.4

GROUND-NUT GRADER

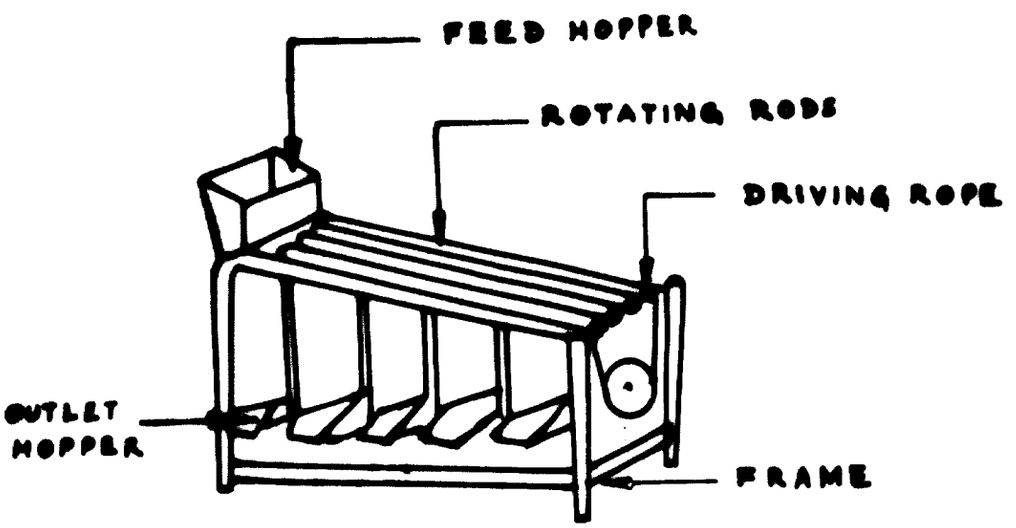
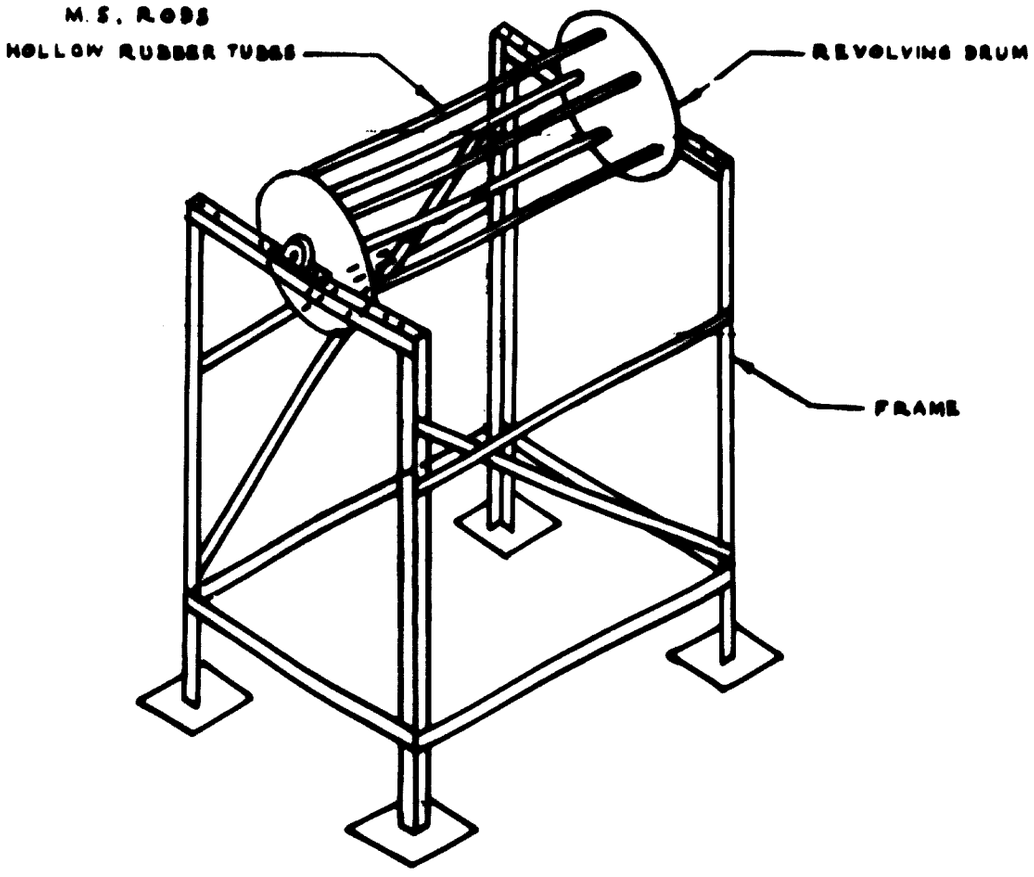
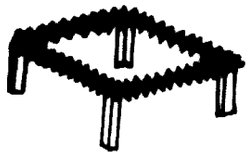


FIGURE- 6.6

GROUNDNUT STRIPPER

(DRUM TYPE)





(COMB TYPE)

FIGURE-6.6.1

GROUNDNUT STRIPPER [DRUM TYPE]

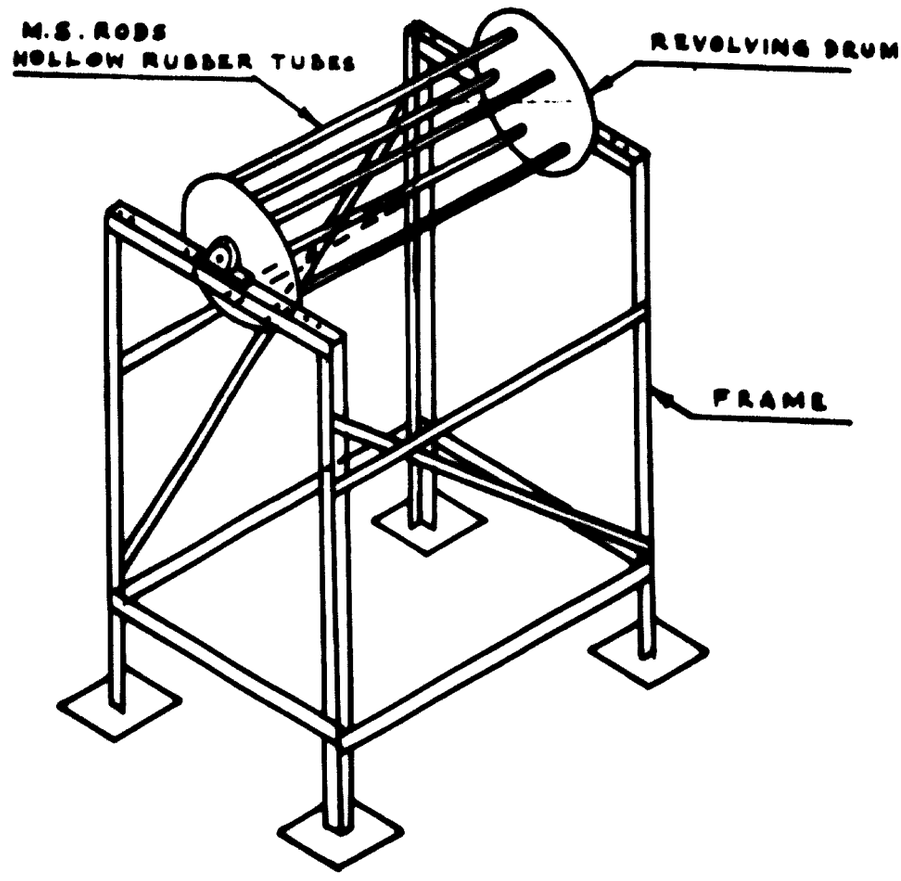


FIGURE-6.6.1 (I)

GROUNDNUT GRADER

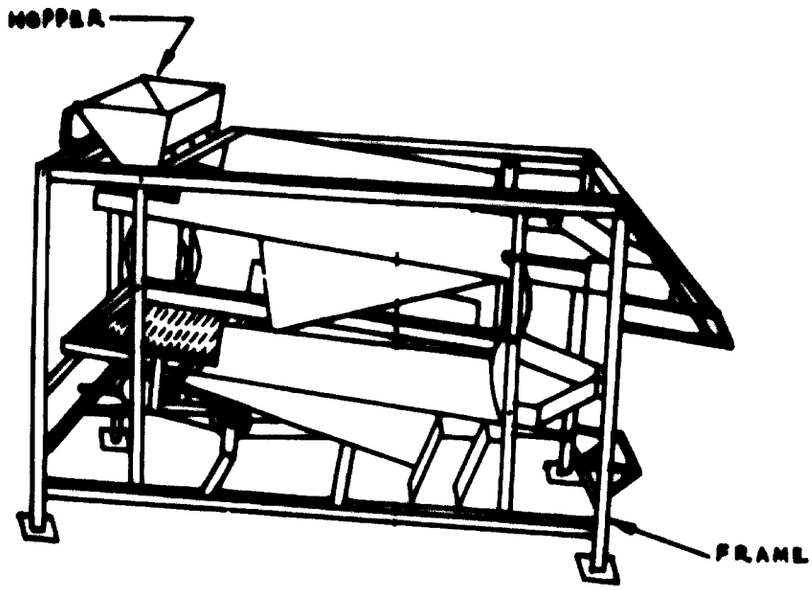
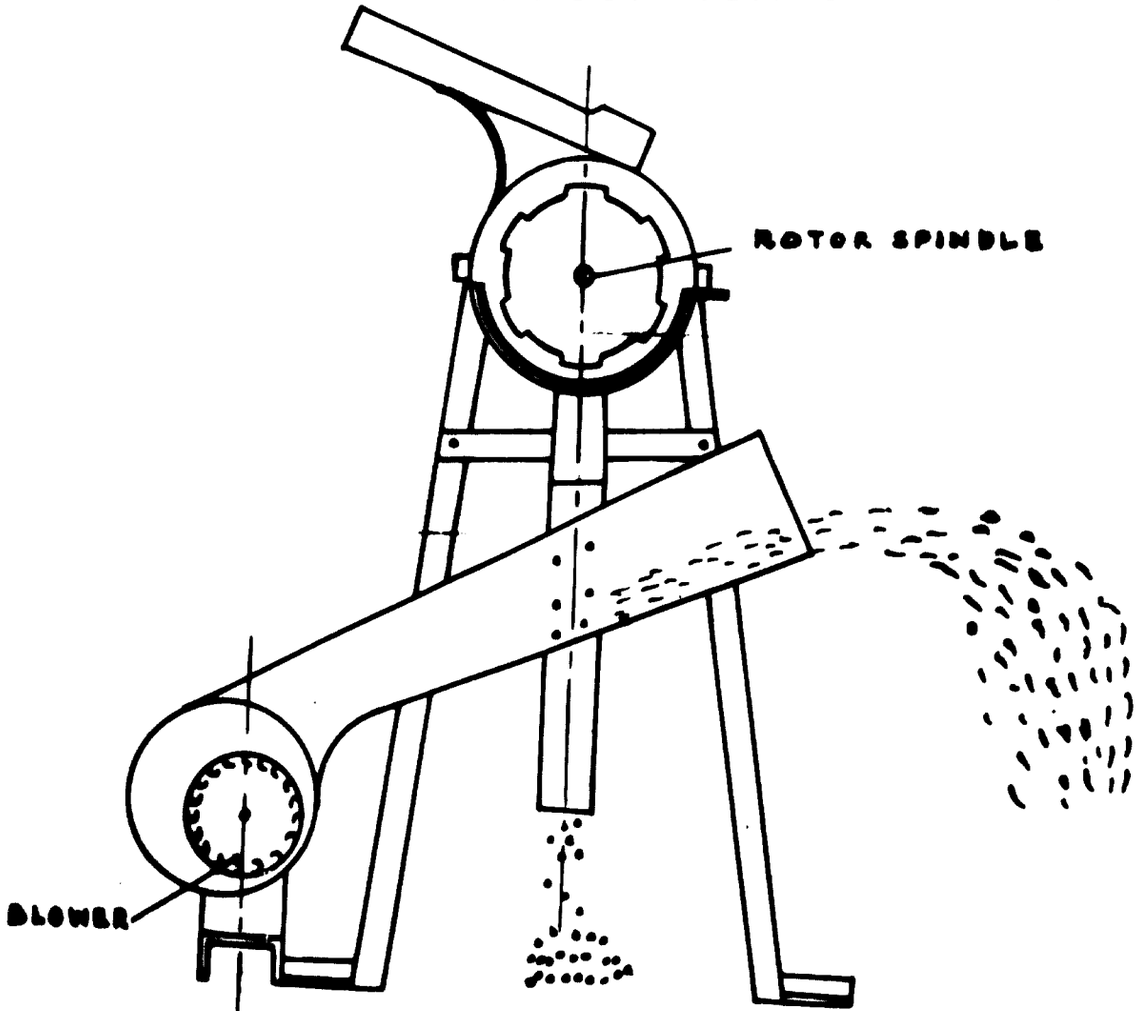


FIGURE – 6.6.2

GROUNDNUT DECORTICATOR-POWER



GROUNDNUT POD OPENER

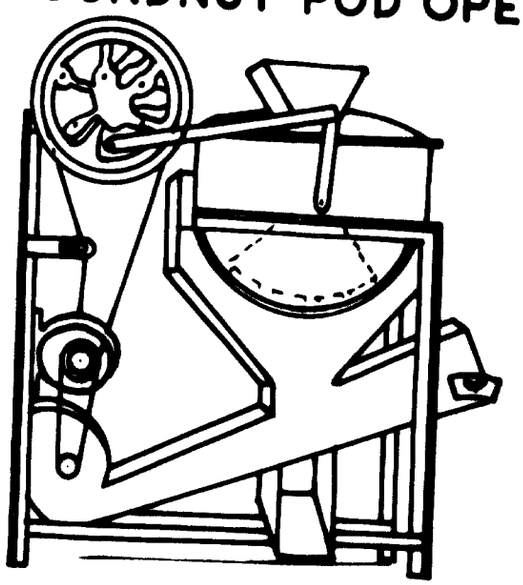


FIGURE-8.8.8(X)

HAND & POWER DECORTICATOR

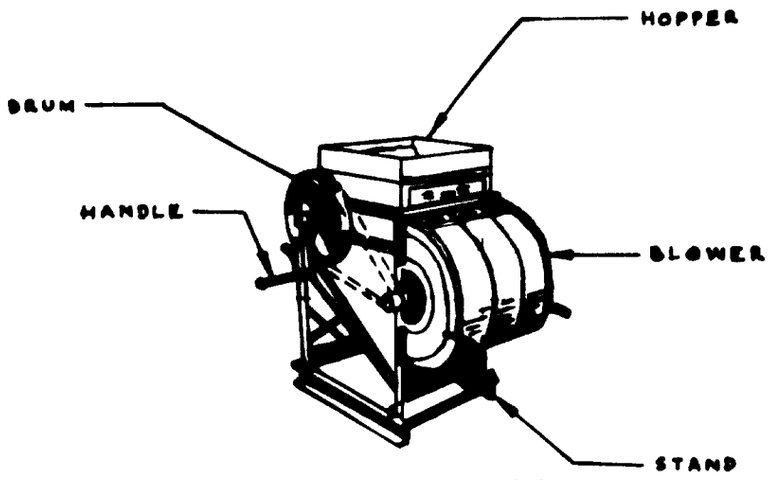


FIGURE-6.6.3(II)

MAIZE SHELLER

(HAND OPERATED)

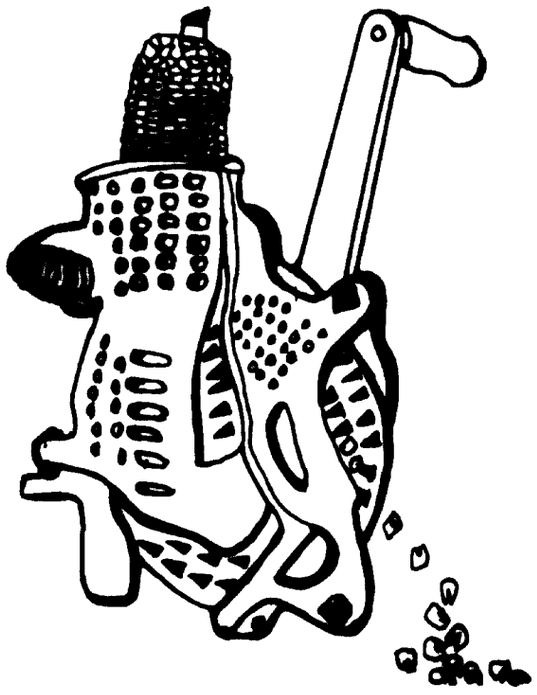


FIGURE-6.6.4

MAIZE SHELLER

(POWER OPERATED)

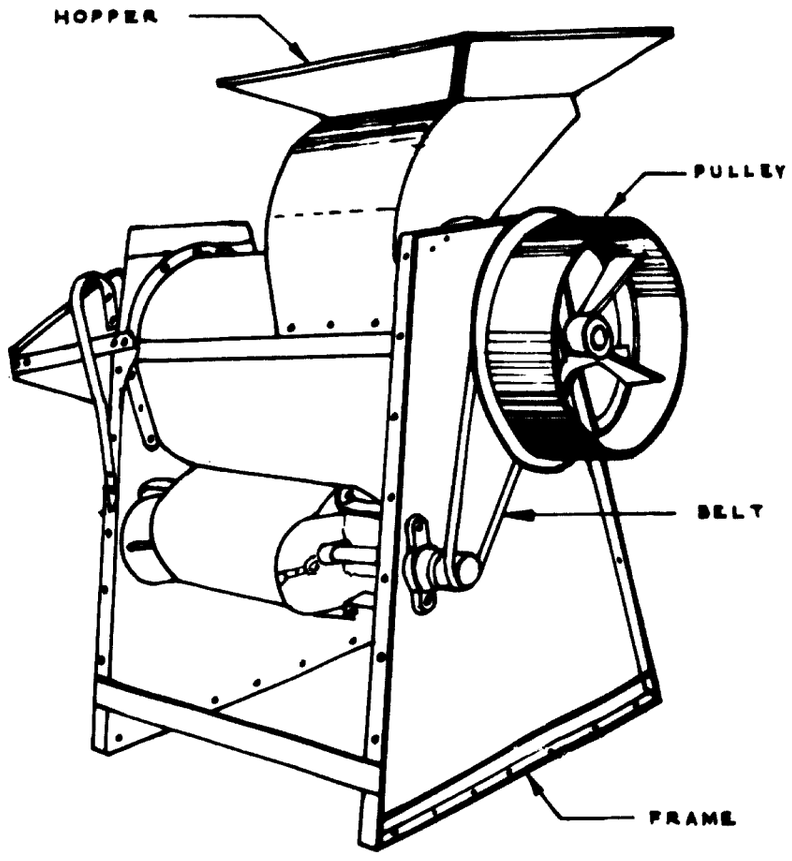


FIGURE-6.6.4

MANUALLY-OPERATED

CHAFF CUTTER

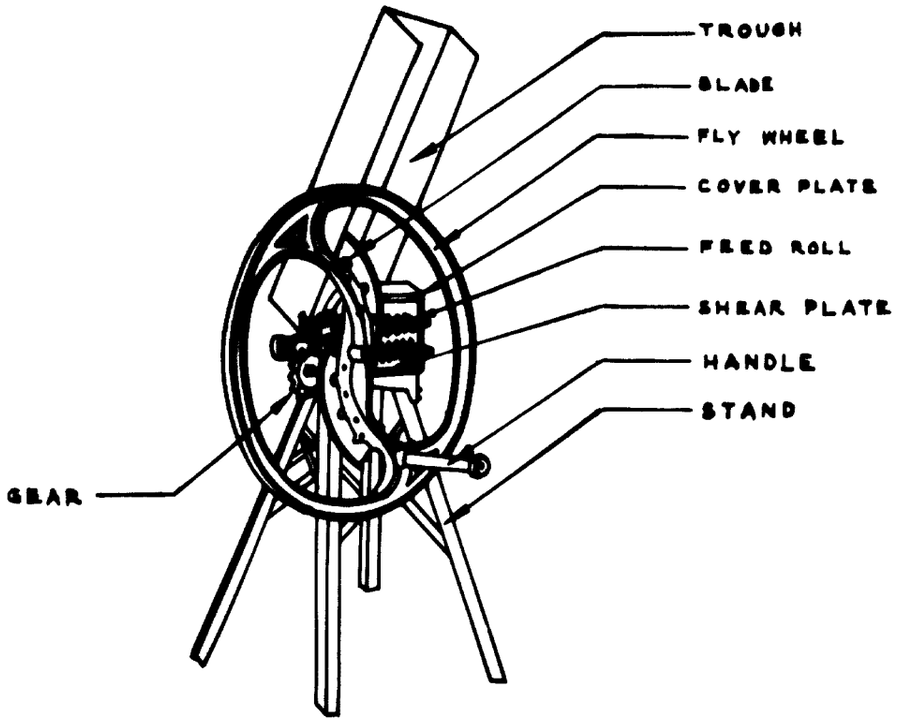


FIGURE-6.6.5

SUGARCANE CRUSHER

(FOR BULLOCK POWER)

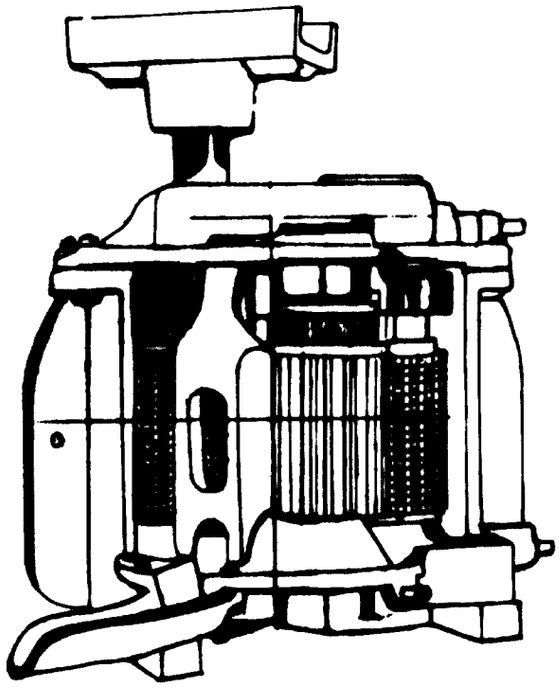


FIGURE- 6.6(I)

