OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

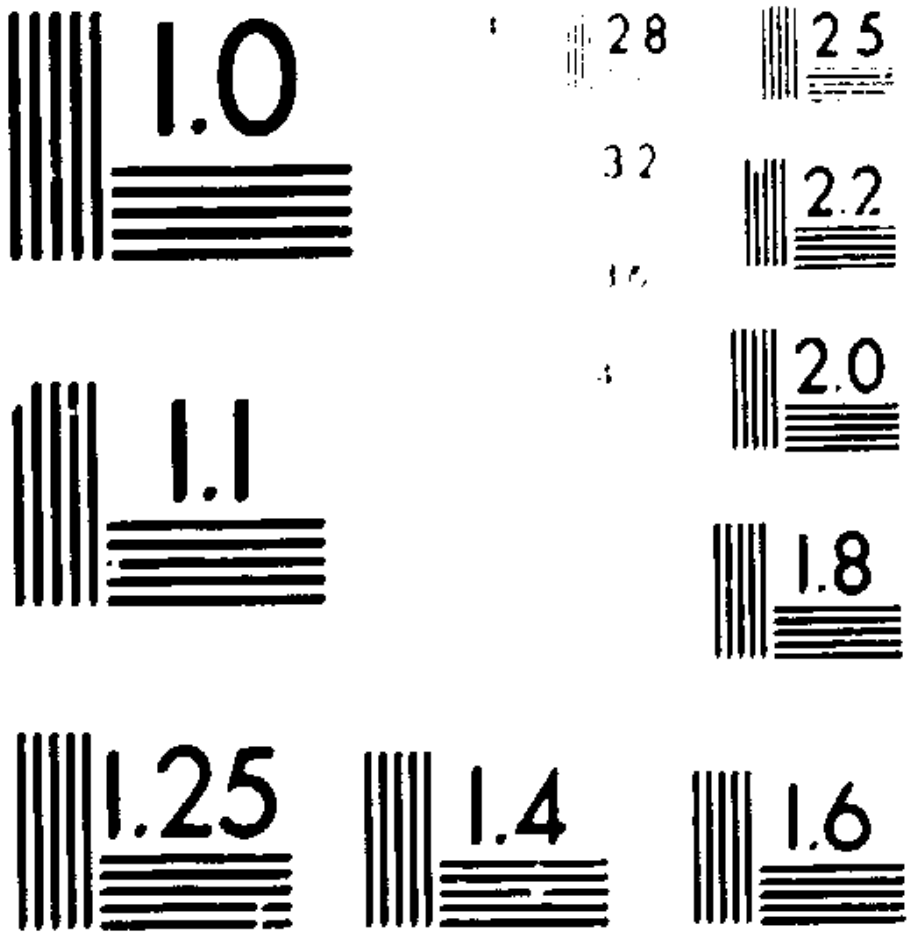
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



1985

India.

MANUFACTURE OF IMPROVED, MANUAL AND ANIMAL OPERATED AGRICULTURAL IMPLEMENTS AND MACHINERY.

A Techno-Economic Feasibility Report
on the establishment of a Model Factory

Prepared By

SOCIETY FOR DEVELOPMENT ALTERNATIVES
22, Palam Marg, Vasant Vihar,
New Delhi - 110 057.

Tel: 671989

CONTENTS

ANNEXURES

ILLUSTRATIONS

Proposal for funding of a Model Factory for Manufacture of Agricultural Implements

1. Title of the Proposal

A Model Factory for the manufacture of improved agricultural tools and machinery.

2. Institution

SOCIETY FOR DEVELOPMENT ALTERNATIVES
Registration No: 12964, Union Territory of Delhi and
*TARA ENTERPRISES.

3. Objectives of the proposed facility

To manufacture low cost improved agricultural implements and machinery, and to develop manufacturing methods which are commercially viable and *replicable.

4. Project Costs

TOTAL COST	:	*Rs. 19.5 *lakhs
- From Seed Money source (yet to be identified)	:	*Rs. 4.0 *lakhs
- From Bank Loans	:	*Rs. 15.5 *lakhs

5. Feasibility Report

Attached.