SUGARCANE CRUSHER

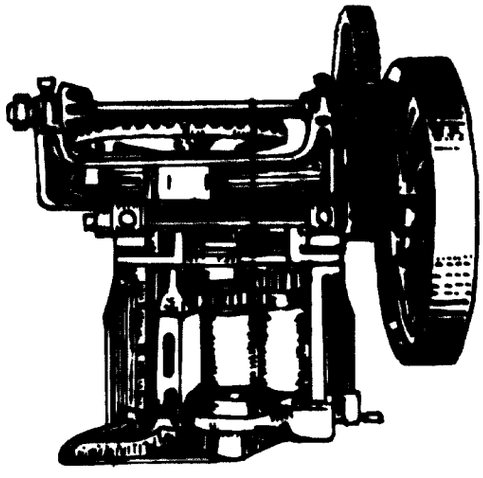
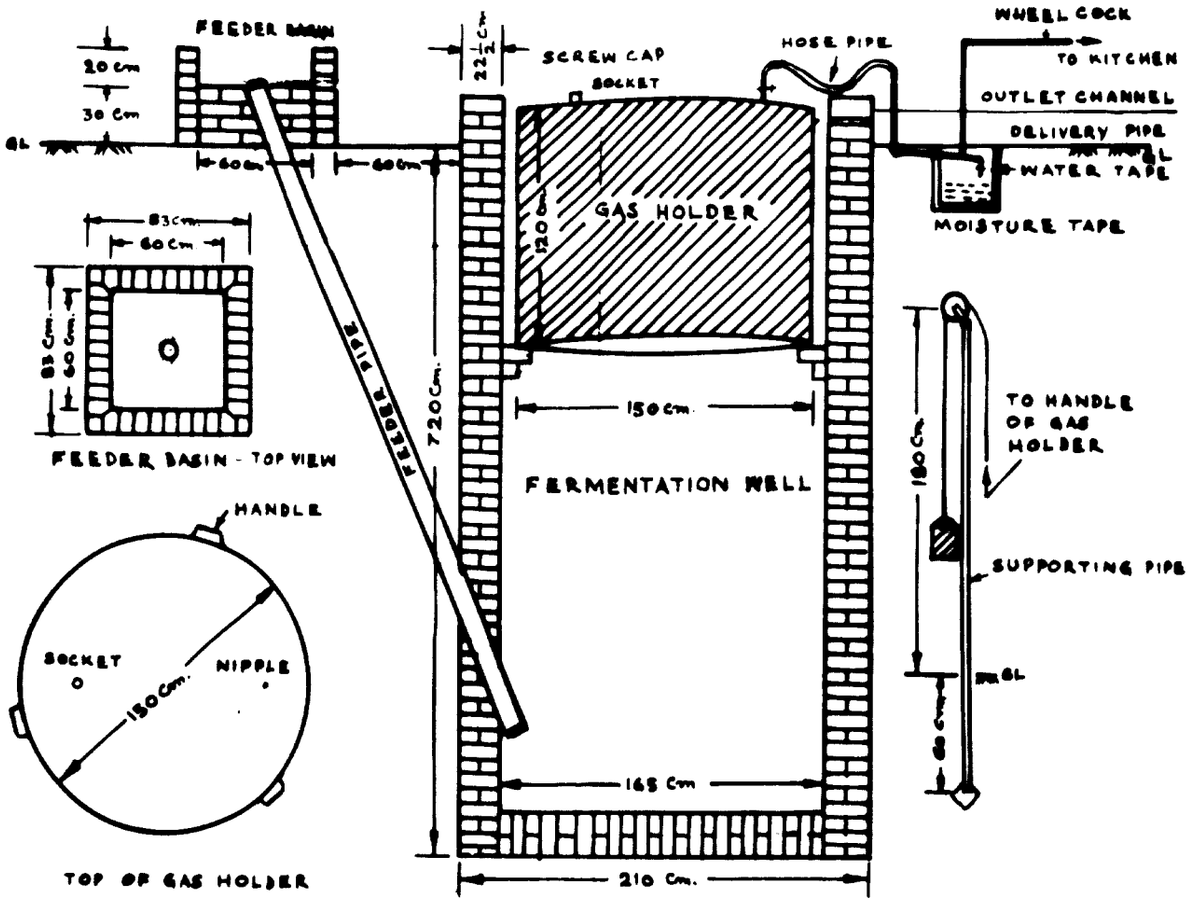


FIGURE-6.6.6(II)

COW DUNG GAS PLANT



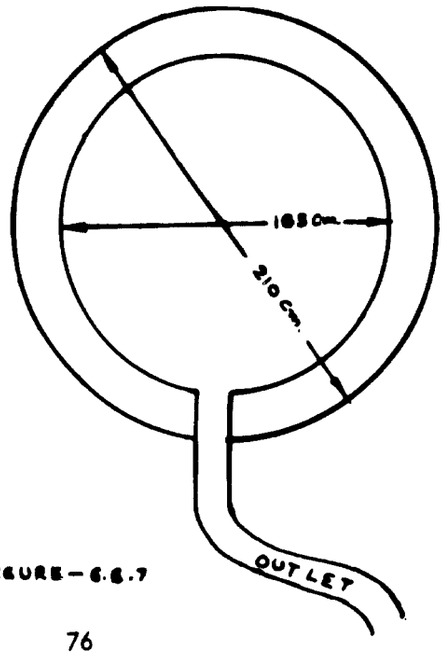


FIGURE – 6.8.7

STORAGE BIN

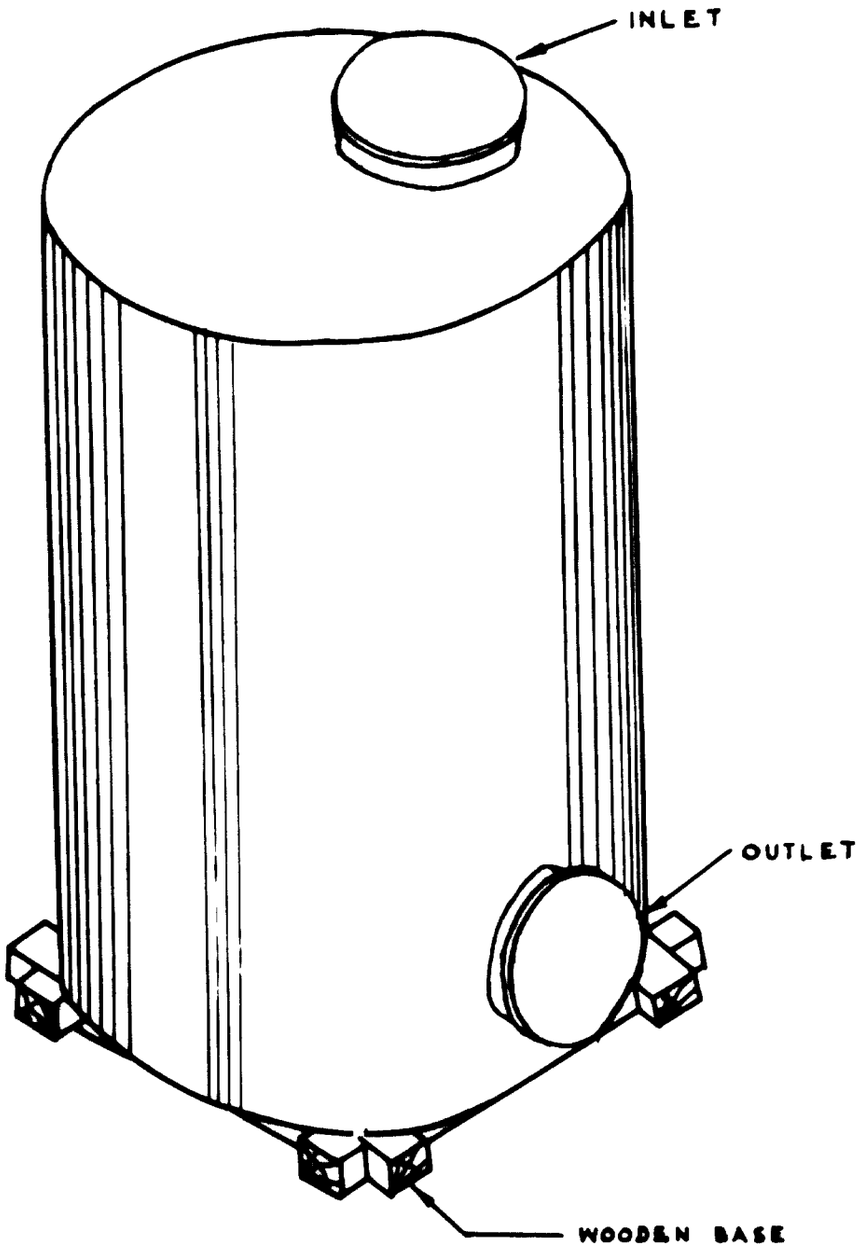
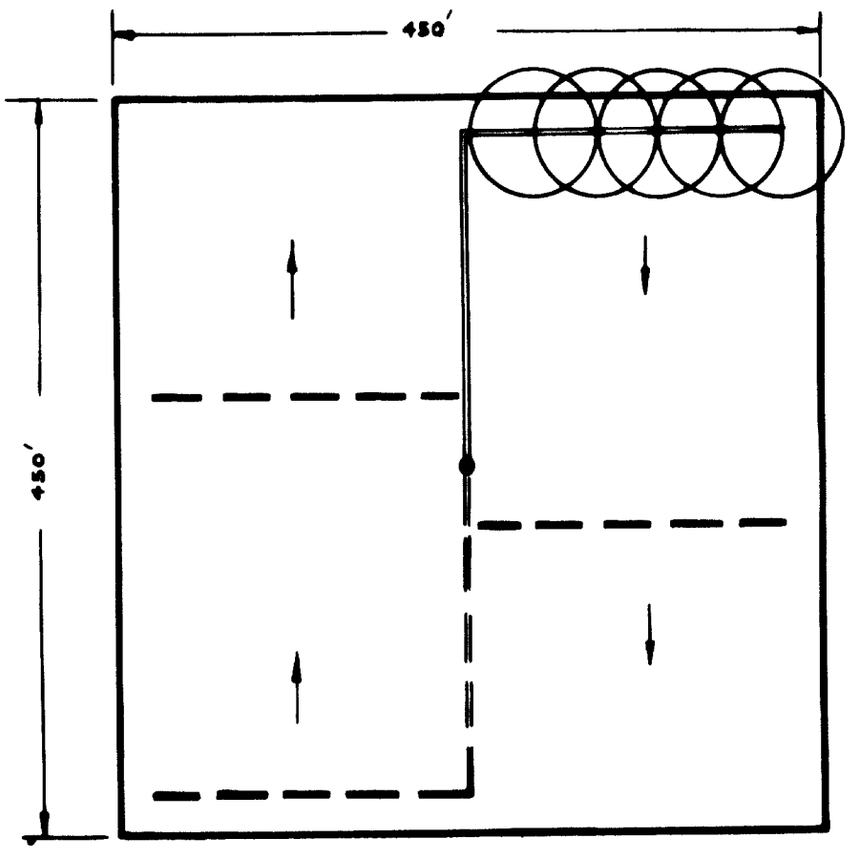


FIGURE - 6.6.8



STANDARD SPRINKLER UNIT FOR 5 ACRES

SCALE 1" = 100'

MAINLINE :-

SPRINKLER LINE :-

SUBSEQUENT POSITION OF MAINLINE :-

SOME " " " SPR. LINE :-

PUMPING POSITION :-

COURTESY : PREMIER IRRIGATION EQUIPMENT, INDIA.

FIGURE - 6.7

7. IMPORT AND INDIGENOUS MANUFACTURE OF AGRICULTURAL IMPLEMENTS AND TOOLS

The machinery needed in agriculture can be procured through imports or through indigenous manufacture. The existence of a potential internal market can be used to foster the growth of a local farm machinery manufacturing industry. In most developing countries, a realistic aim should be a judicious blend of imports and indigenous manufacture with a definite policy of progressively raising the proportion of the market that is satisfied from within. In almost every country, it is possible to establish a production unit to the local demand for agricultural machinery and at a level of technology appropriate both to the manufacturers and the farmers. In many cases, the manufacture is able to handle only part of the chain of industrial activities between design and commercilization. If this limitation is recognized and steps are taken to assist the agricultural machinery industry within a national plan for development, it should be possible to accelerate industrialization and promote progress in the agricultural sector of the economy.

7.1 Imports

Certain agricultural implements and machineries are not required in large quantities in a wide range of design and their demand in the country may be limited and seasonal. Such items of narrow range may, therefore, be imported from other countries.

7.2 Manufacture

Agricultural machinery, implements and tools are important industrial inputs, Agricultural such an industry offers a wide choice of technologies appropriate to the level of industrialization in the developing countries. In most of the developing countries a prioirty has been awarded to the use of modern methods of agriculture and the local development and manufacture of agricultural implements. This industry also diffuses technology throughout the countryside and generates local employment to many.

7.2.1 The agricultural machinery, implements and tools industry deals with a large variety of products from hand operated tools and animal drawn implements, irrigation equipment, crop-protection machinery to power machinery and equipment, such as tractors, power tillers, engines, harvesters and threshers and covers a wide spectrum of technology ranging from the simple technology of small work shop to that of large scale industries. It involves metal working, metallurgy, automotive and electrical engineering at different levels of product ranges. Since this industry is a basic one, government policies and planning at the national level must take it into account, particularly with regard to financing, investment promotion on the one hand, and research and development and training and management on the other hand, with special reference to the transfer of appropriate technology.

7.2.2 In the manufacture of agricultural machinery and implements three distinct levels of technology can be identified:

a) simple hand tools hand operated machines and selected animal-drawn implements that can be fabricated or manufactured in small workshops with relatively low investment;

b) most tractor-drawn implements, selected irrigation equipment including pumps, and crop protection equipment that can be assembled, fabricated or manufactured on a batch basis in medium size engineering production plants; and

c) power equipment including tractors, power tillers and engines requiring relatively large investment in production facilities and demanding a higher volume of production to achieve economics of operation.

Small workshops to manufacture the first level would be suitable for the least developed countries. After they have gained some experience, they can add assembly line and the second level mentioned above. The characteristic feature of such workshops should be to serve predominently local needs. They may also undertake maintenance and repair jobs. The strength of such workshops should base on local skills, managements and mechanical ingenuity.

7.2.3 It is not economical to produce only a small quantity and range of implements and tools and operate at full capacity. The manufacture of agricultural implements may be combined with that of other products of the metal working and engineering industry. In addition, the following methods of production and commercialization may be explored:

a) concentration on a small number of items whose production meet national demand. The technological advantages of manufacturing a limited range are balanced against the marketing disadvantages of spreading over a wide area,

b) there is often an imbalance between an economic scale of manufacturing and an economic scale of marketing. An obvious solution for the manufacturer is to enter into marketing agreements with the manufacturers of complementary lines of agricultural machinery, which can be handled by his dealers and should enhance their turnover and profit.

c) a suitable product mix is most likely to be based on either cultivation or harvesting machinery as the main line of activity, supplemented by some products of an intermediate kind.

7.2.4 In the least developed countries because of inadequate management, it is unlikely that they can produce wide range of agricultural implements and tools unaided. They could therefore, seek the following assistance and help from the developing countries through UNIDO:

a) by supply of working drawings of well designed equipment suited to the level of mechanization in the country and manufacture with limited facilities;

b) by offering practical training courses in production technology and management services;

c) by providing prototype of equipment; and

d) by providing assistance in setting up pilot manufacturing demonstration training.

7. 2. 5 Step by step introduction and adoption of total project concept

The least developed countries may like to initiate the programme of manufacture and industrialization in agricultural tools and equipment by undertaking the following studies and programmes.

a) Exploratory missions

The aim of these fact-finding, project identification or sectoral development missions is primarily to obtain a bird's eye view of the situation, and to highlight the major areas that need attention, identify projects for technical assistance and recommend action to implement the project. These missions analyse agricultural mechanization, present and future demand, trends in designs and general production specifications, status of existing facilities for design, development, adaptation, testing, maintenance and repair, the need for strengthening existing facilities, and scope for local manufacture.

b) Market-survey missions

The objective of market-survey missions is to establish the present demand for agricultural machinery, future requirements and product specifications and to recommend a suitable manufacturing programme and over-all policies. To achieve this objective, it is necessary to analyse the existing pattern and future trends in agriculture, land development, irrigation extension, crop pattern, rural economy, use of agricultural machinery, government plans for mechanization, rural credit, data on imports, sales and existing production of agricultural machinery. It is also necessary, based on the above analysis, to identify present and future trends in the level of mechanization, designs, production specifications and over-all needs and to estimate the annual demand for selected agricultural machinery and implements.

c) Feasibility study

Feasibility study is carried out when the demand for a product or a group of products is identified and established. However, it may be desirable to re-examine information on existing demand, design, specifications and data on future requirements and design trends in order to establish the basis for the manufacturing study. It may be necessary to evaluate already existing proposals for manufacture. This study involves an analysis of the availability of raw materials, the status of supporting and ancillary industries and the level of technical skill available.

d) Pre-investment analysis

Pre-investment analysis includes formulation of a manufacturing programme based on data available, analysis of production volume, manufacturing schedule, techniques, machine-tool requirements, raw material availability, manpower requirements, and a financial analysis of the manufacturing proposal.

e) Rationalization of manufacturing programme

This involves analysis of proposals for manufacture, analysis of existing manufacturing facilities (including supporting and ancillary industry), establishing correlation between demand figures and production volume and plant capacity, analysis of raw material, substitution of local materials for imports and a phased manufacturing programme.

f) Establishment of manufacture

Based on the pre-investment analysis, the activities for esta blishing and commissioning of a plant may include design of plant layout, selection and installation of machine tools and equipment, production planning and control, quality control, cost control, engineering services (industrial, tool, development, plant, production, material control), organization, operation and management.

g) Design, development and adaptation

The purpose of design, development and adaptation activities is to suit a manufacturing programme to local conditions and to assist small and medium-sized industrialists to become self-reliant in matters of engineering design and development and in adaptation of technology acquired from abroad. To adapt the design and manufacturing the machine requires engineering capabilities. The modification of designs may be a major task especially in terms of selection of materials, since it may involve further design and development. Thus, activities in this field consist in establishing not only the physical facilities but also programmes for training local personnel in engineering techniques. It may be necessary in the beginning to analyse existing facilities and items to be manufactured, identify future design requirements and formulate projects. A design, development and adaptation programme may be integrated with a manufacturing enterprise or treated as an independent activity depending on the needs of the country.

h) Testing, quality control and evaluation of product performance

Quality control is an essential part of any industrialization programme. It serves both the manufacturer and his customer by ensuring that the product conforms to its design specification. Laboratory and field tests show the performance of the product and suggest how the design should be altered. Ultimately, quality activities affect every aspect of the enterprise. But quality control requires many sophisticated facilities, testing equipment, knowledge of statistical procedures, standards of measurement, and most of all, an engineering approach to problem of design.

i) Maintenance and repair

The two problems in maintenance and repair are the establishment of adequate workshops, mobile and stationary, and the integration of maintenance and repair schedules in the overall industrialization programme. Diverse activities are involved in training of personnel, spare parts man ufacture and control, selection and operation of specialized tools, machine rebuilding and technical organization. In certain cases such allied products as crawler tractors and heavy earthmoving and road-construction equipment will be included with agricultural machinery and implements in the maintenance programme.

j) Marketing, sales, service, commercialization

Marketing, an integral part of a manufacturing activity, is a link between production and product use. The demonstration of the product (agricultural machinery and implements) and its popularization are the responsibility of the marketing division of a manufacturing organization. Only by encouraging manufacturers to be directly involved in marketing it is possible to build up an integrated system of service and performance feedback.

k) Activities at the plant level

Product design, process planning, product planning and control, plant layout and construction, selection of processes and equipment, quality control, standardization cost control, modernization of plants and other related activities in industrial engineering, tool engineering, maintenance engineering, development engineering are some of the activities carried out at the plant level.

l) Pilot Plants

Establishment of pilot plants, for the purpose of training in engineering and production, with special reference to the transfer of appropriate technology, is essential.

m) Development of institutions

The project involves the establishment of new or upgrading of existing institutions dealing with various aspects of agricultural machinery and implements such as planning, development, design and adaptation, repair and maintenance, Special attention should be given to engineering institutions in the metal working sector.

n) Seminars, workshops and expert group meetings

At the end of a specified period, seminar and other meetings be organized to provide an opportunity for exchanging information. This activity shall assists the developing countries and UNIDO in assessing the past activities and in improving and formulating suitable programmes in related fields.

7.3 Demonstration pilot engineering workshop for assembly and manufacture of agricultural tools, animal drawn implements, hand operated machines and allied simple metal products with repair and maintenance activities

The establishment of a pilot demonstration engineering workshop for assembly and manufacture of agricultural implements and simple metal products is based upon the UNIDO's analysis of the requirement in the country and on governments plan, as well as UNIDO's previous activities in this area. The overall analysis indicates the need for the establishment of physical facilities for the manufacture of agricultural hand tools, sheet metal products and fabricated items. If the concept is supported by the Government, the implementation should take into account the following aspects:

a) possible expansion of the existing facilities;

b) possible utilization of local raw material including scrap iron; and

c) desirability of establishing a new unit.

7. 3. 1 As the developing countries are placing emphasis on technical manpower development, rural industrialization, import substitution and extension of repair and maintenance activities, the proposed pilot demonstration engineering workshop will contribute to their objectives. It will also facilitate further training of the students of the polytechnic schools and personnel of the agricultural engineering section, in engineering production techniques and management and also assist in the development of local entrepreneurship at a later date. The product range recommended to be manufactured are limited and the production volume is to be on a modest scale to start with, which may be expanded at a later date.

7. 3. 2 The details of the magnitude as well as sources of financing may be worked out after this project concept is accepted by the Government. It is to be pointed out that the project concepts place a great emphasis on project implementation by local personnel, with catalytic UNDP/UNIDO assistance. A draft specimen project data sheet for the pre-project activity (project document preparation mission) has been suggested as an example in part two of this study.

7. 3. 3 Recommended product manufacturing programme

a) Phase I- priority manufacture

It is recommended that only a limited product range may be considered for manufacture/assembly in phase I. This could include,

i) selected hand tools such as spades, shovels, pickaxes, steelbaskets, rakes, hoes, weeders, sickles,

ii) hand operated machinery such as hand pumps, dusters, sprayers, maize shellers, groundnut decorators, foot-operated threshers, seed treaters, chaffcutters, transplanters, and

iii) animal drawn equipment such as mould-board ploughs, cultivators, harrows, ridgers, seed drills with fertilizer distributors, planters with fertilizer distributors, toolbars, levellers, paddy puddlers, mowers, horrows, threshers and carts.

The actual priority of products and the quantity could be worked out based upon the existing demand, as elaborated by the surveys and studies already suggested. If this project concept is accepted, the details of implements to be manufactured could be further elaborated during "Pre-project activity mission".

b) Phase II- Development programme for future local manufacture.

Any additional manufacturing programme should be based upon the research and development, testing and extension work that may be undertaken by the Agricultural Engineering Department. In this regard UNIDO assistance would be available for supply of a number of prototypes and samples of the above tools and implements from the developing countries of Asia and Far East on a priority basis to the least developed countries and also for testing and development of machinery and instruments and technical journals.

7.3.4 Workshop pilot plant details - general guidelines

PART A: Summary of findings

Section A: Techno-economic analysis

- market analysis
- viability and profitability
- location of new industry
- labour and experts needed
- capitalization and availability of working capital
- supporting industry needed
- quality control
- raw material and auxillary supply
- scope for expansion
- organization - overall plans for development of each sector
- specific proposals for establishing manufacturing units.

PART B: Technical analysis

Section B: Analysis of proposed manufacturing plant

i) Specification of implements to be manufactured

ii) Manufacturing procedure-list of components and process planning for three lines of products, (include line sketches of the components, and line diagram of flow of components, process planning and material handling)

iii) possibility of sub-contracting components to outside vendors/manufacturers - advantages and disadvantages.

iv) Components to be imported

v) determination of working time, machine time, manual work time and number of shifts

vi) Machinery and machine tool selection

- numbers
- specification
- approximate cost

vii) Organisation

- number of engineers, technical personnel, semi-skilled and unskilled workers
- machine shop
- welding and fabrication
- quality control and inspection
- industrial engineering
- assembly
- purchase
- accounting
- sales, etc.

Section C: Proposed layout of the plant

i) Lay-out of the plant
(Give floor space for complete plant including a drawing of the building, location of machine, flow chart for raw material and components)

- stores
- manufacture
- assembly
- inspection
- offices, etc.

ii) factors to be considered for successful manufacturing programme (supplies needed for a year)

- electric power
- fuels
- water
- other items,

iii) Setting and factory building

general layout 1:200
(short explanation of the drawing)

iv) Possibility of expansion
- scope for expansion, volume, product line
- additional building space and balancing machinery needed.

PART C Financial analysis (in country's own currency) and in US dollars)

Analysis of investment and returns
- capital requurement (land, building, machinery, installation etc.).
- working capital
- foreign and local currency
- fixed investment per employee
- total annual gross sales
- gross annual profit
- total
- as percentage of total capital
- as percentage of gross sales
- analysis of cost of production of each item and recommended sales price

Cost-benefit analysis

(1) Conclusions:

- economic benefit of establishing such a plant
- recommended time-table for project execution (time required, finance, etc.)
- desirability of technical assistance from manufacturing and internal agencies
- a programme for investment promotion

II) External Factors:

- technical know-how and assistance
- marketing set-up
- export analysis.

III) Anticipated time schedule to execute the total plant analysis, development, negotiations, procurement, plant construction, installation, running-in and production.

7.3.5 Estimated UNDP Inputs

a) Pre-project mission

2 experts, 2 m/m (one industrial engineer/economist and one agricultural engineer)	$ 10,000

b) Operational activity

1. Project personnel

a) Project manager	Industrial engineer 36 m/m	$ 90,000
b) Workshop engineer	mechanical engineer	$ 60,000
c) Design and development engineer.	agricultural tools/ implements (mechanical engineer) 24 m/m	$ 60,000
d) Associate expert	design and development 12 m/m	
e) Associate expert	workshop technology 12 m/m	
f) 1 UN volunteer	agricultural engineer 24 m/m	$ 10,000
		$ 220,000

II. Equipment

I) Prototype sample implements, design, drawings, jigs fixtures, dies, etc.	$ 30,000
ii) 2 mobile unit/repair and maintenance and 1 jeep.	$ 35,000
iii) Workshop machinery	$ 125,000
iv) testing equipment	$ 20,000
	$ 200,000

III.	Fellowships	6 nos 3 m/n	$ 10,000
			$ 10,000
IV.	Short term consultants	4x6 m/m	$ 60,000
			$ 60,000
	Total UNDP inputs		$ 490.000
	plus initial raw material		$ 15,000
	Total		$ 505.000
	Grand Total		$ 515,000

(Notes: Workshop machinery: universal lathe - $ 15,000; bench drill - $ 1,500; horizontal milling machine - $ 3,000; power hack saw - $ 3,000 upright drilling machine - $ 1,000; screw cutting lathe - $ 8,000; total grinding machine - $ 2,000; shaping machine - $ 3,000/power grinder - $ 1,000; circular saw - $ 1,000; pipe bending machine - $ 2,000; hydraulic jack - $ 500; hand metal cutting machine - $ 1,000; power shear - $ 2,000; power punch press - $ 2,000 forge - $ 1,000, washing machine - $ 1,000; spot welder - $ 1,000; electric welder - $ 4,000; gas welder - $ 2,000; are welder transformer - $ 2,000; compressor - $ 1,000; forging equipment - $ 1,000; power tools - $ 2,000; hand tools - $ 5,000, heat treatment equipment - $ 5,000, total bits etc. $ 5,000; wood working machinery - $ 5,000; miscellaneous items - $ 35,000).

7.3.6 Government Contribution is recommended in the form of land, building, personnel, working capital (to be elaborated during pre-project mission).

7.4 Integration of manufacturing activities with repair and maintenance programme (supplementary assistance)

In order to incorporate integrated repair and maintenance activities, it may be desirable to include two mobile repair and maintenance workshops with all equipment and total kits. Such mobile units may be considered under UNIDO voluntary contribution financing, if the Government so wishes. The local mechanics may also be trained in the mobile unit donor country under UNIDO fellowship for a duration of 3 m/m each in techniques of mobile unit operation. In addition, it is necessary to provide two experts from the donor country for a duration of 3 m/m each, proferably under S. I. S. financing to assist in establishment of a repair and maintenance programme including local personnel training. It is recommended that this repair and maintenance assistance and activities are integrated under pilot demonstration manufacturing unit after one year of successful operation. The following supplementary assistance is recommended for consideration regarding repair and maintenance:

Item	Amount	Possible sources of financing
a) Equipment 2 mobile repair and maintenance workshop units	US $ 30.000	UNIDO V. C.
b) Fellowships: two local mechanics in the donor country (3 m/m each)	US $ 6.000	UNIDO V. C.
c) Two experts: organization and operation in repair and maintenance (3 m/m each)	US $ 15.000	S. I. S.
Total	US $ 51.000	

8. STRENGTHENING OF THE EXISTING AGRICULTURAL MACHINERY AND IMPLEMENTS DESIGN, ADAPTATION AND TESTING SECTIONS OF LDCs

Strengthening of Agricultural Machinery Section of a developing country, would help in transforming it into an industry oriented national institution with expertiese and infrastructure competent to meet the regional requirement in future. The design, development and adaptation activities of such section should be developed primarily to suit the manufacturing programme and local conditions and to assist the country to become self-reliant in matters of engineering, design and development, both in respect of improving local available designs and adaptation of technologies obtain from abroad. Even a basic design of a machine is available, it requires to be suitably modified and altered to suit the local conditions and manufacture and trial of prototypes. All these activities do need adequate engineering capabilities. Therefore, these activities should consist of establishing not only the physical facilities, but also programmes for training local personnel in engineering techniques.

8.1 In the beginning, it may be necessary

i) to identify items which need manufacture,
ii) to analyse existing facilities, and
iii) to formulate projects for implementation.

The design, development and adaptation programme may, therefore, be integrated with a manufacturing plans or/treated as an independent activity depending on the heeds of a country.

8.2 Quality control

Quality control and performance evaluation is another essential part of any induatrialisation programme. It serves both the manufacturer and the customer by ensuring that the product confirms to its design specification and performance characteristics Laboratory and field tests show how the designs should be altered. The quality control activities embraces different aspects of enterprise development as it involves an engineering approach to the problems of design, adaptation and assembly/ manufacture.

It is suggested that this activity be initiated as a cooperative programme between the National Agricultural Machinery Section and Agricultural Machinery Institute of a developing country, with active support and participation by UNIDO.

8.3 Financing

The details of the magnitude and source of financing (UNDP country programming , IPF, UNIDO Voluntary Con tributions and UNIDO Regular Programme) may be worked out after this project concept is accepted by the Government.

If the above project proposal is acceptable in principle, a draft project data sheet for a pre-project activity (project formulation mission) as detailed in the second part of this study may be prepared and submitted to UNIDO.

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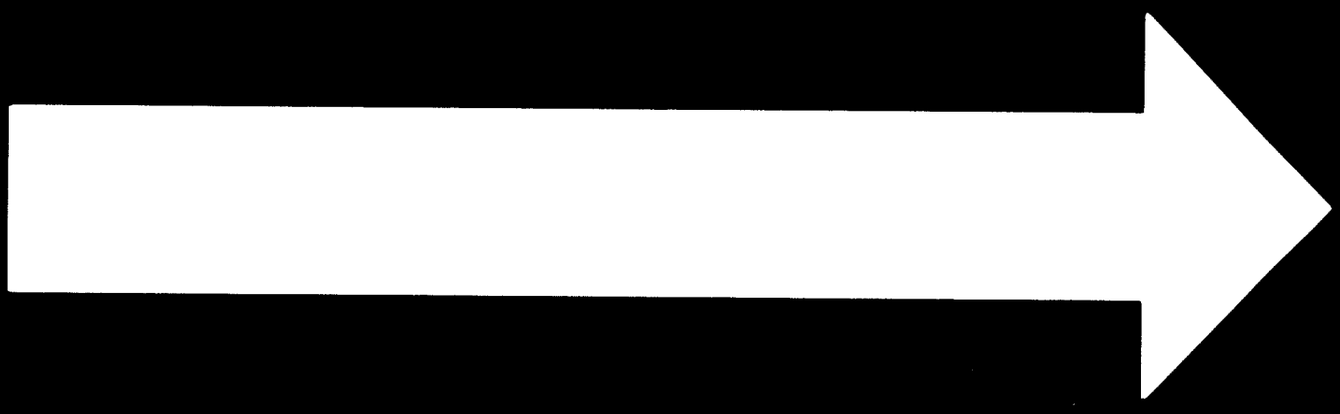

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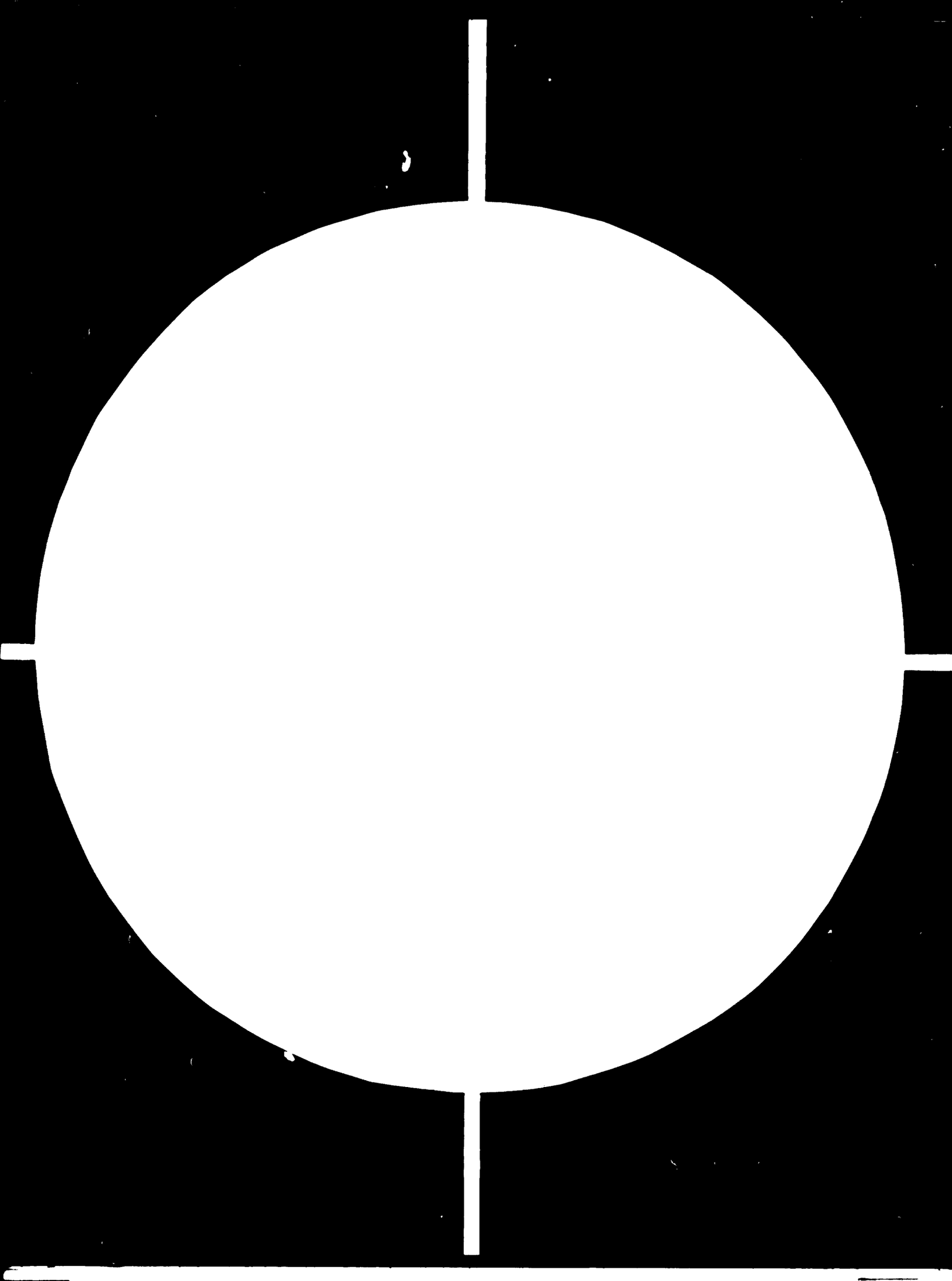
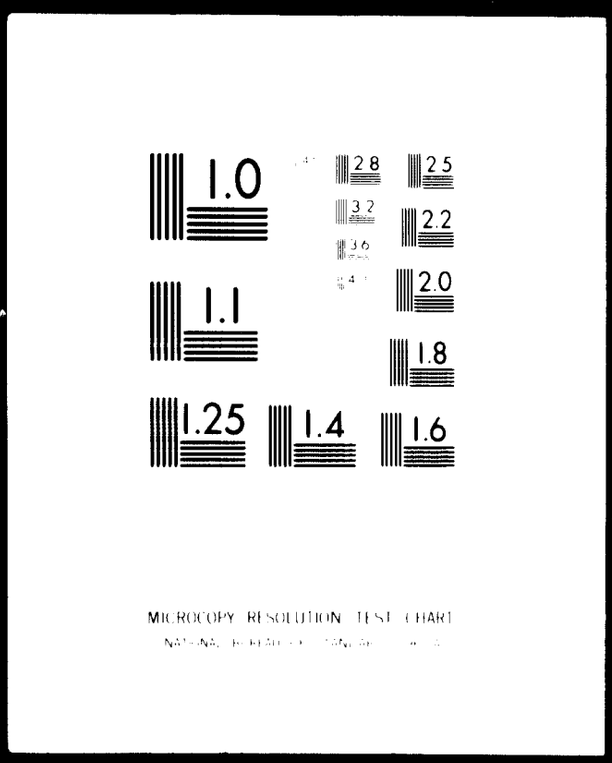




9. PILOT DEMONSTRATION OF AGRICULTURAL TRACTORS AND MACHINERY HIRING STATION

Pilot demonstration ot agricultural tractors and machinery hiring station with stationary workshop and mobile units for integrated repair and maintenance activities would help in rehabilitation of domestic resources (existing tractor and machinery pool and workshop facilities) and transformation of the same into a commercially viable pilot demonstration activity through UNDP/UNIDO supplementary assistance.

9.1 Some of the Least Developed Countries have imported a number of tractors, implements, machinery, engines, pumps and allied equipments.

A significant number of these remain idle due to lack of repair and maintenance facility and spare parts supply. In case of those which are working, it has been noted that the effective utilisation (in terms of number of hours used, area covered, number of operations undertaken) is very low. From a national economy point of view, therefore, all efforts for better utilisation of agricultural machinery should be promoted. In addition, setting up of a tractor hiring section at a judicious level may also be necessary. In order to facilitate optimum utilisation of high horse power, sophisticated and complex tractors within the frame work of existing land ceiling and tenancy acts, it is necessary to introduce institutional changes within the country. Promotion of tractor hiring together with repair and maintenance facilities and introduction of rural credit and management is, therefore, a desirable step.

9.2 The proposed project is a step to initiate such activity in the public sector (Ministry of Agriculture) on a pilot demonstration basis, which may be further promoted in the private sector. The project aims at the consolidation of existing facilities and modest expansion through supplementary assistance. Based on the experience gained through local manpower, technical training could be enlarged. Similar projects could be duplicated in appropriate rural areas at a later date.

9.3 The implementation of work programme mainly depends upon domestic resources, technical personnel and UNDP/UNIDO supplementary assistance which acts as a catalyst in effective organisation of a tractor and machinery hiring system with integrated repair and maintenance activities. Diverse activities are involved in this programme viz training of personnel, spare parts manufacture, selection and operation of specialised tools, machine rebuilding and technical organisation. In certain cases, allied machinery such as crawler tractors and heavy earthmoving and road-construction equipment may be included with agricultural machinery and implements in the maintenance programme.

9.4 The supplementary assistance for the stationary workshop for repair and maintenance will depend upon the extent of existing facilities. A comprehensive will depend upon the extent of existing facilities. A comprehensive workshop may consist of a main workshop with office, repair shed with mono-rail and platform, store house for oil and other storages. Such a mobile shop should be equiped with fast moving spare

parts, equipment and facilities for repair "in situ" and capable personnel. In addition to a pilot tractor and machinery hiring scheme, the work programme could consist of

- testing and repairing of engines, and other complicated components, such as transmission, final drive, etc;
- tool room, machine shop, welding, forging etc., together with testing and laboratory facilities; and
- effective emergency repair and maintenance at the farm level in rural areas.

9.5 If the above project is acceptable in principle by the Government, a draft project data sheet for a pre-project activity (project formulation mission) has been suggested as an example in part two of this study.

10. WORKSHOP

10.1 From the list of selected Least Developed Countries (LDC) it is observed that the population engaged in agriculture in these countries vary from 75% to 90%. Since the requirements of these countries are different, specific details cannot be prepared till we identify the country's requirements by personal visit and discussions. However the general requirements of these countries have been discussed in chapter C. This chapter on workshop has been written in a modular way and the concerned country can select the appropriate modules and prepare its own feasibility report with the help of UNIDO expert. The use of the modular approach is illustrated with examples.

The workshop modules have been prepared with a view:

1) to help in the fabrication of agricultural tools and equipments;

2) to help in the repair of the tools and equipments with minimum wastage of farmers' time;

3) to help in the involvement of maximum number of people in this project.

10.2 The workshops modules have been discussed in three different levels:

LEVEL-I Elementary level workshop is capable of manufacturing only the agricultural hand tools. They can also do the repair works on agricultural tools and implements.

LEVEL-II Medium level workshop is capable of manufacturing all the agricultural hand tools and some simple implements. They can do most of the repair works.

LEVEL-III Central Workshop is capable of manufacturing all the agricultural tools and implements under consideration.

The capacity of each elementary level workshop should be kept to a minimum and the number of such workshops should be as many as possible, It is preferable to have at least one workshop in each village so that the farmers can get the minor repairs done within the village.

The medium level workshop should be located in some important places preferably having electric supply. They should be easily approachable from the neighbouring villages. The capacity of this workshop will depend on the demand of the region as well as on the capacity of other workshops in that region. There will be one Central Workshop for each region. All the medium and elementary level workshops will be under the direct supervision of the central workshop of that region. The number of

such regions should be selected on the basis of demand of the country, geography of the country and the means of transportation available.

The Central Workshop will act as the industrial nucleus of the region and should have the responsibility of providing raw materials, spare parts, technical know-how and training to medium and elementary level workshops. The elementary and medium level workshops may get some work from the central workshop. However, they should not expect to get work from the central workshop to their full capacity. At most 25% of the capacity of elementary and medium level workshops can be utilised by the jobs of the central workshop. The remaining capacity of the workshops should be utilised in repair work and to meet the local demands. The schematic diagram of the workshops of one region is shown in Figure 1. The basic operations required in the workshops are shown in Table 3

Table 1

List of facilities recommended for elementary level workshops

1. Forging
2. Drilling
3. Grinding
4. Wood-working

Table 2

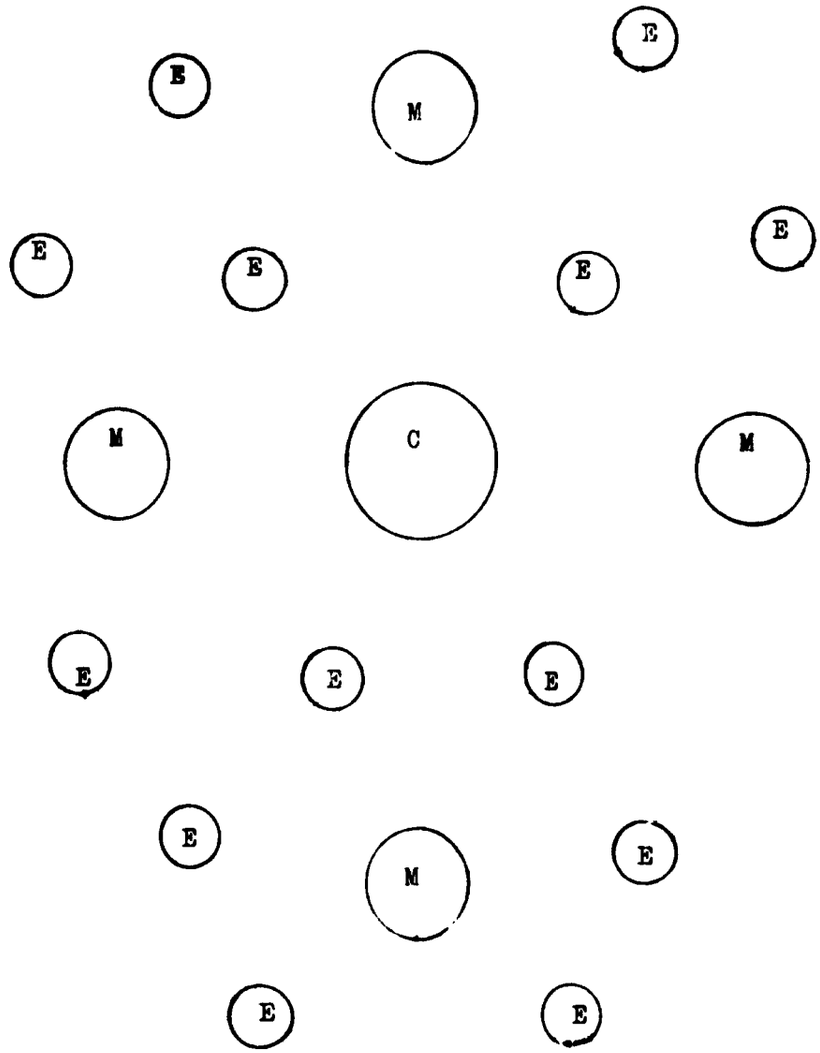
List of facilities recommended for medium level workshops.