A MODEL FACILITY FOR MANUFACTURING OF IMPROVED AGRICULTURAL IMPLEMENTS & MACHINERY

1. INTRODUCTION

1.1 The quality and yield of crops depends on many factors, and not least on the climate and soil conditions under which agricultural operations are performed. Agriculture in India has always been and still is deeply affected by the vagaries of the weather. But the proper agricultural practices, combined with timely and adequate supplies of inputs like fertilizers, seed, water, pesticides and energy, and the requisite infrastructure for procuring these and marketing the produce, can help to reduce the major fluctuations in both the income of the farmer and in the nation's food availability.

1.2 Well designed tools play a central role in our efforts to get the most out of the land, and to minimise the risks and uncertainties inherent in agricultural activity. Appropriate agricultural machines and implements are necessary human aids for timely agricultural operations at every stage, from land preparation, sowing, nurturing and protection of crop, to harvesting, processing and handling of the farm produce. They are also needed to save the crops from avoidable damage and loss, and to reduce human drudgery. With good tools, the productivity of the land can be brought to a greater degree under human control.

1.3 Sustainable gains in agricultural productivity will require us to look increasingly in the future to the development of new food production techniques. From an environmental and resources management point of view, agricultural productivity is but one component in the wider problematique of generating adequate supplies of food, fuel, fibre and fodder to satisfy the needs of the people. In achieving these goals, new approaches to agricultural and food management are becoming increasingly necessary, including techniques such as genetic engineering, tissue culture, high yielding varieties, not to mention recent advances in nitrogen fixation, integrated pest management, single cell protien extraction, etc. Notwithstanding the major advances being made in these areas, traditional agriculture with incremental improvements will be the mainstay of food production for many decades to come.

1.4 A majority of the farmers of Northern India have small and marginal holdings of about 2 hectares or less. The traditional hand tools and implements, presently in operation, result in poor and delayed land preparation, inadequate use of costly inputs and delays in the critical time schedule

for sowing, harvesting and threshing, thus causing financial loss to the individual farmers and foodgrain loss to the country. Improved manually operated and bullock drawn implements, and machines and equipment using upto 5 HP. engines are in many cases the technologies appropriate to their situation.

1.5 An earlier fear that improved implements would displace farm labour and accentuate rural unemployment has proved unfounded. Improved technology introduces more intensive use of land by multiple cropping, leading to a direct creation of additional work. Moreover, carefully planned farm management usually generates newer and more interesting kinds of jobs, often considerably reducing drudgery. Provided, then, that the implements are not highly capital intensive, and are designed for use by the small farmer, they can contribute positively to the distribution of wealth in rural areas.

1.6 As shown below, there exists a large number of designs for agricultural implements incorporating significant improvements over the traditional designs. With a reasonable amount of specific development work to adapt and productionise them, they could be quickly made ready for manufacturing. The market analysis to be presented later also shows that there exists a considerable demand for such products, provided they meet the necessary design criteria.

1.7 It is also shown below that if such implements and machines are to penetrate the rural market on a large scale, they must be designed for location-specific requirements and manufactured and marketed locally. To promote the establishment of local units for this purpose, it will be necessary to demonstrate their commercial viability.

1.8 We propose, therefore, to set up a model unit to manufacture improved agricultural hand tools, manually operated implements and machinery, bullock operated agricultural implements and machinery, and agricultural machines operated on 5 HP. engines in the environs of Delhi, to cater to the agricultural machinery needs of small and marginal farmers of Western U.P., Haryana and parts of Rajasthan having alluvial soils.

2. THE ECONOMICS OF RURAL TECHNOLOGIES

2.1 Throughout the country, there is an evident and pervasive need among both rural and urban poor for a whole variety of technologies ranging from cooking stoves and agricultural implements to producer gas plants and windmills.

- Why have these needs not led to a more widespread demand?

Moreover, tens if not hundreds of designs are available for each such technology, scattered in laboratories, workshops and archives throughout the world.

- Why has the existing technical capacity not led to supply?