1. Forging
2. Drilling
3. Grinding
4. Wood-working
5. Sheet-metal working
6. Welding.

Table 3

List of basic operations required in the Central Workshops

1. Forging
2. Drilling
3. Grinding
4. Wood-working
5. Sheet-metal working
6. Welding
7. Turning
8. Boring
9. Milling
10. Shapping/Planing
11. Sawing.



E - Elementary Level workshop
M - Medium level workshop
C - Central workshop

Figure-1. A typical regional plan of different levels of workshops.

The operations listed in Table 3 can be performed in various ways- some require only manual labour with simple non-powered implements and the others require sophisticated machines. These are shown as modules under each category. Each module shows the operation, approximate working floor area, approximate cost of the machine and manpower requirement. The cost of a machine will very widely depending on specifications. Here, we have shown the price ranges for the simplest machines and moderately sophisticated machines highly sophisticated machines are not considered because of their exorbitent prices.

All the operations listed in Table 1 may be performed manually without the aid of electricity with some limitations, of course. However, if the electric supply is available, some of the operations should be done electrically. The operations listed in Table 2 may also be performed without the aid of electricity. However, it is preferable to have the medium level workshops in places having electric supply. The central workshop is recommended to have all the facilities listed in Table 3. This workshop cannot run without electrical power. This point must be taken into account during site selection. The Central Workshop will need additional floor area for the stores and administrative office. This may be assumed to be about 10% of theshop floor area in the preliminary report.

In addition to the operators shown in the modules, the Central Workshop will also have other administrative and supervisory staff as well as unskilled helpers for smooth running of the workshop. Thus, the manpower requirement of the entire workshop will comprise of the number of operators (as found from the modules), number of helpers and the supervisory staff. A general organizational chart is shown in Figure 2. However, the number of supervisors will depend on the number of operators and helpers. The number of helpers is determined from the requirement of the entire workshop. Usually a ratio of 1:2 is maintained by unskilled workers to skilled and semi-skilled workers. The ratio of operators and helpers to supervisory staff is usually maintained to 12:1. Thus, the total manpower requirement of the workshop can be estimated.

10.3 Workshop superintendent

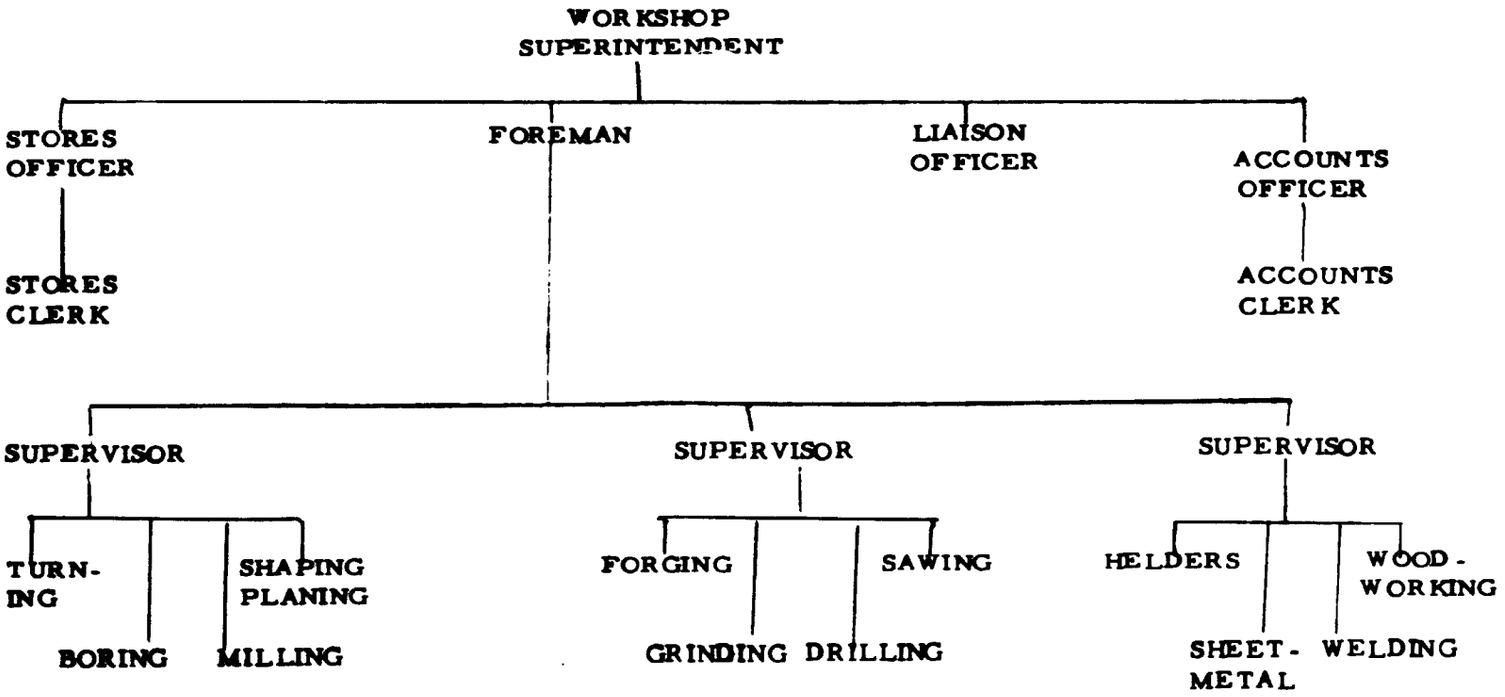
The workshop superintendent will be responsible for smooth operation of the entire workshop. He will be assisted by Foreman, Stores Officer, Liaison Officer and Accounts Officer. The foreman is responsible for executing the works in the shops. Stores officer is responsible for procurement of raw materials and despatch of finished products. He should maintain adequate inventory of raw materials. He is also responsible for distribution of raw materials to Elementary and Medium level workshops. The Liaison Officer is responsible for coordinating the activities of the different Elementary and Medium level workshops. He should arrange for the training of the people from small workshops. He is also to help small workshops in their planning of activities. Accounts Officer is responsible for keeping the accounts up to date and to prepare costing of the items produced. He is also responsible for disbursement of wages and salaries.

The medium level workshops also need one or more supervisors depending on the number of operators. An accounts clerk is also required for proper maintenance of accounts and records. For the elementary level workshops the accounting work is done by an operator in consultation with the accounts clerk of nearby medium level workshop.

10.4 Use of modules

The feasibility report for workshops can be prepared from the modules by following the procedures shown here.

Step-1 First identify the products to be manufactured in the workshop. Prepare a bill of materials for each product. (This of course, needs the technical details of the manufacturing process).



Note: The lowest level stands for the operators in respective trades.

Figure-2. A general organizational chart for Central Workshop.

Step-2 From the bill of materials identify the purchased components (or supplied by central workshop in case of elementary and medium level workshops) and manufactured components. Whether a component is to be purchased or manufactured depends on economic factors which are influenced by local conditions. For any specific country this selection can be made by any standard procedure.

Step-3 For each manufactured component identify the operations required. (This also needs the technical details of the manufacturing process of the components)

Step-4 Now select the modules (one or more units) for these operations. The most economical selection of the modules can be made for any specific country by any standard procedure. To avoid complicacy, the optimum selection procedure is not included in this report; it may be supplied on request.

After selection of the modules the project report can be made very easily as is shown in the following examples. However, this project report is only a preliminary report to give a guideline. A final detailed project report must be prepared before implementation. All the machines shown in this report can be supplied by several Indian industries; a list of these industries can be supplied on request. Regarding sources of raw materials the concerned country should have its own information. The costs in Indian Rupees shown here are approximate with respect to present Indian condition and this may vary from time to time.

Example - 1

First, let us consider an elementary level workshop to be located in a place having no electric supply. It was observed that all the operations listed in Table 1 are required. Thus, we select the modules Forge-1, Furnace-1, Drill-1, Grind-1, and Wood-1.

Table - 4

Module No.	No of units.	Floor area	Cost of modules	manpower requirement Skd.	S. Skd.	U. Skd.
Forge-1	1	80 sq. ft.	Rs. 1500/-	0	1	1
Furnace-1	1	20 sq. ft.	Rs. 500/-	0	0	0
Drill-1	1	20 sq. ft.	Rs. 500/-	0	1	0
Grind-1	1	20 sq. ft.	Rs. 1000/-	0	1	0
Wood-1	1	100 sq. ft.	Rs. 3000/-	0	1	1

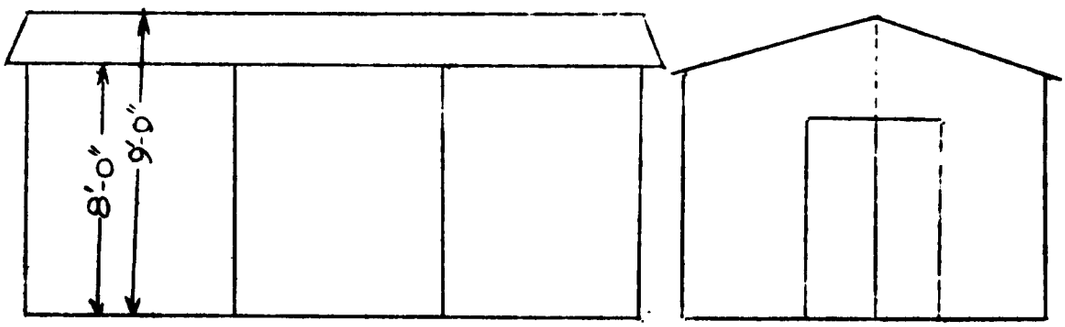
Skd-Skilled, S. Skd - Semi skilled, U. Skd- Unskilled

For the workshop shed we select Bamboopanel, Earthen floor, wooden frame and G.I. roof. The floor area of the shed, as read from Table -4, is 240 sq.ft. This gives a panel area of about 560 sq. ft. Thus, the cost of the shed is Rs. 1.00 x 560 + Rs. 1.00 x 240 + Rs. 2.50 x 240 + 2.50 x 240 = 2000.00

Cost of machines = Rs. 1500.00 + Rs. 500.00 + Rs. 500.00 + Rs. 1000.00
+ Rs. 3000.00
= Rs. 6500.00

Installation cost of the machines is about 10% of the cost of the machines. Thus, installation cost is Rs. 650.00. A typical layout of this workshop is shown in Figure 3.

Total floor area	240 sq. ft.
Cost of the shed	Rs. 2000.00
Cost of the machines	Rs. 6500.00
Cost of installation	Rs. 650.00



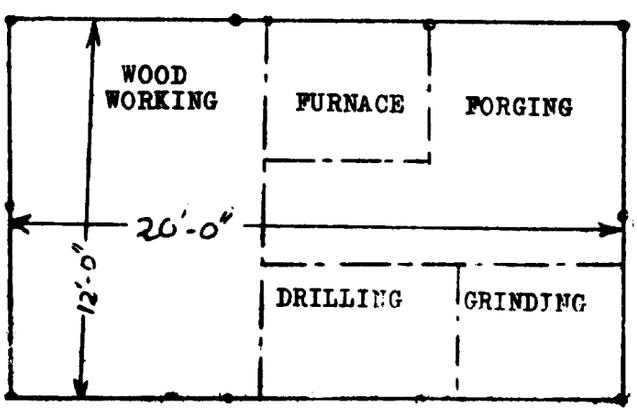


Figure - 3. A plan for an elementary level workshop

Manpower requirement	4 semi skilled and 2 unskilled
Facilities required	water, electricity (if available)
Raw materials	work blanks, coal
Total project cost	Rs. 9150.00*
Working capital	depends on country

* The costs shown here are according to present Indian market condition which may change from time to time.

Example-2

Here we consider a medium level workshop located in a place having electric supply. Based on the workload of the workshop we select the following modules: Forge-1, Furnace-1, Drill-2, Drill-3, Grind-2, Wood-2, Sheet-2, Weld-1, Weld-2

Table - 5

Module No.	No. of units.	Floor area	Cost of modules	manpower requirement Skd.	S. Skd.	U. Skd.
Forge-1	2	160 sq. ft.	Rs. 3000/-	0	2	2
Furnace-1	1	20 sq. ft.	Rs. 500/-	0	0	0
Drill-2	1	20 sq. ft.	Rs. 1000/-	0	1	0
Drill-3	1	25 sq. ft.	Rs. 7000/-	0	1	0
Grind-2	1	20 sq. ft.	Rs. 3000/-	0	1	0
Wood-2	1	100 sq. ft.	Rs. 10000/-	1	0	1
Sheet-2	1	100 sq. ft.	Rs. 10000/-	0	1	1
Weld-1	1	150 sq. ft.	Rs. 500/-	1	0	0
Weld-2	1	150 sq. ft.	Rs. 6000/-	1	0	0

Skd.-Skilled; S. Skd.- Semi-Skilled; U. Skd. Unskilled.

For the workshop shed we select Brick wall, Concrete floor, Wooden frame and G.I. roof. The floor area of the shed is 745 sq. ft. which will give a wall area of 1550 sq. ft. and 10" thick. This gives about 1300 cft. wall. 4" thick floor gives about 248 cft. of cement concrete. Thus the cost of the shed is

Rs. 12.00 x 1300 + Rs. 16.00 x 248 + Rs. 2.50 x 745 + Rs. 2.50 x 745
= Rs. 23298.00 = Rs. 23,300.00

Cost of the machines:
Rs. 3000.00 + Rs. 500.00 + Rs. 1000.00 + Rs. 7000.00 + Rs. 3000.00
+ Rs. 10000.00 + Rs. 10000.00 + Rs. 500 + Rs. 6000.00
= Rs. 41000.00

Installation cost of the machines is about 10% of the cost of the machines. Thus, installation cost is Rs. 4100.00.

The project report is summarised as

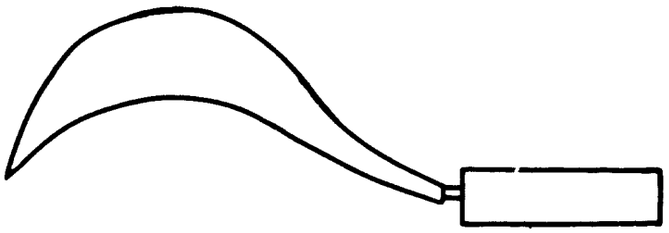
Total floor area	750 sq. ft.
Cost of the shed	Rs. 23300.00
Cost the machines	Rs. 41000.00
Cost of installation	Rs. 4100.00
Manpower requirement	3 Skd., 5 S.Skd., 4 U.Skd. + 1 Supervisor + 1 Accounts Clerk.
Facilities	Water, Electricity
Raw materials	work blanks, electrodes, coal cylinder gas.
Total project cost	Rs. 68400.00*
Working capital	depends on country

* The costs shown here are according to present Indian market condition which may change from time to time.

Specimen medium level workshop

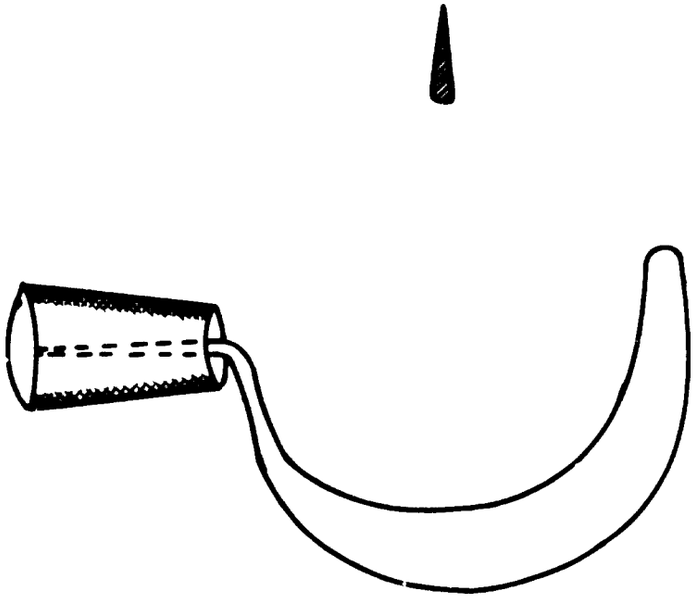
10.5 As an illustration this detailed project report of a Medium Level workshop is shown here. Since the wage structure and cost of raw materials vary widely from country to country, this report is prepared in respect of the Indian conditions. This will act only as a guideline for preparation of project reports for other countries. Besides, the manufacturing times, shown against the different implements are also not actual; these are only some rough estimates. These timings are shown for explaining the methodology. However, during preparation of the final report of any country the machine timings and other local conditions should be taken into account.

Products selected for manufacture in this workshop are shown in Table 6. Figure 4 shows the sketches of some of the products; the sketches of the other products are shown in the plates given elsewhere. Table 7 shows the different operations for the products along with the approximate time of each operation. In this report the products are selected arbitrarily. In any final report the selection of the products should depend on the local market, the capability of the workshop and the integrated plan of manufacture in the country. The volume of production is also related with the local conditions. First, the volume of production and the number of machines are selected such that most of the machines are fully utilised. Later, by applying Linear Programming and Post-optimality analysis the number of machines and the volume of production for economic operation are determined. In this report however, this was not done as this is only an illustrative report.



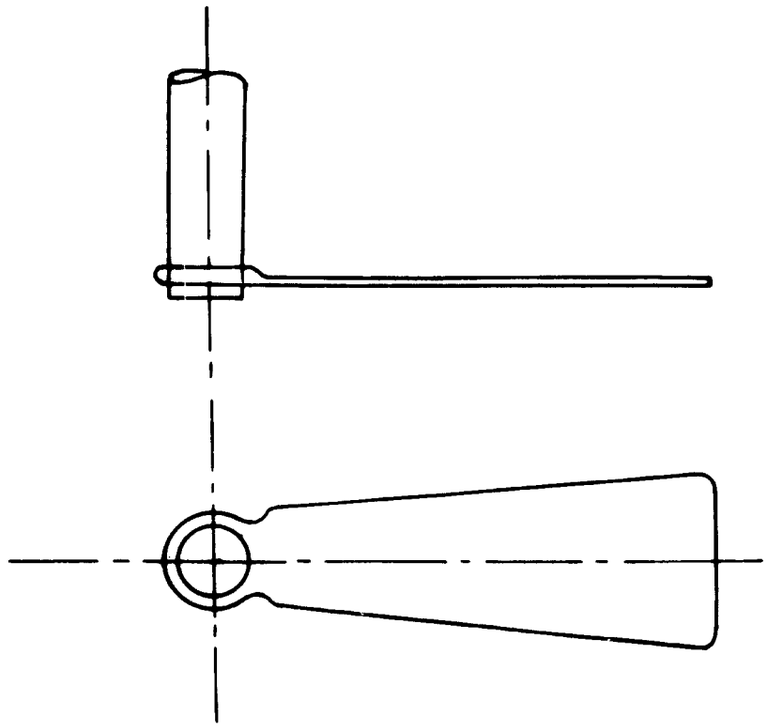
CHOPPER :- MILD STEEL FOR BLADE AND WOOD FOR HANDLE

Fig. 4a. USED FOR HARVESTING OF SUGARCANE, BANANA AND BAMBOO.



SICKLE :- MILD STEEL FOR BLADE AND WOOD FOR HANDLE

Fig. 4b. USED FOR HARVESTING CROPS.



HAND HOE :- MILD STEEL BODY AND WOODEN HANDLE USED FOR DIGGING AND WEEDING.

Fig. 4c.

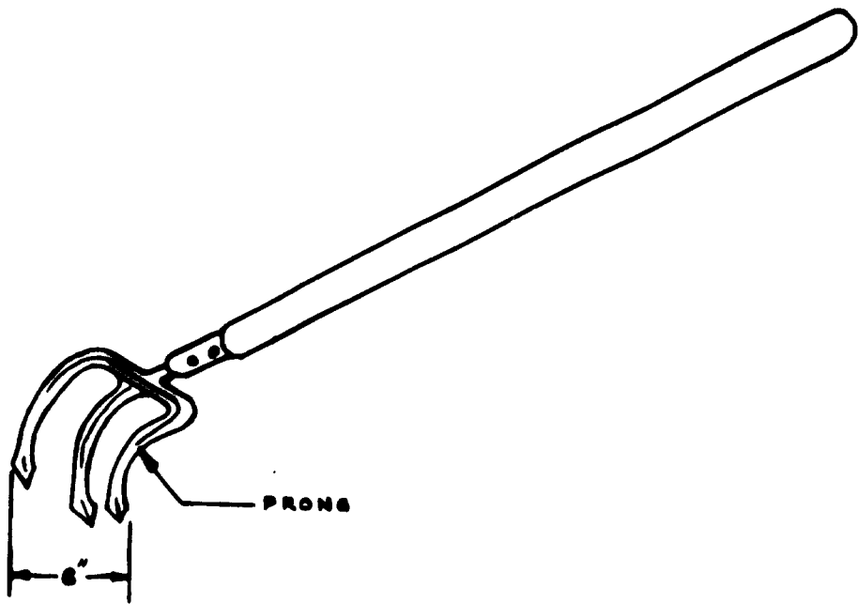
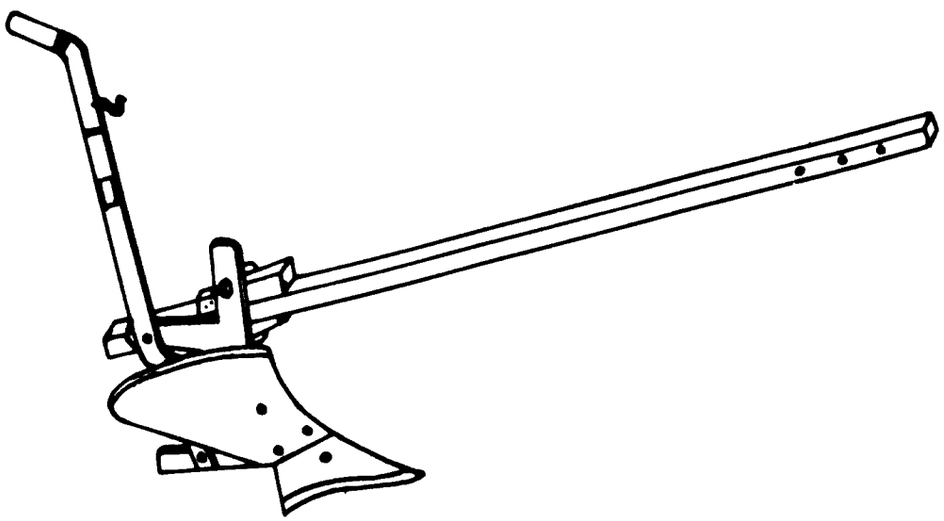


Fig. 4d. **SINGH HAND HOE**



DETAILED DRAWING

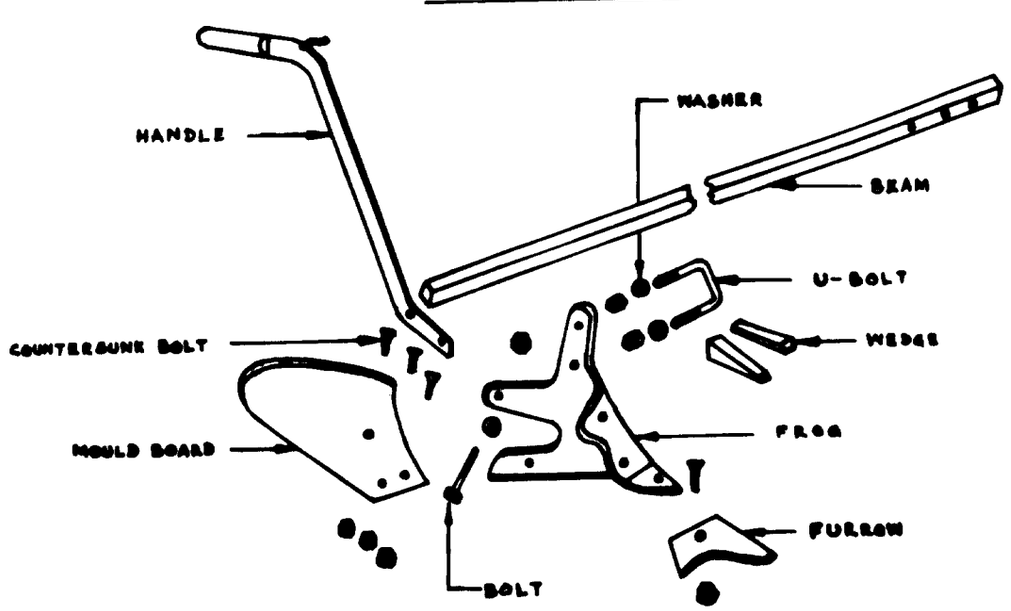
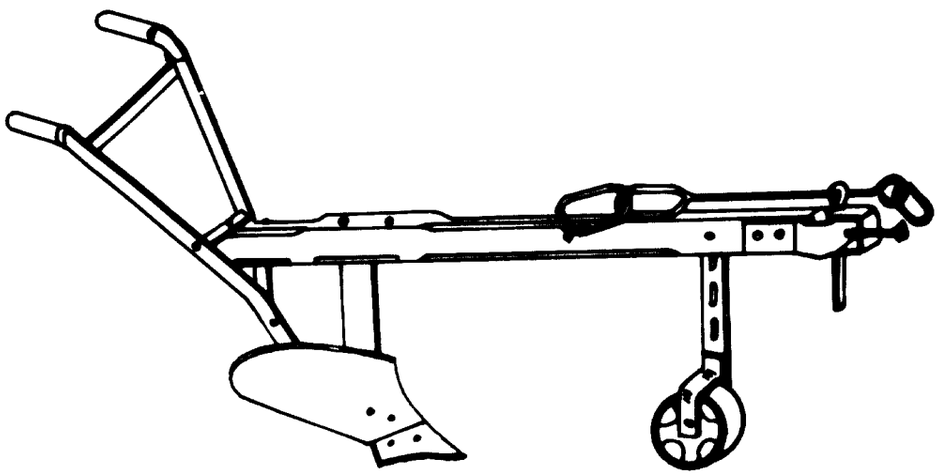


Fig. 4e. **GURJAR PLOUGH**



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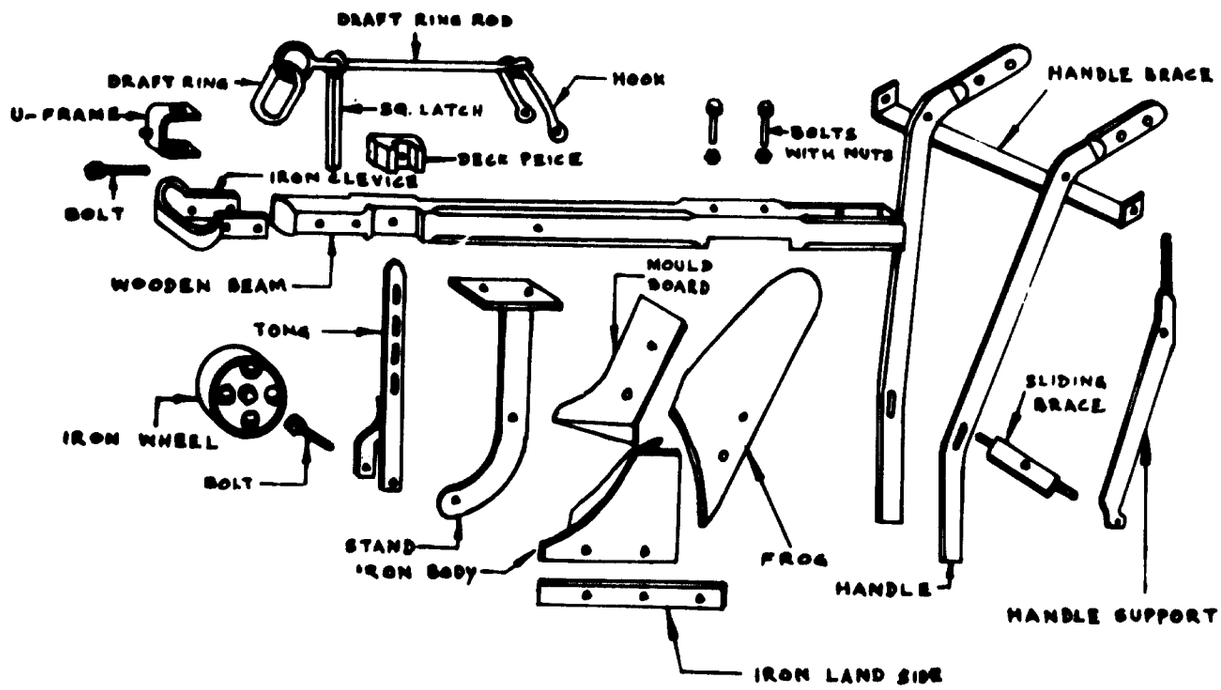
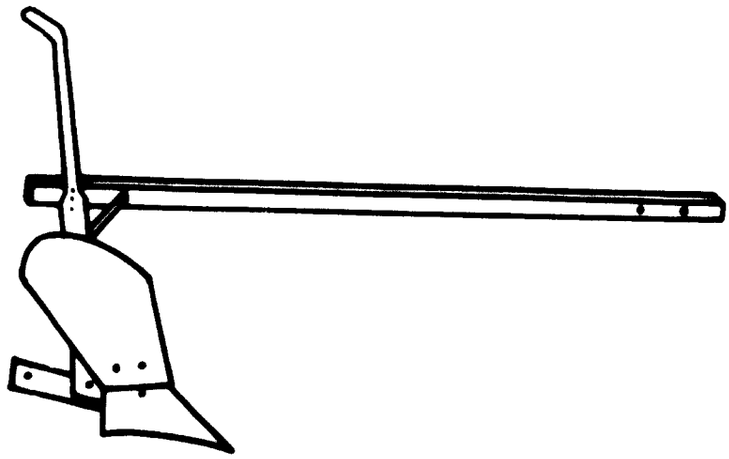


VICTORY PLOUGH

Fig. 4f.

UP PLOUGH



TURN WREST PLOUGH

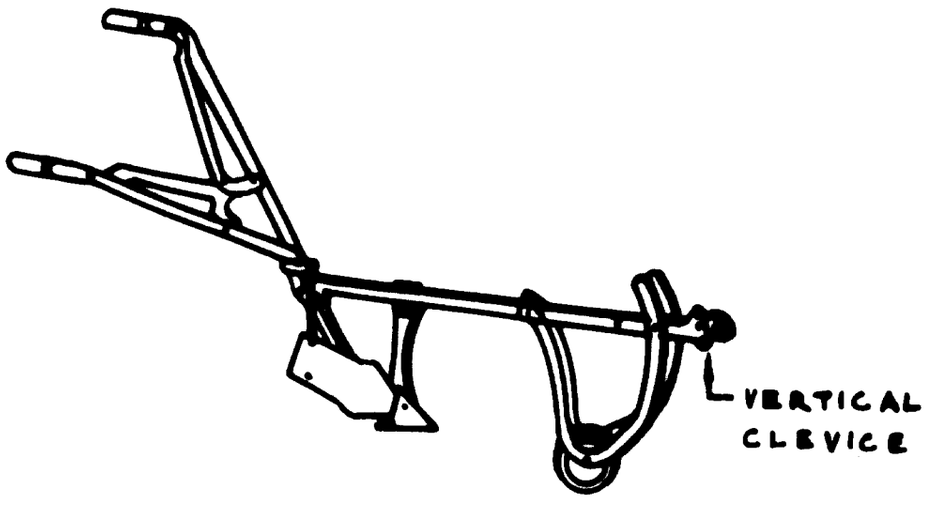
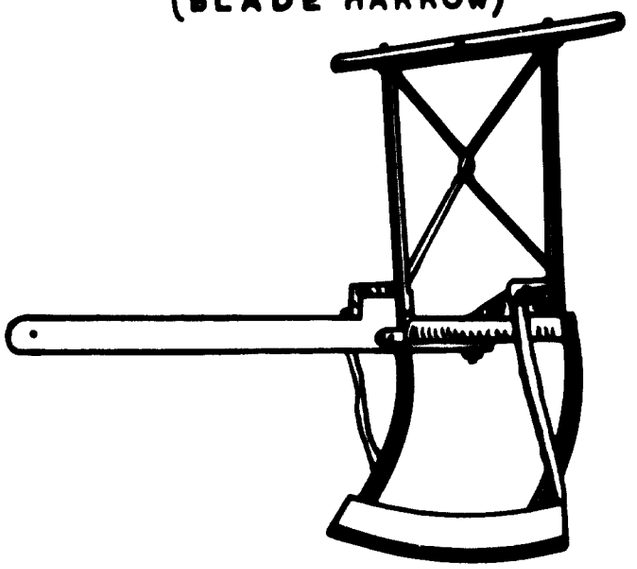


Fig. 4g.

GUNTAKA
(BLADE HARROW)



BUND FORMER

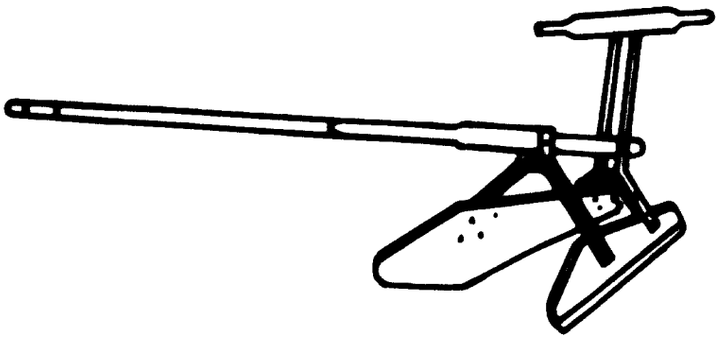


Fig. 4h.

Table 6. List of products to be manufactured with approximate price and requirement of raw materials.

Product and app. price	Volume of production	Raw materials	Use of the product
Chopper $ 1.20	100 per day	M.S. plate and wood	Harvesting
Sickle $ 1.00	100 per day	M.S. rod and wood	Harvesting
Garden Shears $ 3.00	100 per day	M.S. plate and wood	Gardening
Hand hoe $ 2.00	100 per day	M.S. plate and wood	Weeding
Fodder cutter $ 50.00	2 per day	M.S. angle, rod and carbon steel plate	Fodder cutting
Mouldboard Plough $ 20.00	2 per day	Cast iron, carbon steel plate and wood	Land preparation
Bladed harrow $ 20.00	1 per day	carbon steel plate and wood	Land preparation

Table 7. The different operations for the products and and the approximate time of operations.

	Shear	Grind	Forge	Wood work	Press Bend Assem.	Turn	Cut Weld	Drill
Chopper	1	2	9	4	-	-	-	-
Sickle	1	2	7	4	-	-	-	-
Garden Shear	2	3	14	12	1	-	-	2
Hand hoe	-	-	5	2	-	-	-	-
Fodder Cutter	-	2	6	-	12+ 90	60	8+ 60	20
Mould Board Plough	2	-	-	240	-	-	-	8
Bladed Harrow	-	2	-	240	-	-	8	-

Time shown is in minutes

Break-up capital expenditures:

	in U.S. Dollars
One Shearing machine	6000.00
Two grinders (pedastal type)	1000.00
Two mechanical forging machines	30000.00
Two wood working machines	2500.00
One centre lathe	8000.00
Welding set	1000.00
One ball press	500.00
Four country type furnace & 8 anvils	1200.00
Miscellaneous	2000.00
Buildings	16000.00
Installation of machines and facilities and office furnitures	5000.00
Total	73000.00

Break-up of running capital:

Monthly salary of staff	3070.00
Monthly consumption of utilities, coal	500.00
Cost of raw materials for one month (assuming a lead time of one month)	10000.00
Total	15570.00

Requirement of Utilities:

Electrical - 100 KVA, 440 V, 3 phase, 50 hertz supply.

Water - 10,000 litres per day.

Table 8 shows the manpower requirement for each operation as well as for other supervisory works. The cost of labours is also shown in details in Table 8. A general sketch of the workshop and the ground plant of the workshop are shown in Figures 5 and 6 respectively.

Table 8. Manpower requirement

	Skilled	Semi skilled	Unskilled	Pay
Forging	-	8	8	$ 70 x 8 + $ 50 x 8 = $ 960.00
Shearing	-	1	-	$ 70.00
Grinding	-	2	-	$ 70 x 2 = $ 140.00
Woodworking	2	5	3	$ 90 x 2 + $ 70 x 5 + $ 50 x 3 = $ 680.00
Turning	1	-	-	$ 90.00
Welding	1	-	1	$ 90 + $ 50 = $ 140.00
Drilling	-	1	-	$ 70.00
Assembly	1	-	1	$ 90 + $ 50 = $ 140.00
Supervisors for workshop		2		$ 120 x 2 = $ 240.00

Stores Supervisor	1	$ 100.00
Stores assistant	1	$ 70.00
Office clerk	1	$ 70.00
Office Attendant	2	$ 50 x 2 = $ 100.00
Manager (plant & office)	1	$ 200.00

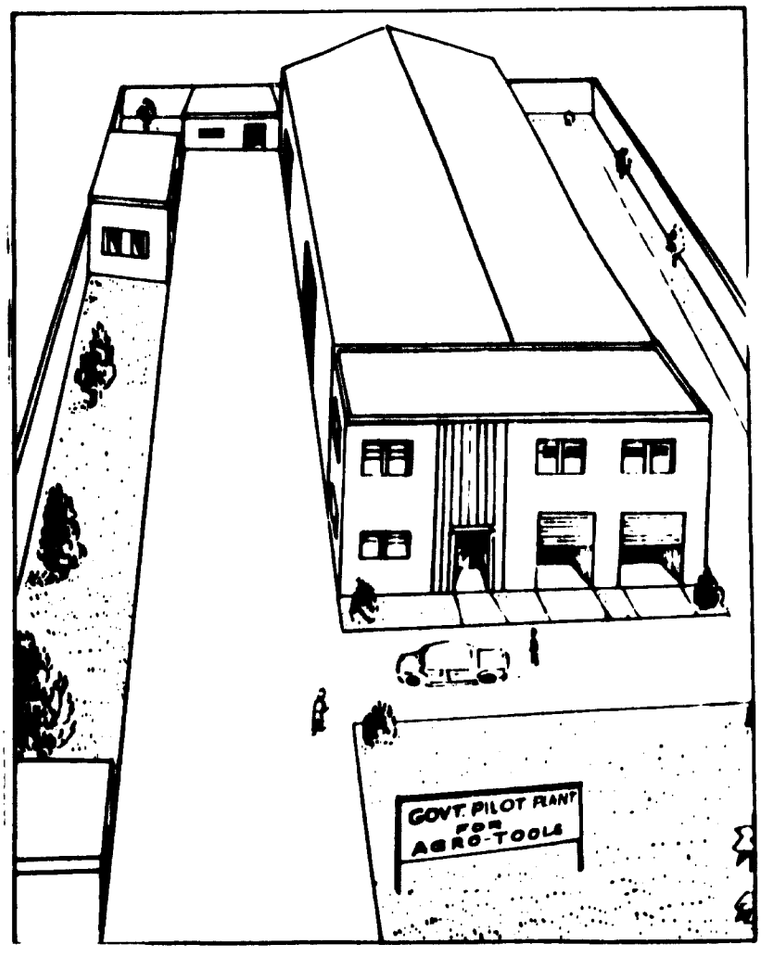
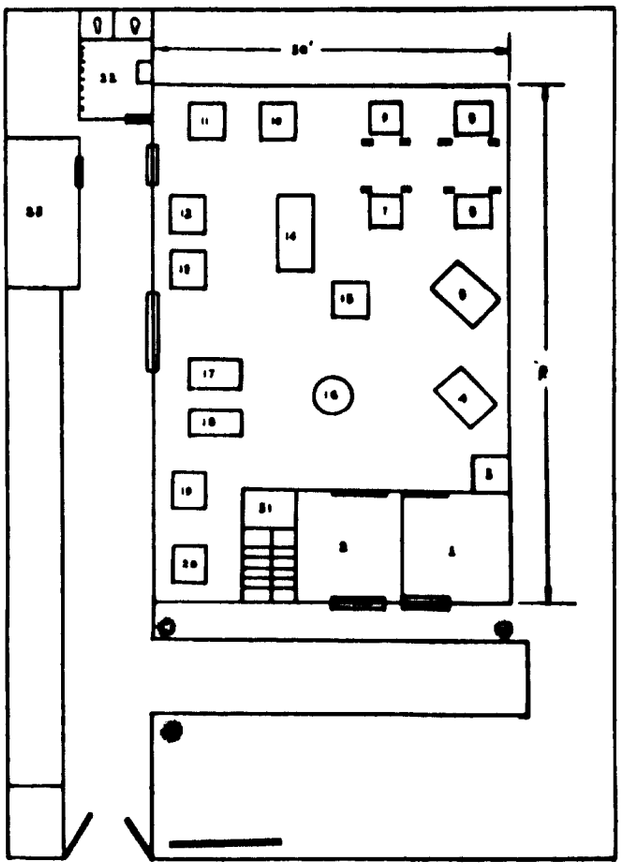


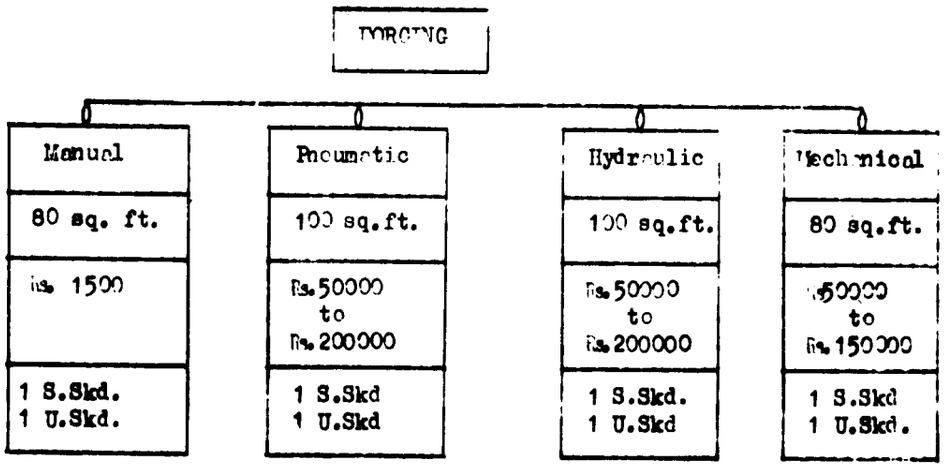
Fig. 5.



Legends of the ground plan:

1. Stores (incoming)
2. Stores (outgoing)
3. Stores assistant's cabin
4. Powered hacksaw
5. Shearing machine
6. Country type furnace
7. do
8. do
9. do
10. Grinding machine
11. do
12. Drilling machine
13. Ball press
14. Centre lathe
15. Supervisor's cabin
16. Place for assembly and welding
17. Wood working tables
18. do
19. Wood working machine
20. do
21. Supervisor's cabin
22. Toilets
23. Cafeteria

Fig. 6.



Skd - skilled; S.Skd - semiskilled; U.Skd - unskilled.

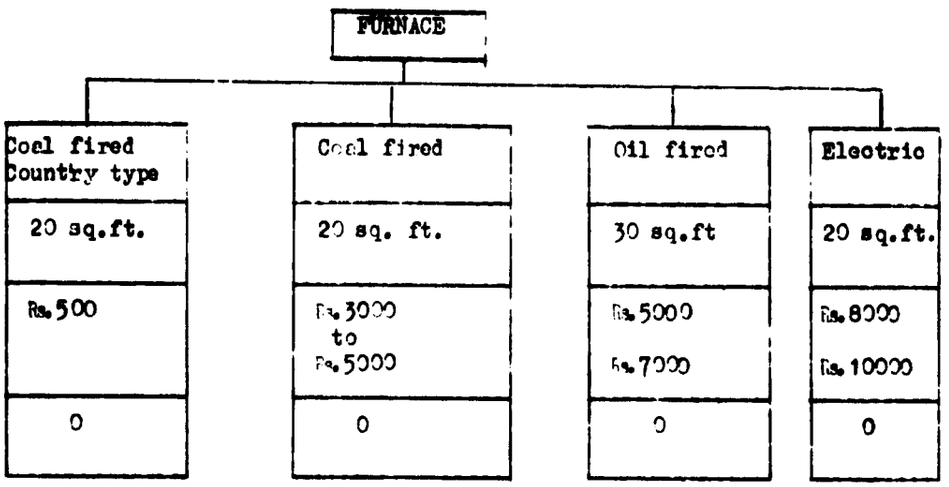


Fig 7 Furnace modules

For manual forging there is a limitation on size and production rate. However, this process requires very little capital investment and is recommended for elementary level workshops. Medium level workshops may also have it if the work pieces. The unskilled helper in the forging operation will look after the furnace.

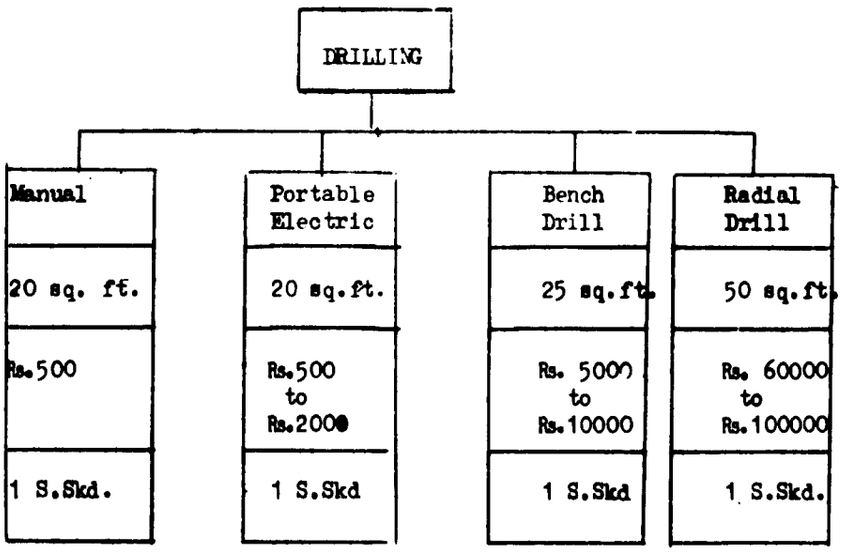


Fig. 8. Modules for drilling operation

Manual drilling is available only for soft metal and upto 6 mm dia. This usually, should be avoided. One portable electric drill is very handy and should be kept in each workshop. Bench drills are usually sufficient for medium level workshops. Radial drill can be kept only in the central workshop if it is justified by workload.