2.2 The answers to these two questions are complex, and interlinked. A combination of economic, social, political and cultural -- not to mention scientific, technical and institutional -- factors have greatly inhibited the supply and demand for appropriate technology. They apply, in varying mixes, to all rural technologies. The more important among these factors are:

- capital/operational costs
- efficiency of the technology
- evidence of improvement over traditional methods
- ease of operation and ergonomic design
- availability of spare parts and ancillaries
- ease of repair and maintenance
- problems of production
- adaptation to local conditions
- existence of marketing organizations
- availability of information
- promotion, training and extension services
- management skills and social organization
- social, class, political and cultural attitudes

2.3 Above all, the "appropriateness" of a technology must be measured by how well it satisfies the needs of the end client and with what success it takes advantage of the opportunities and constraints of the production and marketing processes.

2.4 Given the magnitude of the problem of disseminating a technology widely, and the limits to the public resources likely to be devoted to it, any successful delivery mechanism must be self-financing and self-supporting at each stage of the product cycle. It must pay someone to make the products, it must pay someone to sell them, it must pay someone to maintain them; and of course it must be worth someone's while to buy and use them.

2.5 If the premises listed above are accepted, several conclusions follow more or less logically:

* the innovation process must link design of the technologies much more closely to the needs of manufacturing and marketing than it has generally done in the past. No matter how efficient a design may have been shown to be in laboratory tests, or how well it is claimed to fulfil socio-economic criteria, it cannot be considered complete or acceptable until it has been productionized and field-tested

= "productionizing" requires full design specifications and blueprints: material specification taking account of local resources, skills and substitution possibilities; and tooling needed for systematic production -- all tested for the conditions under which the production is expected to take place

= "field-testing" requires detailed studies of the technology in use, accelerated life-cycle tests, and iterative re-adaptation and redesign until the technology has a demonstrated market acceptability

* widespread dissemination of appropriate rural technologies requires new types of institutional structures carrying out new kinds of functions.

* the production and marketing activities (and indeed the innovation process also) must be decentralized to be responsive to the local needs and conditions

* the product range and territorial coverage must be large enough to provide significant economies of scale in each of the three functions, innovation, manufacturing and marketing

* the methods of modern business management, appropriately adapted to the rural milieu, have much to offer in achieving the goals of mass dissemination

2.6 In other words, if technologies for agricultural, village industrial, and domestic use are to reach the masses, they must be locally available. This in turn implies that they be largely manufactured and marketed at the local level. And if they are to achieve widespread acceptance, there must be well organized and accessible after-sales servicing. Such decentralised production, marketing and maintenance facilities can only be self-sustaining and financially viable if :

i) they are supported adequately by backup systems organized for product development, innovation, technical and managerial knowhow, financing, standardisation and quality control, bulk purchasing, etc.

ii) they have a sufficiently broad range of products to spread the overhead costs and achieve economies of scale at present available only to the urban industrial enterprises.

3. TARA ENTERPRISES AND THE SOCIETY FOR DEVELOPMENT ALTERNATIVES

The proposed manufacturing facility will be a unit of Tara Enterprises, a non-profit Society engaged in the manufacturing and deli-very of rural technologies. Tara Enterprises has a close working relationship with the Society for Development Alternatives which provides a full range support of R&D, testing and design to it on a contractual basis.

In order to fulfil the conflicting requirements of decentralization on the one hand and adequate commercial viability on the other, as described above, Tara Enterprises is organized as a franchised network. This organizational structure permits localised production, marketing and maintenance by small-scale entrepreneurs (which can include, individuals, cooperatives, firms, or even companies) having contractual relationship with the franchising agency, Tara Enterprises. In this manner, the network benefits from the advantages of both the large-scale and the small-scale.

The term "Franchizing" implies a well-defined allocation of responsibilities between the network partners, and brings individual, autonomous production and marketing units under the umbrella of a common purpose, strategy and brand image.

Franchized networks also allow a much greater possiblity than do centralized institutions for the implementation of the "cooperative vision". In addition to the network, which forms a cooperative of the partner franchizees, local franchizees can be production and/or marketing cooperatives in their own right.