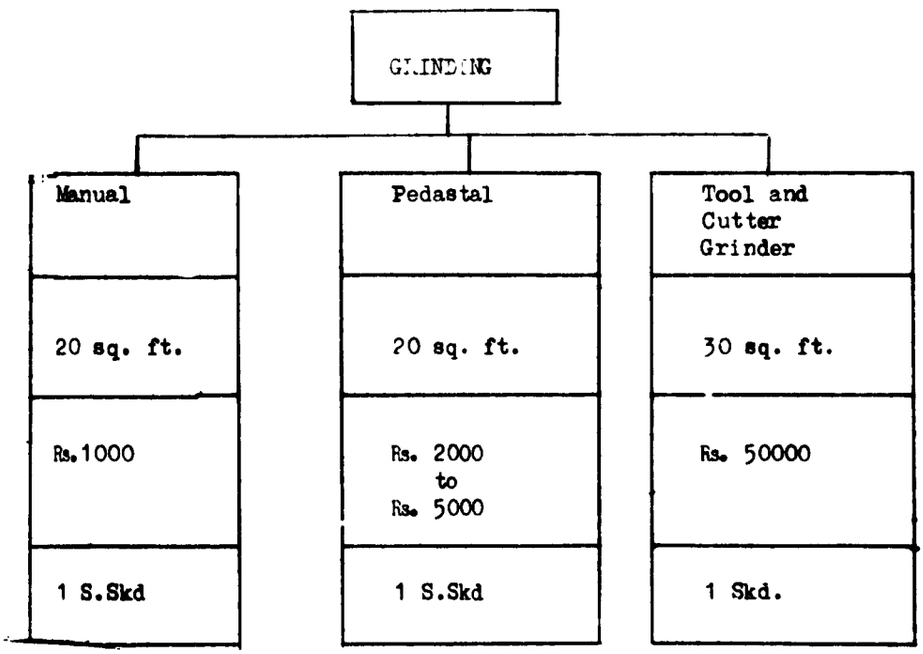


Fig. 9. Modules for grinding operation

The manual grinder can be used in places having no electric supply. However, pedastal grinders are recommended for usual work. The central workshop must have a Tool and Cutter Grinder. The elementary and medium level workshops will have their tool and cutter ground from the central workshop.

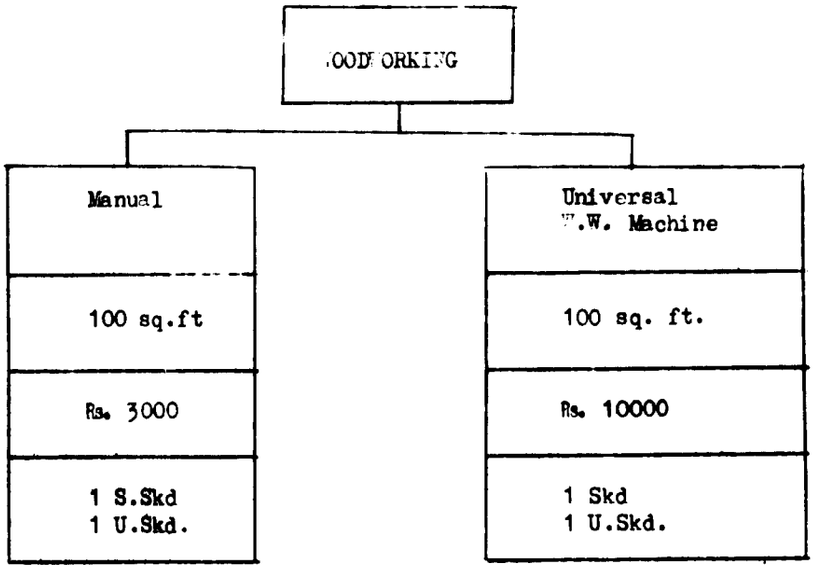


Fig. 10. Modules for woodworking operation

Manual wood working is recommended for elementary level workshops. Universal wood working machines are recommended for central workshops. Medium level workshop may opt for either manual or universal machines depending on the work load.

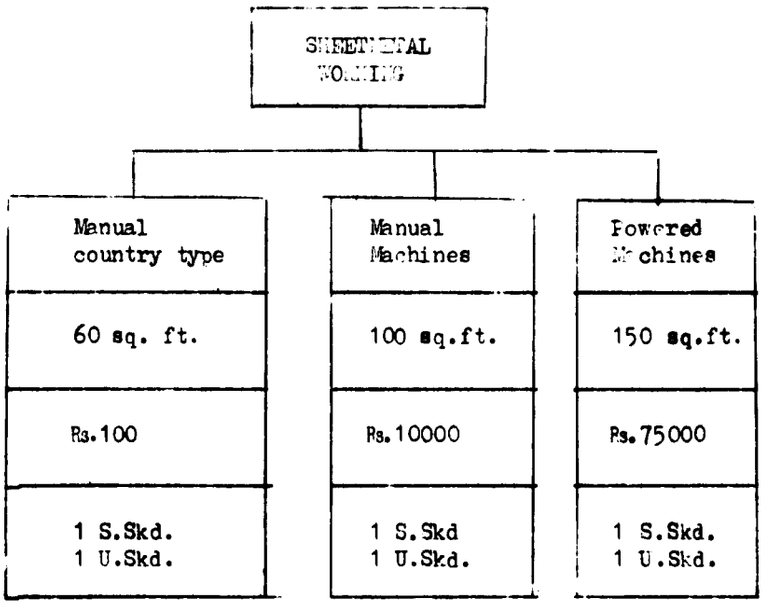


Fig. 11. Modules for sheet metal working

In the sheet metal working modules we have considered the shearing, bending and forming operations. The manual operation needs only hand shear, hammer, some form tools and hand tools. There is a limitation in the thickness of the sheets. These are recommended for light work. Powered machines are recommended for heavy duty work

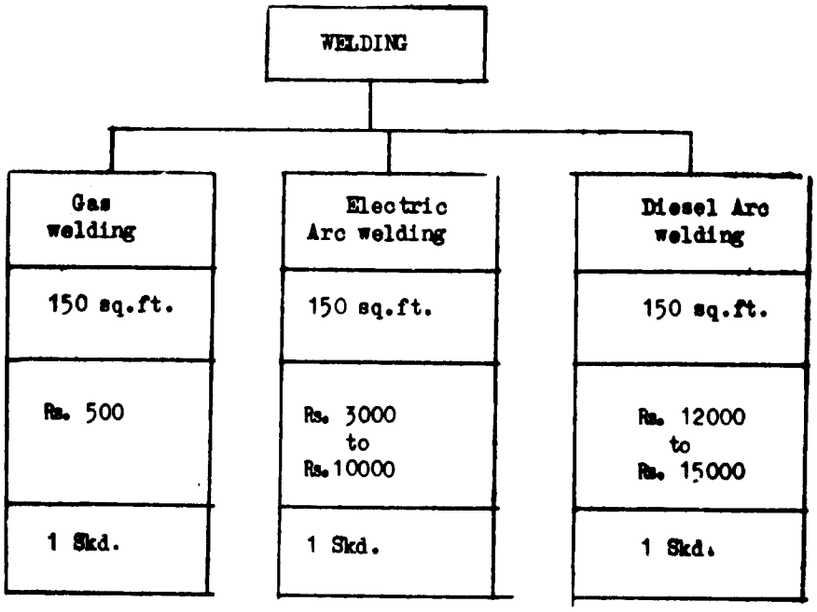


Fig. 12. Welding modules

Gas welding is recommended for places requiring both welding and cutting and having less work. Places requiring heavy duty welding as well as cutting are recommended to have both gas and electric arc welding facilities. Places not having electricity may have either gas welding or diesel arc welding depending on the work load.

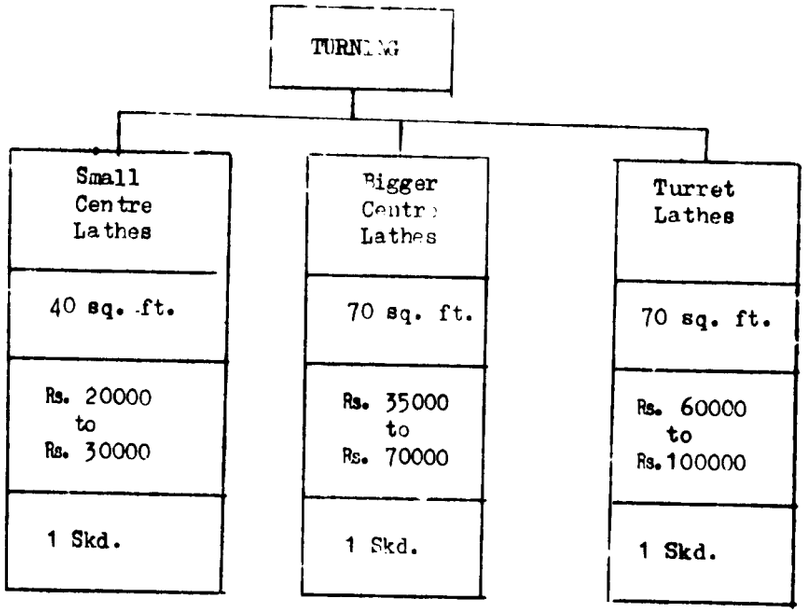


Fig. 13. Modules for turning operation

The choice of turret lathe depends on the work load and may only be made after careful time-study. If overlapping operations are needed to optimize the time and cost, a turret lathe is an essential option whereas for other purposes ordinary centre lathe would be sufficient.

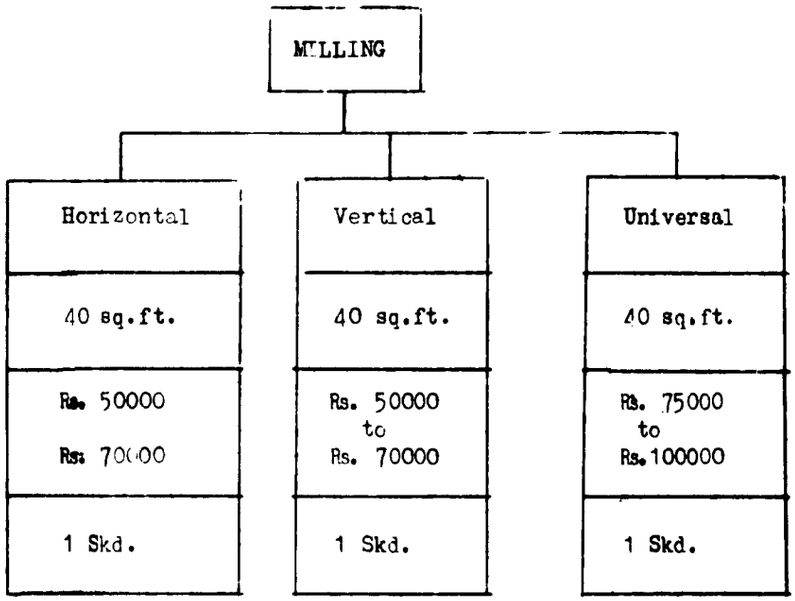


Fig. 14. Modules for milling operation

The choice between the horizontal and vertical milling machines depends on the nature of jobs to be done.

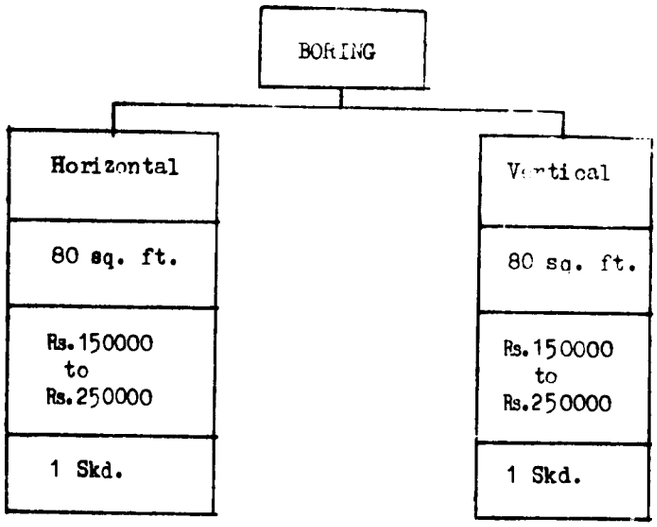


Fig. 15. Modules for boring operation

A medium scale workshop should have a shaping machine. For the larger workshops it is suggested to install both the shaping and planing machines and one operator may run both the machines if the work load is too much.

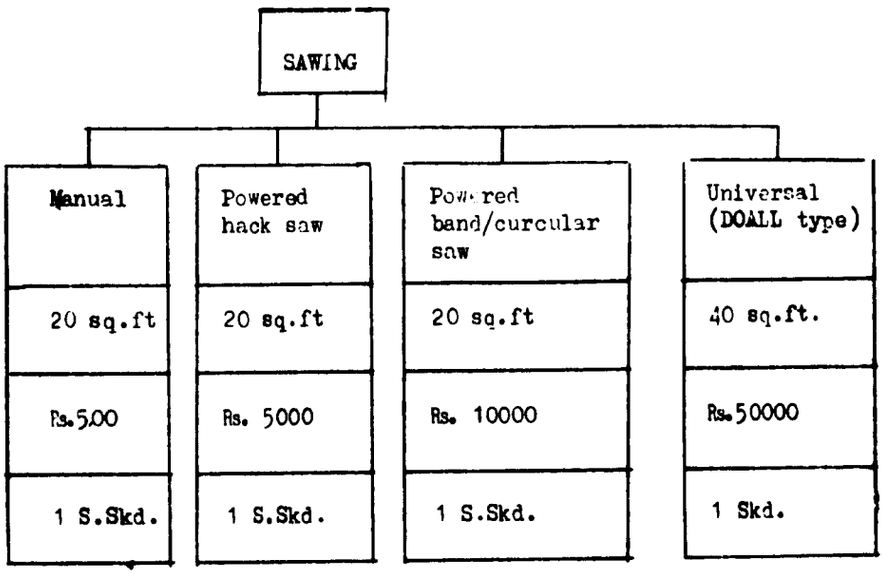


Fig. 16. Modules for sawing

Manual sawing is a must for every workshop. Powered saws are recommended for heavy duty work. The selection of a particular type of machine depends on the nature of work. However, the universal type of cutting machine is a costly machine and its purchase should be justified by the work load.

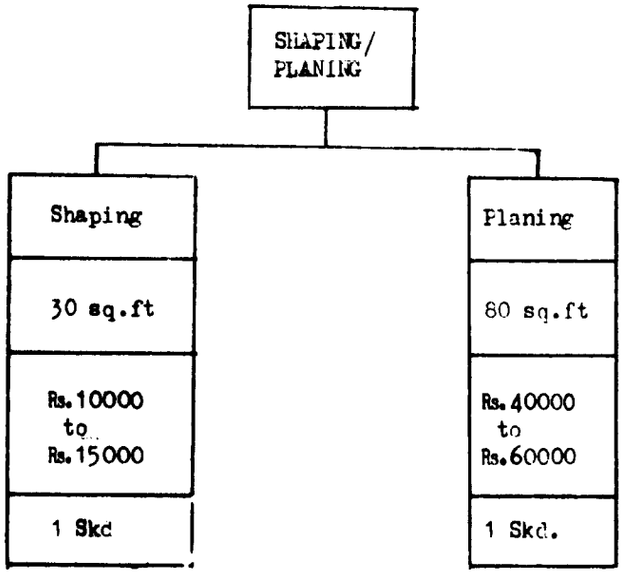


Fig. 17. Modules for Shaping/Planing

The selection between the horizontal and vertical ones depends mainly on the size and weight of the work piece. However, as both the machines are costly, a careful consideration is needed before purchasing the same.

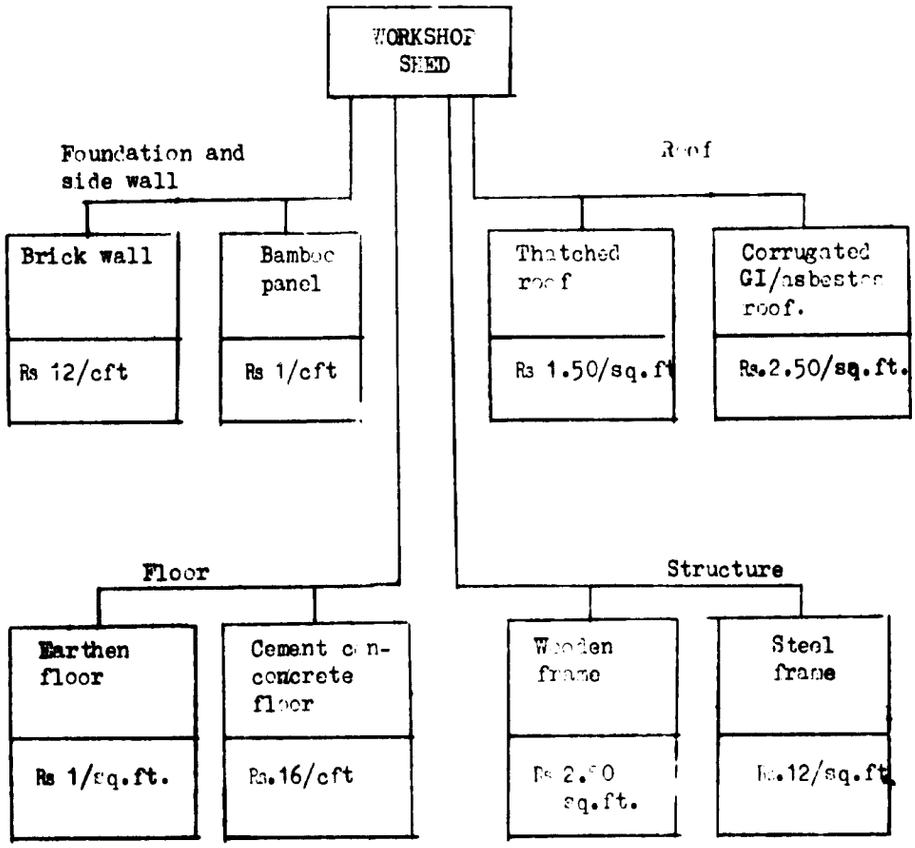


Fig. 18. Modules for workshop shed.

Steel frame, if used, should be prefabricated and they need only be assembled at sight. Other operations can be performed at sight. Most of the operations can be done with two semi-skilled operators and two unskilled helpers. However, the work can be speeded up with additional manpower. Except for large workshop sheds no special machines like concrete mixer are required.

11. TRAINING

Agriculture forms the backbone of the economy of LDC's. Any programme for the development of this economy should inevitably include a programme for the improvement of agriculture. One of the ways by which agricultural production can be increased in through progressive use of modern agricultural machinery and improved farming techniques. This has been well realised and use of farm machinery is steadily increasing. But agricultural engineering being a relatively new venture in these countries there is a lack of knowledge and experience in proper operation and maintenance of farm machinery and also in the selection of machines and implements to suit various farming conditions. This has resulted in non-utilisation of these to the fullest extent. Frequent breakdowns, unskilled use of the machines and inadequate knowledge of techniques used in the farming often do not permit deriving of best advantages from the use of machines. Therefore, training of technicians in the selection, operation and maintenance of farm machinery is of great importance. This type of training will also be beneficial to employees of Government departments engaged in agricultural engineering pursuits.

11.1. Courses

Training in India would cover the following courses: -

i) Research, development and testing of farm machines and equipment.

Theory and Practice

Objectives of farm mechanisation, progress of mechanisation in India and other countries, its scope and limitation, selection of farm machinery and farm safety.

Working principles, operation, adjustments, maintenance and repair of different types of plows harrows, cultivators, tillers, rotary tillers, fertilizers application equipment, seed drills, crop planting machines; row crop cultivation equipment, grain harvesting machinery (movers, reapers, binders, threshers combines, ensilage cutters, etc) miscellaneous equipment viz, seed cleaning and grading machines, sprayers and dusters.

ii) Field operation and practice of farm machinery

Field operation of the above machines, diagnosis of implements, field troubles and remedies, daily maintenance and upkeep, etc.

iii) Prime movers

Development of farm machines, equipment and tools, its scope and limitations, factors to be considered for their selection. Different assembly controls, instruments and their function; safety precaution.

iv) Survey and irrigation

Construction details and operation principles of different types of pumps, selection of pumps and simple calculations on discharge, power requirements and cost of irrigation of pumping set troubles in pumps, their causes and remedies.

v) Manufacture

The training will include in various operations from raw material to the finished product. It will also include operation of workshop, its machinery, foundry, carpentry and heat treatment.

vi) Management, production and distribution

vii) General visit to industry, agro-service centres and processing plants.

11.2 Medium of instruction

The training would be imparted in English. Trainees should therefore, be able to understand and express in english language.

11.3 Discipline

During the period of the training the trainees will be under the direct control of the Director of Training and will be governed by the guidelines prepared by UNIDO.

11.4 Social activities

The trainees would be given opportunity to participate in social and cultural programme, organized from time to time. This may include visit to places of interest.

11.5 Requirements

The trainess must be of sound physique and must be prepared to do all type of work in the field and workshop. The real requirement for training is a genuine love for farm machinery, ability to think "on the job" and willingness to work.

11.6 Boarding and lodging

This would be provided in the hostels or guest houses in the Universities located away from big cities and towns and in good hotels in other places.

11.7 Certificte

On successful completion of the training course, each trainee would be awarded a certificate.

11.8 Duration of training	20-25 weeks
11.9 Number of trainees	In batch of 12 trainees.
11.10 Approximate cost	$ 1250 per month for a batch of 12 including internal travel, but excluding international travel.

12. TECHNOLOGY OPERATIONS[1]

The different kind of equipments for various cultural operations and the kind of power required to operate them have been discussed earlier under the various head of implements and machines. These canbe divided under the following categories:

i) hand tools
ii) bullock drawn implements
iii) manually operated machines
iv) power driven machines
v) prime mover (tractors, power tillers, diesel engines and electric motors).

In all the cases, it is proposed to supply the prototypes for initial testing to assess the suitability for local soils and agro-climatic conditions. For this, some of the minimum workshop machinery and testing equipment would be required.