3.1 Range of Products of Tara Enterprises:

Tara Enterprises has a range of products in addition to agricultural implements including :

- Lamps.
- Cooking stoves.
- Hand water pumps.
- Bicycle carts for both people and goods.
- Multi-purpose hand presses for making paper, oil and other household products.
- Paper and board-making equipment for building materials and handicrafts.
- Solar water heaters.
- Solar cookers.
- Storage bins - food dispensers.
- Biogas systems to produce energy & fertilizers.

3.2 Being non-profit organizations, neither Tara Enterprises, nor the Society for Development Alternatives is in a position to have access to the normal sources of venture capital for the purposes of raising funds for its initial investments. In view of the fact that both the organizations aim at financially self-sustaining operation in the longer term, a large part of the fixed and working capital required, will be raised from commercial sources such as bank loans.

The model production facility of the type to be established under this project will provide hard empirical data on the type of machinery, skill and resources needed in making rural technologies on a financially viable basis in identifying the types of management systems needed to ensure its success. One major purpose of the project is to determine and develop methods for improving the economies of scale possible in a multi product factory in which the overheads of capital and operational expenses are spread over a variety of outputs.

3.3 In order to develop the production capacity of the franchised network, it is essential for Tara Enterprises to establish a model factory on the basis of which franchises can be negotiated for efficient and economic manufacture of agri-cultural implements and to the ultimate advantages of both franchisees and the end-client.

3.4 While the primary activity of the model production facility will be to manufacture improved agricultural implements, its spare capacity, particularly in the early stages, will be utilized for the manufacturing of other rural products of Tara Enterprises, such as Chulhas, Solar Cookers, Biogas Plant Kits, etc.

4. PRODUCTS

4.1 Agricultural operations for cultivating crops are listed in Annexure 1. As no single hand tool or implement can perform all the required agricultural operations, we propose to develop 'kits' consisting of sets of tools suitable for different levels of farmers.

4.2 Hand Tools Kit:

Marginal farmers, agricultural labourers and other workers are operating on the most meagre of land holdings, on scales varying from Ø.1 to 1 Hectare. They do not have the resources to purchase draught animals. We propose to develop a hand tool kit for such farmers to enable them to perform all agricultural operations manually. Such a tool kit will be based on local and specific requirements as well as cropping patterns. The content of the kit will be standardised according to the needs of the farmers. The kit

will contain implements to be selected from the following items :

1. Axe (hand).
2. Pickaxe.
3. Khurpi.
4. Hand Trovel - heavy duty.
5. Hand Cultivator.
6. Transplanter.
7. Rake.
8. Digging Spade.
9. Phowrah.
10. Ghamelas (Mortar Pans).
11. Sickle CIAE.
12. Dibbling Stick.
13. Singh Hand Hoe.
14. Wheel Hoe.
15. Sugar Cane Harvesting Knife.
16. Cycle Winnowers.
17. Hand Maize Sheller.
18. Potato Grader.
19. Seed Dressing Drum.
20. Grain Cleaning Device.
21. Manually Operated Chaff Cutter.
22. Hand Sprayer.
23. Hand Duster.
24. Storage Bins.
25. Watering Cans.

4.3 A Kit of Tools drawn by one Animal:

Many farmers are not able to maintain a pair of animals and sometimes only one animal is available to them. Therefore, we propose to provide a suitable tool-kit befitting the pulling capacity of the animal possessed by these farmers. Such a tool kit may also be expanded to include a Buggy (Durala design) for transport needs.

4.4 Kit of Tools and Implements drawn by a pair of Animals:

The average operational holding of about 2 hectares can be cultivated by a pair of animals. The farmer having upto 2 hectares of land still depends on draught animal power for agricultural operations. This situation is likely to continue during this century because of the large population of draught animals available in the villages, limited supply of petroleum fuel, high cost of agricultural inputs and levels of skills and technology available in the existing rural situations. We propose, therefore, to offer a menu of tools and implements both manually and animal operated, so that the farmer may select the implements and tools relevant to the crops grown and the prevailing socio-economic conditions. Such a menu of tools and implements will be selected from the following list in addition to the manually operated

hand tools and implements mentioned earlier :

1. Iron Desi Plough.
2. Care Plough.
3. Multipurpose Tool Carrier with attachments.
4. Disc Harrows.
5. Singh Petela.
6. Buck Scraper.
7. Ridger.
8. Single Row Seed-cum-Fertilizer Drill attachment to Desi Plough.
9. Automatic Seed Drill.
10. Hand Maize Planter.
11. HAU Bullock drawn Seed-cum-Fertilizer Drill.
12. Low Lift Hand Pump.
13. Animal drawn Chain-Pump.
14. 3 Tyne Cultivator.
15. Olpad Thresher.
16. Sugarcane Crusher - bullock operated.
17. Wheel Rims and Axles for bullock carts.

5. MARKET POTENTIAL

5.1 Practically all the tools and implements are at present made by local artisans using wood as the main material of fabrication. Wood is now rapidly becoming scarce and expensive, while its quality and durability are deteriorating. There is, therefore, a need to manufacture the agricultural tools and implements using alternative materials and to replace the existing tools and implements by improved ones. New tools and implements are continuously being developed by the R&D institutions and Agricultural Universities in the country. Commercial production of these new tools and implements is essential to enable farmers to reap the benefits of the latest developments in agricultural science and technology. The Government is providing substantial subsidies for popularising such improved agricultural tools and implements, under various programmes. Therefore, there is tremendous scope for marketing the improved agricultural tools and implements in the country. Moreover, in the African and South East Asian countries also, the farmers are either using manual labour or animal power on the farms. These countries do not have adequate and appropriate production facilities for improved agricultural implements and are, therefore, importing such equipment. Thus there is also a good scope for exporting equipment to such countries.

5.2 The special circumstances of marketing technologies in rural areas will be met by the franchised network of Tara Enterprises. It should be particularly noted that these circumstances impose certain requirements on the manufacturing process which will underlie the organization and activities of the proposed model factory. These include the

need to make implements and products which are of the lowest possible cost, highest possible durability and life span, maximum maintenance intervals, and generally high quality. To achieve the economies of scale required to make its products marketable, one of the most important functions of the factory will be to evolve the most appropriate mix of manual and automated manufacturing process.

For the purposes of this report no attempt has been made to present details on a comprehensive set of products. With the type of machinery installed, other desired implements can also be manufactured.

6. PRODUCTS AND THEIR USES

6.1 Plough and Plough Shares:

Ploughs are used as the primary tillage tools 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 the mouldboard. 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 the 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 of 7 to 25 cms. and widths of 10 to 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, to provide a good cut of the required depth and to minimise the need for multiple ploughing. The share is made of high carbon steel. The frog is made of cast iron. The beam is of sal wood. These ploughs give an out-turn varying from 0.3-0.4 ha. per eight hour day, depending upon the width of cut. Maintenance is simple. Since we plan to standardise all our parts, including the bolts and nuts, only a set of two spanners is required (and supplied with the equipment) for maintenance needs.

6.2 Disc Harrow:

This is a useful tillage implement used for preparing a seed-bed. In light soils, however, this can be used even for primary tillage. The bullock drawn models normally have six 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 depth respectively. A gang angling mechanism is provided for this purpose. The discs are spaced uniformly and a cast iron spacer is provided between each of them. The beam is of sal wood. A seat is provided for plowman to sit on. A set of two transport wheels is provided which will be at the top when the implement is in working position. When the implement is turned over for transport, wheels rest on ground. Disc shafts are mounted in ball bearings of bronze or cast iron, bush bearings in well protected housings. It can cover two hectares a day.

6.3 **Cultivator:**

This is a simple and useful secondary tillage tool for breaking the clods left after ploughing, stirring the soil and removing the dry weeds. It can be used as an intercultural 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, 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 holes for yoking to different animal heights. About a hectare a day can be covered with it.

6.4 **Seed Drill:**

In a single row Seed Drill model, the metering device 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.