12. 1 In the second stage the production of prototypes[2] of those found suitable can be taken up in the following order depending upon the technological development of different countries:

i) manufacture of hand tools with indigenous raw materials, their testing and large scale field operations,
ii) manufacture of bullock drawn implements, their testing and adaptation to local agronomical practices,
iii) manufacture of more complicated manually operated machines, their evaluation and production, and
iv) manufacture of power operated equipment and to make them fit into the different cropping systems.

12. 2 It is not proposed that the production of prime movers, should be taken up by any of these countries in the next few years in view of the high technology required to produce them and their number required may also be very small. Unless a demand survey is undertaken and the manufacturing capacity clearly assessed, these may be supplied from countries which are manufacturing them.

1. See the enclosed list of implements, their Indian specification and manufactures as appendix 1.

2. Foreign institutions which expressed interest in following work (appendix 2).

Annexure-1

Sl. No.	Name of Implement	Applicable Indian Standard (IS)	Name of Manufacturers	Availability of drawing/ design	Approximate cost in Indian rupee	US $ (1 $ = Rs. 9)
TILLAGE AND INTERCULTIVATION EQUIPMENT						
1.	Mouldboard Plough	IS:2192(Part II)-1976 IS: 6327-1971	i) General Manager, Agriculture Implement Factory, Rajasthan Agro-Industries Corpn. Ltd., Jotwara(Jaipur)	i) Agri Engg. Division, IARI, New Delhi		
				2) ISI, Manak Bhawan, New Delhi.		
			ii) M/s. Kirloskar Bros. Ltd., Kirloskarvadi, Sangli	ii) ICAR, New Delhi.		
			iii) M/s. Cossul & Co. Ltd., Agricultural Engineers, 123/67, Industrial Area, Kanpur-208012	iv) Machinery Divn., Min. of Agriculture, New Delhi.	Rs. 135 (15)	
			iv) M/s. Swadeshi Krishi Yamtra Udyog, 79A, Co-perative Industrial Estate, Kanpur-208022	v) Agri. Engineer(HQ) Govt. of U. P., Lucknow.		

			v) M/s. Ganga Rolling Mills, Naini, Allahabad. vi) M/s. Eastern Workshop, Jaunpur(UP) vii) U. P. State Agro Industrial Corpn.Ltd., Agricultural Implements Workshop, Talkatora Road, Lucknow. viii) Agricultural Implements, Workshop, Thiruchy (T. N.)		
2.	Three tyned Cultivator	IS: 3324-1965 IS: 7361-1974 IS: 6023-1970 IS: 6451-1972	-do-	-do-	225 (25)
3.	Ridger	IS: 2565-1963	-do-	-do-	225 (25)
4.	Bund former	IS: 3372-1965	-do-	Agri. Engineer (HQ) Govt. of U. P., Lucknow.	
5.	Disc. harrow (animal drawn)	IS: 3606-1972 IS: 4366-(Part I)-1972 IS: 7256-1974	as for Sl. No. 1	as for Sl. No. 1	Rs. 540(60)
6.	Soil Scoop	IS: 3360-1965	-do-	-	Rs. 225(25)
7.	Levelling Karaha	IS: 3293-1965	-do-	-	Rs. 225(25)
8.	Disc harrow (tractor drawn)	IS: 6635-1972 IS: 4366 (Part I)-1972 IS: 7230-1974	i) Escorts Ltd., 19/6, Mathura Road, Faridabad	-	

			ii) International Tractor Co., (Implements Div.) Nagpur.	
			iii) Rajasthan Agro-Industries Corporation, Implements Factory, Jotwara, Jaipur.	Rs. 3600 (400)
			iv) Implements Factory, Lucknow.	
			v) Bharat Engineering Co., G. T. Road, Karnal	
			vi) National Engineering Co., Near Subzi Mandi, Ambala City.	
9.	Cultivator (tractor drawn)	IS: 6638-1972 IS: 6023-1970 IS: 7565(Part I)-1975	-do-	Rs. 2700 (300)
10.	Rotavator blade for power tiller	IS: 6690-1972	i) Kerala Agri-Industries, P. O., Athani, Ernakalam	
			ii) Krishi Engines Pvt Ltd., Hyderabad	Rs. 900(100)
			iii) M/s. J. K. Satoh, JKCM Premises, Kalapi Road, Kanpur-208012	
			iv) M/s. V. S. T. Tillers Ltd, 22, Mahatma Gandhi Road, Bangalore	

			v) Maharashtra Co-op. Engng. Society Ltd., P. Box No. 175, Poona-Banglore Road, Sirohi, Dist. Kolhapur (Maharashtra). vi) Indequip Ltd., Near Industrial Training Institute, Naroda, Ahmedabad.		
11.	Wheel hand hoe	IS: 3467-1966	as in Sl. No. 1	as in Sl. No. 1	Rs. 180(20)
12.	Three tyned hand hoe (Singh hoe)	IS: 3292-1965	-do-	-do-	Rs. 90 (10)
13.	V. Blade hand hoe (Sharma hoe)	IS: 3185-1965	-do-	-do-	Rs. 90 (10)
14.	Rotary paddy weeder	IS: 1976-1969	American Springs & Pressing Works Ltd., P. C. Box No. 7602, Malad, Bombay-400064		Rs. 90 (10)
	SOWING EQUIPMENT				
15.	Hand seed drill	-	American Springs & Pressing Works, Bombay	-	450 (50)
16.	Seed cum fertilizer drill & wheat planter.	IS: 6813-1973 IS: 6816(Part I to IV)-1973 IS: 6817(Part I & II)-1973	as in Sl. No. 1 & 8		1080(120)
17.	Corn planter		R. Raikhy Enterprises, Raikhy Building, G. T. Road, Ludhiana		900(100)

IRRIGATION EQUIPMENT

18.	Centrifugal pump	IS: 6595-1972	i) Usha Sewing Machine Works, Nev elhi		
			ii) Rasmi Engg. Industries, Coimbatore.		
			iii) Kirloskar Bros., Kirloskarwadi, Dist. Sangli, (Maharashtra)		900 (100)
			iv) Cooper Engg. Ltd., Satara Road, Bombay		
			v) Texmo Industries, P. Box No. 5303, P. O. Gmanambkai, Mills Coimbatore-641029		
19.	Hand pump	-	-	-	270 (30)
20.	Sprinkler	-	Premier Irrigation Equipment Pvt. Ltd., 17/1C, Alipore Road, Calcutta-700027	-	10800(1200-)

PLANT PROTECTION EQUIPMENT

21.	Compression Knapsack sprayer.	IS: 1970 (Part I)-1974	i) American Springs & Pressing Works, Bombay		Rs 360(40)
			ii) N. Das & Co., Calcutta		
			iii) Sigma Steel Industries, A-2, Industrial Area, Millar Gunj, Ludhiana.		

			iv) Shaw Wallace & Co. 7 7, Linghi Chetty Street, Madras-600001. v) U. P. Plant Protection Appliances, Ghazipur (UP) vi) Asian Agrico Industries, P. Box No. 29, Billimora (W. Rly)		
22.	Hand rotary duster	IS: 2477-1970 IS: 5135(Part I)-1974.	as in Sl. No. 21		Rs. 1180-(20)
23.	Gas producer	-	-	-	Rs. 3600(400)
	HARVESTING AND THRESHING EQUIPMENT				
24.	Power thresher	IS: 6320-1971	Union Forging, Sherpur G. T. Road, Ludhiana U.P. Agro Industrial Corporation, Talkatora Road, Lucknow	IARI, New Delhi Punjab Agriculture Univ, Ludhiana	Rs. 4500 (500)
25.	Paddy thresher	IS: 3327-1965	as in Sl. No. 1	-	Rs. 4500 (500)
26.	Olpod thresher	IS: 3153-1965	as in Sl. No. 1	-	Rs. 600(70)
27.	Paddy winnowar	-	-	-	Rs. 270(30)
	PROCESSING EQUIPMENT				
28.	Decorticator	-	-	-	Rs. 540(60)
29.	Maize sheller (hand) Maize Sheller (power)	IS: 3939-1967 IS: 7051-1973	as in Sl. No. 1 Escorts Ltd., Faridabad	- -	Rs. 270(30) Rs. 900(100)

30. Seed cleaner	-	Engineering Services Corporation, 2, R S V Naidu Street, Kilapur-Madras-600010	-	Rs. 1170(130)
31. Peanut sheller	-	-	-	-
32. Sugarcane crusher	IS: 1973-1973 IS: 6983-1973	i) Kirloskar Bros., ii) Kirloskarwadi/Satara	-	Rs. 2700(300)
		ii) Rampur Engg. Co., Gaziabad.	-	-
33. Chaff cutter	IS: 7898-1975 IS: 1511-1968	i) M/s. Watikins Myor & Co., Nehru Garden, Jullundur	-	Rs. 450(50)
		ii) Punjab Agri. Syndicate, G. T. Road, Batala. (Punjab)	-	-

POULTRY EQUIPMENT

34. Poultry feeder	IS: 5255-1969	i) M/s. Dayal Poultry Appliances, Lajwanti Garden Coloney New Delhi	IVRI, Izatnagar
		ii) Haryana Agro-Industries Coporation, Nilokheri-132117, Dist: Karnal	
35. Poultry waterer	IS: 5283-1969	-do-	
36. Poultry brooder	IS: 5309(Pt. I)-1969 IS: 5309(Pt. II)-1970	-do-	
37. Poultry incubator	IS: 5310-1969	-do-	
38. Egg fertility tester	IS: 6228-1972	-do-	

39.	Egg Washing machines	IS: 6696-1972	-do-		Rs. 9000(1000)
40.	Trap nests	IS: 7516-1974	-do-		
41.	Pedigree hatching box	IS: 7517-1974	-do-		
42.	Laying battery cages	IS: 7518-1974	-do-		
43.	Poultry debeaker	IS: 5805-1970	-do-		
44.	Wing band	IS: 6544-1972	-do-		
45.	Leg band	IS: 6545-1972	-do-		
	HAND TOOLS				
46	Spades	IS:1759-1961	Agrico, TISCO, Jamshedpur		Rs. 118(20)
47.	Axes	IS: 703-1966	-do-		Rs. 90(10)
48.	Shovel	IS: 274(Pt I & II)-1966	-do-		Rs. 90(10)
49.	Garden rake	IS: 2559-1963	M/s. Mudhar Allied Traders, Karol Bagh, Delhi-5	-	Rs. 90(10)
50.	Hedge shears	IS: 2563-1963	-do-		Rs. 180(20)
	MISCELLANEOUS				
51.	Steel bins (Assorted)	IS: 5606-1970 IS: 7147(Pt I)-1973	Farmaids Coporation E-Block, Connaught Circus, New Delhi.	Indian Grain Storage Institute, Hapur.	Rs. 4500(500)
52.	Nagpuri yoke	-	-	-	Rs. 270(30)

53. Biogas plant	-	-	IARI, New Delhi Khadi & Village Industries Commission, New Delhi.	Rs. 4500(500)
54. Power tiller(with attachments)		as in Sl. No. 10	-	Rs. 22500(2500)
55. Engine	IS: 1601-1969	Please see list placed below.	-	Rs. 5400(600)

Note: Sl. Nos. 5, 14, 18, 21, 22, and 55 are covered under ISI certification.

scheme.

ADDRESSES OF ENGINE MANUFACTURERS

1. Kirloskar Oil Engines Limited,
Elphinstone Road, Kirkee,
Poona-3

2. Cooper Engineering Limited,
Satara Road (South Central Rly)
Maharashtra.

3. P.S.G. Industrial Institute,
Peeoamedu, Coimbatore-4.

4. Ganga Precision Industries,
Avanashi Road, Pappanaic-
Kenpalayam, Coimbatore-18.

5. Diesel Engineers,
37, Waltax Road,
Madras-1.

6. Textool Company Limited,
Branch Factory,
Sunganallur Post,
Coimbatore-5.

7. Shriram Refrigeration Industries Ltd.,
Bangalore,
Township, Hyderabad-37,

8. Accumax Limited, "Appeksha"
Bhaktinagar, Station Road,
Rajkot (Gujarat)

9. Sova Private Limited,
Sundakkamuthur Road,
Kuniamuthur Post
Coimbatore-5 (Tamilandu)

10. Madras Machine Tool Manufacturers
Limited,
8/146-B Richy Road,
Singanallur Post,
Coimbatore-5.

11. Kirloskar Oil Engines Limited,
15/4 Milestone, Mathura Road,
Faridabad (Haryana)

12. Ruston and Hornby (India) Ltd.,
Chinchwad, Poona-19.

13. Velumani Engineering Industry
9/1 Mettypalayam Road, Tudiyallur
P.O., Coimbatore-11.

14. The Maharashtra Cooperative Engineering Society Ltd.,
Industrial Estate, Poona
Bangalore Road, Shiroli,
Kohlapur (Maharashtra)

15. Krishi Engines Ltd.,
A-7 Unit, Industrial Estate,
Sanatnagar, Hyderabad-500018

16. India Casting Ltd.,
Balkeshwar Road,
Agra-282004 (UP)

17. Sigil (India) Services Pvt. Ltd.,
Bajuva, Distt. Baroda.

18. Basant Industries,
Opposite Mahapalika Check Post,
Nunihai, Agra (UP)

19. Sterling Machine Tools,
Indra Mills, Compound
Jeoni Mandi, Agra (UP)

20. Javahar Engineers Pvt Ltd.,
Javahar Estate,
Sangamner Road, Shrirampur,
Distt. Ahmednagar.

21. Bharat Electricals,
37B, Kanpur Industrial Development
Cooperative Estate,
Govind Nagar,
Kanpur.

22. Victor Diesel Industries,
40/A Vellai Karattu Morambu,
Magnisite Mines Post,
Salem-5.

23. J. K. Satoh Agricultural Machines Ltd., 14th Km/Stone, Kalpi Road (N. H. No. 25) Kanpur.

24. Indian National Diesel Engine Company Limited, P-61 B, Circular Garden Reach Rd., Calcutta-700043

25. Patel Manufacturers, Aji Industrial Estate, Post Box No. 510, Rajkot-3 (Gujarat)

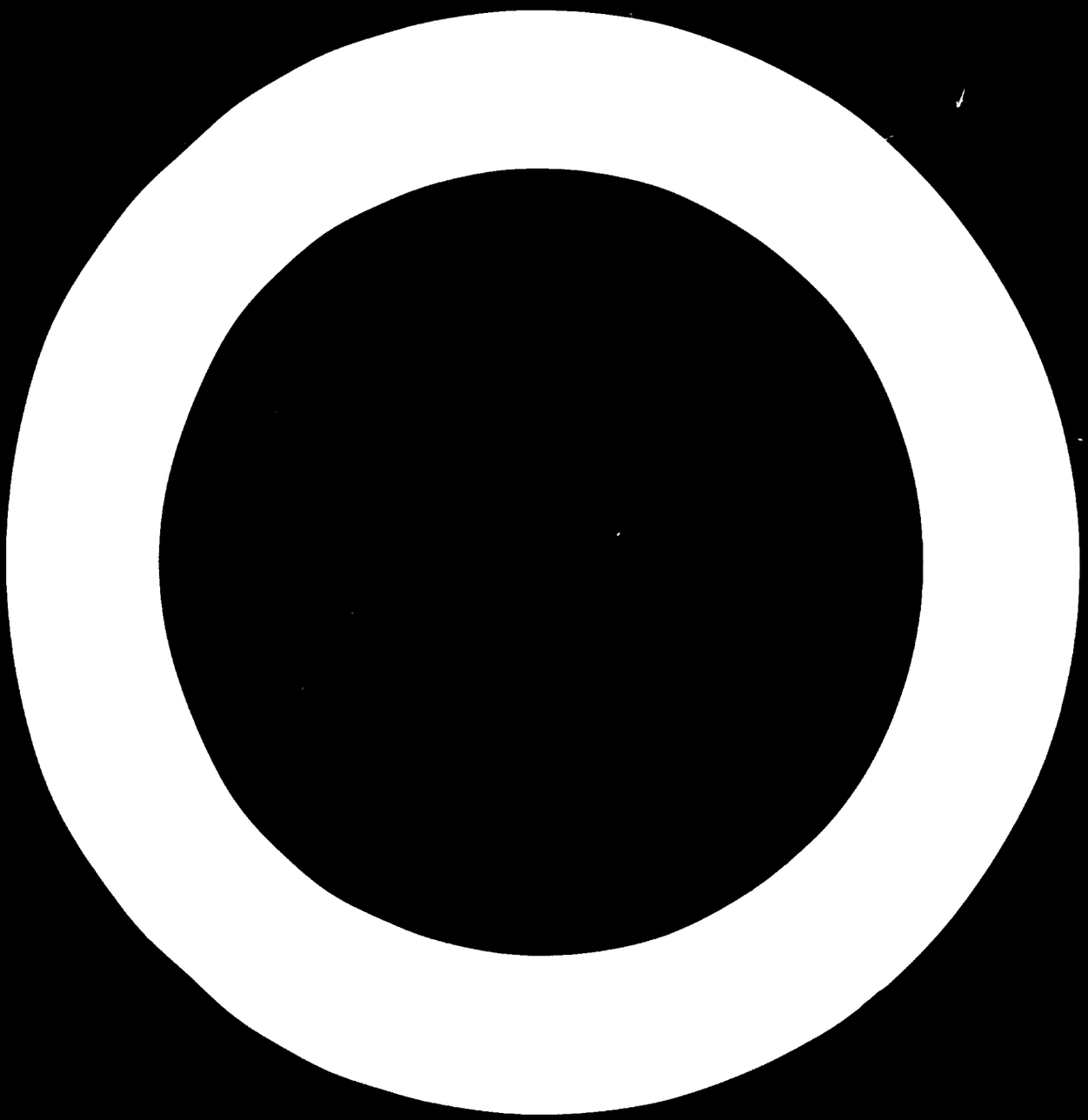
26. Rocket Engineering Corporation (Ahmedabad) Naroda Road, Saijpur Bogha-382345, Ahmedabad.

Appendix - 2

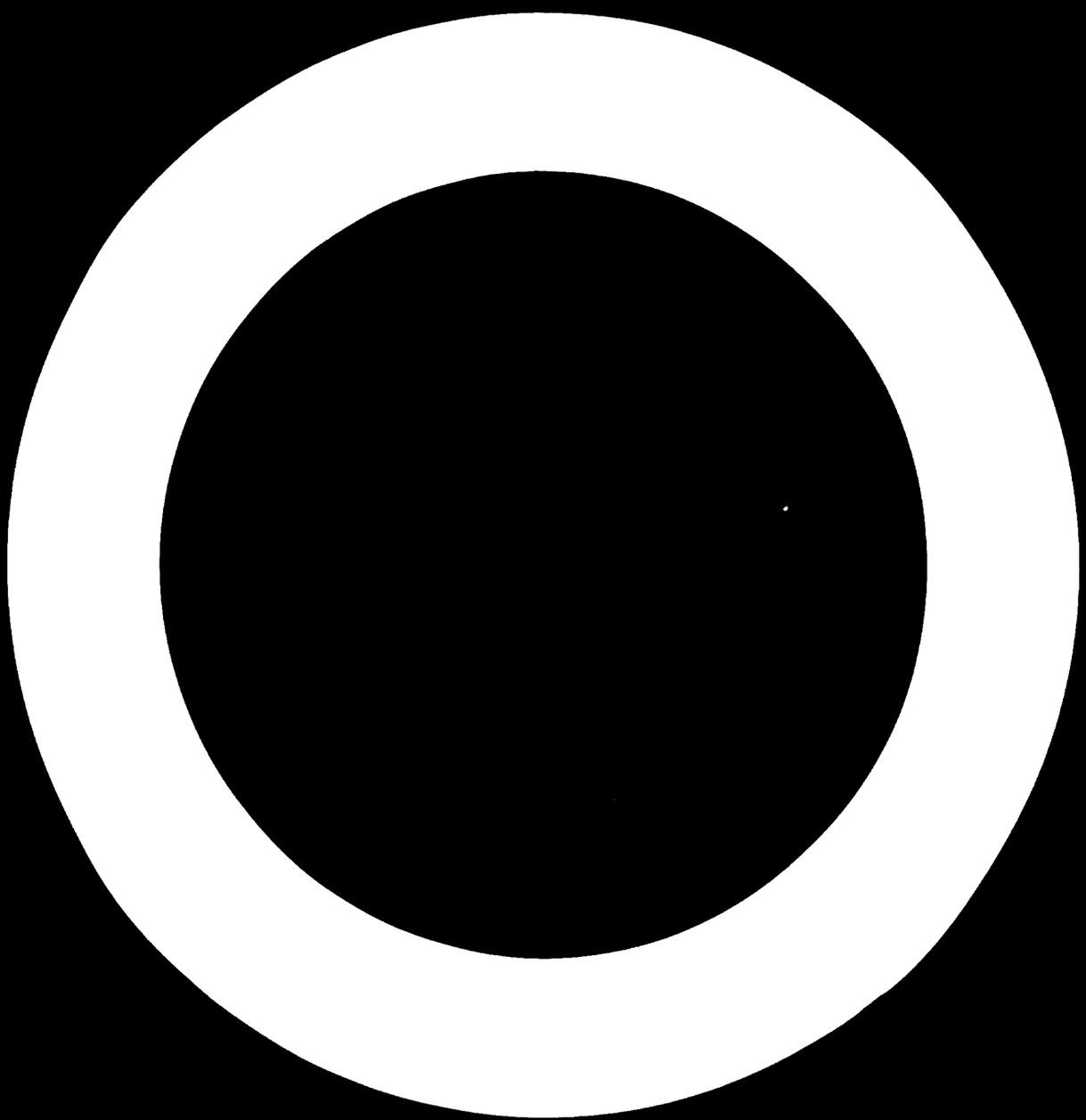
Organisations which expressed interest in the follow-up sections in each country.

Bangla Desh	Bangladesh Machine Tool Factory, Joydevpur, District Dacca, Bangla Desh.
Bhutan	Directorate of Agriculture, Ministry of Development, Royal Government of Bhutan, Thimpu, Bhutan.
Egypt	Tractor and Farm Machinery Testing and Research Station, Ministry of Agriculture, Baccos, Alexandria.
Ethiopia	Extension and Project Implementation Department, P. O. Box 3824, Addis Ababa.
Fiji	Nagan Engineering (Fiji Ltd.), Ba., Suva, Fiji.
Haiti	Institute for Development of Agriculture and Industry, P. O. Box 1313, Port-au-Prince.
Indonesia	Directorate General of Basic Industry, 8, HI Gajah muda, Djakarta.
	Metal Industry Development Centre, P. O. Box 113, Bandung.
Kenya	Agricultural Faculty, University of Nairobi.
Laos	i) LAO-Commercial Industry, 117, Phone Kheng Road, Vientiana.
	ii) Ministry of Planning and Cooperation.
Lesotho	Thaba Bosiu Project; Private Bag, Maseru.
Malaysia	Farmers Organisation Authority, No. 6, Jalan 21/30, Petaling Jaya, Kuala Lumpur.