Multi-row Drills require a pair of animals, whereas, some single row drills can be operated manually. Multi-row drills consist of a seed box which is fitted on the axle by means of brackets. Seed metering mechanisms 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 tynes in the furrows opened by furrow openers. These are of different designs like knife, boot shovels, 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 three row machine has an out turn of 1.5 ha/a day.

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 the 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. Single row seed drills, even though simpler in design and cheaper in costs may have limited efficiency.

6.5 Wheel Hoe and Hand 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. The hand hoes (without wheels) have tynes and tools according to the types of the soil and are operated with 'pull' action. These may have wooden, bamboo or iron bar handles.

6.6 Sickle:

The ancient sickle has remained the universal harvesting tool for all field and fodder crops. The traditional system in the village is to harvest the crop with the sickle and then thresh either by the bullocks or thresher. Improved sickles have specially designed wooden handles and steel blade.

6.7 Thresher:

Multicrop threshers are agricultural implements used for mechanical threshing of crops to separate grains from the straw. This quickens post harvest agricultural operation to facilitate cultivators to send their produce early to the market or to safe storage to avoid damage by untimely rains, fire or theft.

6.8 Seed Treater Winnower:

Winnowers are used by the farmers for separating the straw out of grains after the harvested stock has been threshed. These are mostly used by the farmers who thresh the crops by animals or by manually operated threshers in which the grain and straw remain mixed and have to be separated with the help of natural wind or a blower. The winnower blows the air for this purpose.

The seed treaters are used for treating the seeds against fungus and insects before storing in the bins or before sowing in the fields.

6.9 Chaff Cutter Blade:

The Chaff Cutter Blade is a tool used for cutting chaff and fodder. A pair of such blades are fitted on a chaff cutting machine which is either hand operated, power driven or bullock driven. Because of the mechanisation of farm, the use of chaff cutters is increasing day by day.

6.10 Ghamela (Mortar Pans):

Ghamelas or mortar pans are widely used all over the country for carrying hand loads of materials by human beings. There is extensive use of this item in agricultural fields for carrying agricultural inputs. Because of its daily use it gets worn out within a short period and has to be replaced quite often.

7. PRODUCTION TARGETS

Unlike other industries, the production of the various agricultural implements is not spread urformally throughout the year. The production of each implement is according to the season-wise demand and, therefore, it is essential to build up an inventory of the agricultural implements for at least 3 months to cater to the seasonal demand. The following production targets are envisaged. Other implements will be included in the production programme gradually :

S.No.	Product	Production Rate (Per Month)	Production Period
1.a	Ploughs	100 each	6 Months
b	Plough Shares		
2.a	Disc Harrow		
b	Cultivator	50 each	6 Months
c	Single Row Seed Drill		
3.	Bullock Seed Drill	100 nos.	3 Months
4.a	Wheel Hoes	250 nos.	6 Months

b	Hand Hoes	1500	nos.	
5.	Sickle	2500	nos.	6 Months
6.	Thresher	50	nos.	3 Months
7.	Winnowers and Seed Treater	10	each	3 Months
8.	Chaff Cutter Blade	1000	nos.	5 Months
9.	Ghamelas	3000	nos.	5 Months

8. PRODUCTION DETAILS AND PROCESS OF MANUFACTURE

8.1 Plough Shares:

The shares are replaceable items. There blades are made of chilled grey iron or hardened steel. Other components may be made of cast iron grade 20 or M.S. The beam and handle are made of seasoned hard wood. These components are assembled by bolts and nuts.

8.2 Disc Harrows, Cultivators, Single Row Seed Drill:

Structures of these implements are to be fabricated from angle iron. These structure members are cut on hacksaw machine according to sizes and holes are drilled in drill machines. They are then welded and assembled. Discs for the harrows are to be purchased from the market (size 18" diameter) but the plough blades are to be forged from EN.4Z Steel in the workshop, and holes made with drill machine. These are to be hardened, tempered and their edges and points ground before fitting to the cultivators. The blades are to be forged from EN.4Z Steel and drilled holes made with drill machine. These are to be hardened and tempered. Edges and points of the plough blades are to be ground before fitting to the cultivators.