Nepgal	Agricultural Tools Factory Ltd., Birganj.
Sir Lanka	State Hardware Corporation 9, 47th Lane A, Wallawatta, Colombo-6,
Sudan	Ministry of Industry & Mining, P. O. Box 2184, Khartoum
Tanzania	i) Small Industries Development Organisation, P. O. Box 2476, Dar-Es-Salam.
	ii) Tanzania Agricultural Machinery Testing Unit, P. O. Box 20126, Dar-Es-Salam.
	iii) Ubango Farm Implements Manufacturing Company, P. O. Box 20126, Dar-Es-Salam.
Uganda	Ministry of Agriculture and Animal Resources, P, O. Box 120, Entebbe.
Upper Volta	Centre National de Perfectionnement des Artisans Ruraux, B. P. 367, Guagadougok.



PART II
HOW TO OBTAIN UNIDO'S ASSISTANCE



HOW TO OBTAIN UNIDO's ASSISTANCE

1. Operational technical assistance activities

Several countries have requested technical assistance aimed at the establishment and development of manufacturing and service facilities for agricultural machinery and implements, with special reference to their linkage to the metal working sector. These requests are the result of the awareness of the developing countries of the need to manufacture equipment suited to local soil conditions and crop patterns, and to utilize the locally available resources to the fullest extent. The developing countries are also interested in enhancing local engineering capabilities in design and adaptation and in establishing suitable facilities for testing product performance. It is also evident that the developing countries have placed emphasis on national repair and maintenance programmes. Assistance in implementing these requests fall under the purview of UNIDO.

2. Procedures

Procedures for the submission of requests for assistance, and the character of the requests themselves, will vary from programme to programme, however, certain general procedures are followed in all cases. The UNDP Resident Representative, the accredited representatives of the United Nations in matters of technical assistance, will advise the Governments on these procedures.

The following points should taken into consideration while requesting UNIDO assistance;

a) assistance is granted only at the request of Governments in a formal communication emanating from the central authorities (Governments establish their own priorities);

b) a request may be formulated through the combined efforts of the national authorities and technical assistance experts including UNIDO staff members industrial development field advisers and the UNDP resident representative;

c) official requests normally contain a description of the project, its objectives, duration, the number of experts, the equipment required and the amount of local costs and counterpart contribution to be provided by the recipient Government;

d) in each of the developing countries, a specific government department has been designated to coordinate the programme for technical assistance provided by the United Nations. The national authority so designated differs from country to country. It may be the Ministry of External Affairs or the

Ministry of Planning. This office transmits all official requests that have obtained government approval to the UNDP Resident Representative in the respective country. The Resident Representative then transmits the official request to UNDP and UNIDO for examination and approval.

e) upon receiving the request, the resident representative conducts preliminary negotiations with the requesting Government on the nature of the request and the source and availability of funds;

f) requests for urgent short term assistance may be made under the SIS programme, while medium-term, advisory missions and pre-investment and pilot projects comprising provisions of experts, fellowships and equipment can be financed from UNDP funds or other appropriate sources of financing;

g) UNIDO reviews and comments on the technical aspects of the request. If further information or revision is needed, arrangements may be made to assist Governments in revising the request;

h) recruitment of experts is undertaken by UNIDO in co-operation with Member States. Recipient Government approve the proposed candidates prior to appointment. In certain cases subcontracting is resorted to instead of individual recruitment.

3. UNIDO technical assistance project data sheets

A few specimen project data sheets relating to technical assistance to the agricultural machinery industry are presented here for reference and assistance to the developing countries to formulate suitable technical assistance projects. Each of the project data sheet provides for one or two experts for a relatively short duration. If a team of experts or equipment or fellowships are required, the data sheets can be modified to include these requests.

When a request is made for technical assistance, the Government is asked to supply background information relevant to the project and to justify the request.

The specimen project data sheets appear in this study in the following order:

1) Strengthening and expansion of agricultural machinery design, development, adaptation and testing activities;

2) demonstration pilot engineering workshop for the assembly and manufacture of agricultural tools, animal drawnimplements, hand operated agricultural machines and allied simple sheet, metal and metal fabricated products with repair and maintenance activities;

3) agricultural tractors and machinery hiring station with stationary workshop and mobile units for integrated repairs and maintenance activities;

4) expert in the manufacture of farm implement and hand tools; and

5) manufacture of farm machines and hand tools.

Example

1. Proposal for UNIDO technical assistance

1. Title of the project

Strengthening and expansion of agricultural machinery design, development, adaptation and testing activities.

2. Objective

To transform agricultural machinery development and testing activities into the industry oriented professional national institution with catalystic and nucleus activities in the development of engineering technical manpower. This proposal is expected to lay the foundation for transforming the existing facilities into an integrated regional institute at a later date. Specifically the following are the main points of the present proposal:

1. development of technical manpower in engineering design and development capabilities;

2. act as a catalyst in local manufacture of suitable products through active liaison with industry, potential entrepreneurs;

3. act as the nucleus for a national agricultural engineering professional society and manufacturers association and a centre for dissemination of technological information;

4. assist the local small and medium scale manufacturers in product introduction, diversification and production through technical service especially through provision of prototypes, design and drawing standards, material selection and heat treatment techniques, product performance, evaluation and industrial and engineering technical service in industrial engineering and quality control; and

5. assist the Government in the formulation of national policies with respect to import, manufacture, marketing and development of infrastructure.

3 Duration

Four years (one year pre-project activies and three years operational activity).

4. Highlights of the project

This integrated project aims at the re-inforcing of the existing facilities (through provision of prototype workshop, laboratory testing and quality control instruments and equipment, technological information material such as journals, standards, literature, etc.) and strengthening of the existing technical manpower through provision of experts and fellowships and formulating an overall work programme. This will not only facilitate existing set-up to be the nucleus of testing and planned programme of present activities, but also supplement the activites for which there is a recognized need and a desire for expansion.

5. UNDP/UNIDO financing

The possible sources of financing are UNDP country programming (IPF), Special Industrial Services (SIS), UNIDO Voluntary Contribution Finances (UNIDO-VC) and UNIDO Regular Programme (UNIDO-RP) The details and source of financing may be worked out during the "Preproject Activity", if this project concept is acceptable to the Government.

Example

2. Proposal for UNIDO technical assistance

1. Title of the project

Demonistration pilot engineering workshop for the assembly and manufacture of agricultural tools, animal drawn implements, hand operated agricultural machines and allied simple sheet metal and metal fabricated products with repair and maintenance activities.

2. Objectives

The objectives of the project are:

1. development of local technical competence;
2. training in engineering aspects with special reference to graduates of vocational training school or polytechnic school;
3. assistance in the utilization of local raw materials whenever feasible;
4. act as a catalyst in local manufacture of suitable simple engineering products and in future rural industrialization;
5. development of local entrepreneurship;
6. extension of repair and maintenance services; and
7. development of a pilot demonstration scheme as the nucleus for future transformation into a viable commercial plant which could serve as a model for further establishment of such small plants in other rural areas.

3. Duration

4 years (one year pre-project activity and three years operation activity).

4. Highlights of the project

a) This integrated project aims at the establishing of physical facilities (workshop and a small foundry) for engineering demonstration establishing manufacture, through training of local personnel (vocational training schools) and initiating preliminary activities towards strengthening of local design development and adaptation capabilities of local agricultural engineers to facilitate production of agricultural implements

b) The immediate objective is to manufacture a limited number of agricultural implements primarily for domestic usage, with special reference to the existing accepted needs of a priority basis.

c) It proposes to establish a practical and direct link between the needs of the agriculture, with agricultural tools and implements as an important industrial input for successful agricultural development and the need for industrialisation with emphasis on appropriate technology transfer

d) This manufacturing plant will act as repair and maintenance units through integration of equipment (mobile units).

e) This project also aims to be the nucleus at a later date for training of local artisans and thus catalyse rural industrialization and local entrepreneurship. It will facilitate promotion of establishment of industrial estates and more than all, will facilitate basic training in industrial technology, production techniques, commercialization and management which are essential for transformation into a commercial venture.

5. Local executive agency

Agricultural engineering section of the Ministry of Agriculture or an appropriate section of the Ministry of Industry.

6. Location

The Government is to decide on the final choice.

7. UNDP/UNIDO financing

The provisional possible sources of financing are (a) UNDP finances under country programme (IPF) and special industrial services (SIS), (b) UNIDO voluntary contribution finances (UNIDO VC) and (c) UNIDO regular programme finances in special cases. It is to be pointed out that the source of financing may be worked out after the project concept is acceptable to the Government and a preliminary request is received.

8. Pre-project activity

The list of workshop machinery, prototype samples of appropriate agricultural implements and machines, laboratory testing equipment and details on jigs, fixtures, etc., could be worked out at a later date. In addition, the details on fellowship training programme can also be eleborated during "Pre-prospect Activity".

3. Proposal for UNIDO technical assistance

1. Title of the project

Pilot demonstration of Agricultural tractors and machinery hiring station with stationary workshop and mobile units for integrated repair and maintenance activities.

2. Objectives

The objectives of the project are:

1. to assist in the effective utilization of tractors implements and machinery owned by the Ministry of Agriculture, state farms and cooperatives agricultural sector through the establishment of a comprehensive farm machinery hiring system; through judicious acquisition of additional new appropriate agricultural tractors, implements and allied machinery for an expanded hiring activity as a second step;

2. to recorganize and expand existing, or establish new stationary workshops for agricultural machinery and allied equipment repair and maintenance;

3. to introduce mobile workshop units for repair and maintenance extension in rural areas;

4. to introduce activities in effective spare parts inventory control, repair and maintenance schedule, and tractor hiring schedule;

5. to develop management and use of existing facilities with supplementary assistance with viable results through a cost conscious commercial approach;

6. to develop technical manpower through training programme at technical as well as at management levels;

7. to support the Government's agricultural machinery extension efforts and assist the Government in formulating guidelines and policies, including regional and district level workshops and supporting activities;

8. to act as a model for the development of commercial individual tractor hiring entrepreneurship;

9. to develop in cooperation with manufacturers, importers and dealers, a national integrated scheme for effective utilization of machinery with a repair and maintenance programme in the area of agricultural machinery and implements, and allied equipment; and

10. to develop indirectly, a market to support local manufacture of agricultural machinery and implements and spare parts.

3. Duration

3 years (one year pre-project activi. and two years operational activity).

4. Highlights of the project

a) This integrated project has two distinct, but interrelated compounds:

i) agricultural tractors, implements and machinery hiring station, and

ii) stationary workshop and mobile units for repair and maintenance of agricultural machinery and allied equipment.

The implementation of the project could be carried out either as a single component, or two separate components and the priorities are to be based on the needs of the country.

b) For the tractor hiring station, station, the priority is to be given to the consolidation reorganization and effective utilization of existing tractors and machinery owned by the Ministry of Agriculture and associated state farm, cooperative units with a view to extend the services to a larger rural areas and more number of farmers on a commercial basis. As a second step the tractor and machinery part is to be enlarged through judicious acquisition of appropriate machinery through commercial channels, or bilateral assistance or international assistance including that from United Nations (UNDP and UNIDO). This phase of the project proposal involves possible UNIDO assistance for the consideration of the Government in realization of the objectives and in implementation of a successful scheme.

c) The stationary workshop and mobile units for repair and maintenance of agricultural machinery and allied equipment, consists of either strengthening and expanding an existing repair and maintenance workshop of the Government or establishing a new unit together with appropriate provisions of physical facilties (workshop, machinery, repair and maintenance equipment, testing and laboratory instruments ets.) and mobile units with equipment and tool kits and provision of experts.

d) Acquisition of new machinery for tractor hiring station, is to be considered at a later stage including the source of financing. Any assistance in initiating commercial or bilateral negotiations for supply or equipment could be also provided under the project.

e) Sufficient funds are to be made available towards supply of steel, spare parts, workshop machinery to be , tools, so as to maintain a healthy inventory control level.

5. Recommended work programme

i) Consolidation and reorganization of existing tractors and machinery pool to make it a nucleus of a tractor hiring station. Also reorganization of existing facilities of a worskhop ao as to provide initial repair and maintenance services.

ii) Starting a modest tractor hiring scheme with repair and maintenance facilities on a trial basis so as to gain experience. This will inclu de local technical personnel intial training.

iii) Strengthening of the project through supplementary workshop equipment and a modest enlargement of tractor hiring, repair and maintenance programme on a pilot

commercial basis. This will include continuation of local personnel training in organization, operation and management.

iv) Acquisition of additional tractors, implements and allied machinery at a later date.

Note: It is recommended that a comprehensive work programme is elaborated during the "Pre-project mission".

4. Request from the Govt. of Thailand for Special Industrial Services.

Job description

1. Title	Expert in the manufacture of farm implements and hand tools
2. Duration	Six months
3. Date when require	As soon as possible
4. Duty station	Thialand, with travel within the country
5. Purpose of the project	The purpose of the project is to investigate the desirability and feasibility of the manufacture of farm and artisan hand tools and recommended to the Government a suitable line of action.
6. Duties	The expert will work in close cooperation with other United Nations experts and officers of the Ministry of Industry and the Ministry of Agricultiture, and will undertake the following tasks:

a) secure all available information on the product line, specifications, present demand and future requirements that have been collected and/or projected by the various agencies and rationalise the data;

b) assess the present status of the subject industry;

c) make recommendations on the improvement and expansion of the present industry;

d) assist in conducting feasibility studies both from the technical and economic view points in support of the recommendations;

e) formulate steps that need to be taken to assure development along the lines recommended.

6. Qualifications	Degree or equivalent in mechanical or agricultural engineering with practicai experience in small manufacture. Experience in plant layout, particularly in regards to small industrial plants and experience in marketing of industrial products would be a definite asset.
7. Language	English
8. Background information (specimen only)	The applied scientific Research Corporation of Thailand (ASRCT) the principal research agency of the Government of Thailand has carried out brief examinations of a number of industries with a view to assessing their potential for deveiopment.

Complementary to the report of the ECAFE/UNIDO Fact Finding mission on agricultural machinery industry which visited Thailand in December 1968, detailed analysis on the various aspects of agricultural machinery and implements has been undertaken by various agencies in Thailand. Based upon these reports and its own preliminary analysis it has been recommended by Applied Scientific Research Corporation of Thailand- in consultation with the Industrial Finance Corporation of Thailand- that there is a necessity to undertake a detailed study of establishment of agricultural machinery manufacture - hand operated and artisan implements and tools in Thailand. Such a study should take into account the agricultural implement industry as a whole.

There is no significant level of manufacture of hand operated implements and tools in Thailand. With the present demand of nearly 4000 tractors per year (in 1969 existing assembly by three firms about 2700 units, taking into account the total import of around 4000 units) the growth rate is expected to be 5-10 percent per year in the next 5 years to come. Thus there is a need for suitable range of implements to meet the requirements of the existing population of around 28,000 tractors and the future growth. Presently a few manufacturers are manufacturing assembling disc plows and disc harrows.

In the farm and artisan hand tool industry, imports have been growing at an average annual rate of 15 percent and reached 9 million US $ in 1968. One large company makes chongkols only, and a number of small companies make the simplier items such as knives, hammers, plough heads, crow-bars, spades, rakes, hoes and harpoons. Apart from the one large factory making chongkols, there are no mechanically equipped forging shops and the quality of production is limited by a minimum of tooling.

However, considering the quantity, quality and manufacturing techniques of existing level of production. there is a necessity for investigating the possibilities of establishing suitable manufacturing units. The Government of Thailand desires assistance of UNIDO regarding the same.

Note: (These recommendations should include improvements in present organisations and use of present industrial equipment as well as additional or new processes and equipment needed. The economic aspects involved therein must receive careful consideration. The credit facilities available to the small industrial plants for procurement of improved tooling requirement should receive careful consideration)

Example

5. Special Industrial services Project Data Sheet for initiating the activity

Reference No. SIS

Country: Thailand

1. Project title — Manufacture of farm machines and hand tools.

2. Date of formal request — - - - - - - - -

3. Government Department submitting request: - - - - - - - -

(Ministry of Industry/Agriculture)

4. Specific Government Agency concerned with the project: - - - - - - - -

5. The purpose of the project:

The purpose of the project is to investigate the desirability and feasibility of the manufacture of farm and artisan hand tools in Thailand and recommend to the government a suitable line of action.

6. Description of the project:

The services of an expert in the manufacture of farm and artisan hand tools will be provided for a period of three months. The expert will be required to undertake the following duties:

a) to secure all available information on the product line, specifications, present demand and future requirements that have been collected and/or projected by the various agencies and rationalize the data;

b) to assess the present status of the subject industry in Thailand;

c) to make recommendations on the improvement and expansion of the present industry;

d) to assist in conducting feasibility studies both fromthe technical and economic view points in support of the recommendations; and

e) to formulate steps that need to be taken to assure development along the lines recommended.

7. Background information
(Specimen only)

The Applied Scientific Research Corporation of Thailand (ASRCT) the principal research agency of the Government of Thailand has carried out brief examinations of a number of industries with a vew to assessing their potential for development.

Complementary to the report of the ECAFE/UNIDO Fact Finding Mission on agricultural machinery industry which visited Thailand in December 1968, detailed analysis on the various aspects of agricultural machinery and implements has been undertaken by various agencies in Thailand. Based upon these reports and its own preliminary analysis it has been recommended by Applied Scientific Research Corporation of Thailand - in consultation with the Industrial Finance Corporation of Thailand - that there is a necessity to undertake a detailed study of establishment of agricultural machinery manufacture - hand operated and artisan implements and tools in Thailand. Such a study should take into account the agricultural implements industry as a whole.

There is no significant level of manufacture of land operated implements and tools in Thailand. Such a study should take into account the agricultural implement industry as a whole.

There is no significant level of manufacture of hand operated implements and tools in Thailand. With the present demand of nearly 4000 tractors per year (in 1969 existing assembly by three firms about 2700 units, taking into account the total import of around 4000 units) the growth rate is expected to be 5-10 percent per year in the next 5 years to come. Thus there is a need for suitable range of implements to meet the requirements of the existing population of around 28,000 tractors and the future growth. Presently, a few manufacturers are manufacturing assembling disc plows and disc harrows.

In the farm and artisan hand tool industry, imports have been growing at an average annual rate of 15 percent and reached 9 million US $ 1968. One large company makes chongkols only, and a number of small companies make the simpler items such as knives, hammers, ploughheads, crow-bars spades, rakes, hoes and harpoons. Apart from the one large factory making chongkols, there are no mechanically equiped forging shops and the quality of production is limited by a minimum of tooling.

However considering the quantity, quality and manufacturing techniques of existing level of production, there is a necessity for investigating the possibilities of establishing suitable manufacturing units. The Government of Thailand desires assistance of UNIDO regarding the same.

8. Relationship with other technical assistance projects or requests:

The expert will work closely with other UNIDO experts involved in Project THA 16.

9. Project components, duration and estimated costs:

Field of Activity	Duration	Cost
Mechanical or Agricultural Engg. No. .... (how many)	Months	$4,000 m/m

10. **Request approved**

For UNIDO	Date	for UNDP	Date

* **Note: (These recommendations should include improvement in present organisation and use of present industrial equipment as well as additional or new processes and equipment needed. The economic aspects involved therein must receive careful consideration. The credit facilities available to the small industrial plants for procurement of improved tooling requirement should receive careful consideration.**

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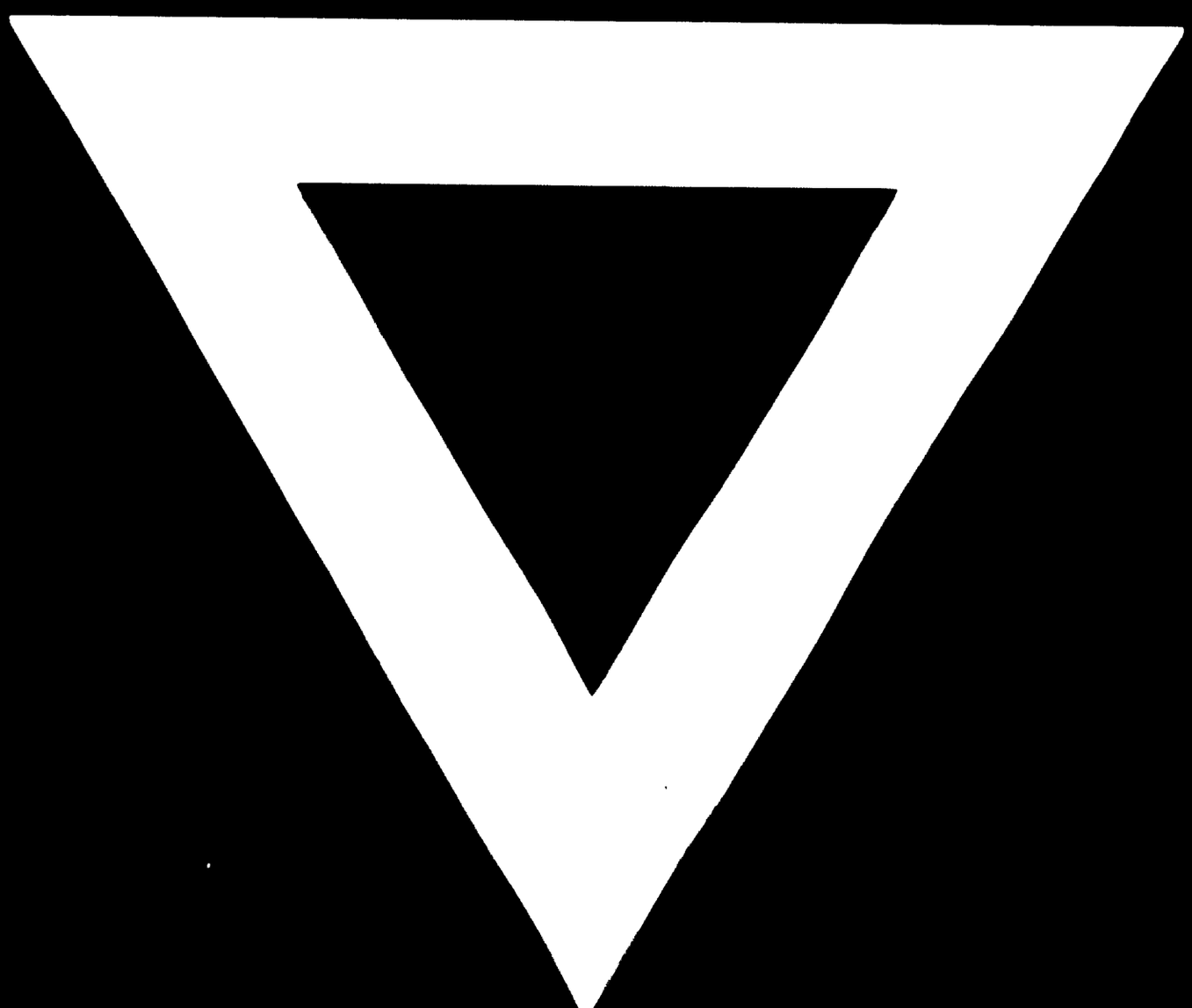

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