8.3 Seed Drill:

The main parts of a seed drill are: Frame, Wheels, Seedbox, Fluted Wheel or Double run Feed, and Furrow Openers. The Frame is usually made of angles and reinforced at the corners. The axle is carried beneath, with the wheels on each end of it. The Seed Box is carried above, while the furrow openers are suspended below. Roller Bearings are used on each end of the axle. The Seed Box is made of sheet metal with a tight fitting lid to prevent rainwater. Inside the box, there are power driven agitator rods. Fluted wheel feed is considered to be the simplerst of the two type of feed arrangement and is generally used. It consists of feed

roll, feed cut off and adjustable gate. The feed roll turns with the shaft, forcing the grain out over the gate where it falls into the seed tune. The gate is adjustable for different type of seeds. Power is transmitted from the main axle to the feed shaft by gears or sprockets and chains. A seed tube conducts the seed from the feed into the boot from which they fall into the furrow. Furrow openers are attached to the frame of the drill by drag bars.

8.4 **Three Tyned Hand Hoe:**

The mild steel frame has its two ends spear-shaped forming two tynes by hand forging. The middle tyne is formed as a separate piece with its other end inserted into the wooden handle with a ferrule. The frame with its two tynes is welded to the middle tyne. The ferrule is fixed to the handle and rivetted. After assembly the exposed metallic parts are applied with a coat of rust preventive and the handle with varnish.

8.5 **Wheel Tyned Hand Hoe:**

The frame of this item can be made of M.S. angle by fabrication on cast iron. The wheel is made of M.S. flat with 3/8" rods forming the spokes. The wheel is attached to the front of the frame by welding and the two tynes are fitted in position to the bottom of the frame, two wooden handles are fitted to the frame at a suitable height. The metallic parts are coated with rust preventive.

8.6 **Sickles:**

The sickles are to be made from carbon steel flats 3 mm. thick and 38 mm. wide. The shape of the sickle is to be made by forging and the cutting edge is to be ground smooth and tempered and a wooden handle is then fixed.

8.7 **Thresher:**

Thresher is a rotating drum with a number of bent galvanized wire spikes fixed on its surface to hit the grains for their separation from the stem. They are available in several sizes. A shaft with ball bearing is, fitted with it for ease in rotating the drum.

8.8 **Winnowers:**

These machines are fabricated using a lathe, drilling machine and welding set, all general purpose machines which may be used for any other purpose when there is a seasonal slump in the agricultural machinery market. The major operations involved in the manufacture of these machines are, cutting the steel sections/sheets of sizes, turning shafts, boring the bearing seats, welding the parts together, fitting the parts/sub-assemblies, complete fitting

of machine and painting.

8.9 **Chaff-cutter Blades:**

The chaff cutter blades are made out of high carbon steel strips. The steel strips are cut to size and the required shape. These pieces are then taken to power press for punching out the holes. After this the pieces are put in a furnace for heat treatment. When hardened and tempered, these are ground on a grinder and polished. The blades are then packed after applying rust preventive paint.

8.10 **Ghamelas:**

The ghamelas can be manufactured by two processes. One is by pressing the blank circles under the deep drawing double action presses and the other is by hammering the blank circle to the hemispherical shape with the help of a mechanical hammer. This profile deals with the former process involving cutting the circles, forming in the press, trimming or bending the edges, degreasing the ghamelas and packing.

9. INSPECTION AND QUALITY CONTROL

Agricultural implements will be manufactured either as per standard designs available in the market or the designs developed and perfected by agricultural Institutions/Universities, of the region. It will be ensured that sections of steel used e as specified with good quality raw materials and welding rods will be used.

The ISI standards will be followed for guidance in manufacturing and testing of all items.

10. R&D FACILITIES

10.1 The principal factor responsible for the lack of success of enterprises working in the area of agricultural implements is their inability to introduce product innovations and, more particularly, to adapt their products to local needs.

10.2 Unquestionably, there is a need for adequate product innovation facility to ensure that the quality as well as cost reductions by the use of new materials are introduced into the product range at every stage. This also applies to the tooling and manufacturing equipment to be used in the factory.

10.3 For this reason, a basic R&D facility will be associated with the factory from the beginning, responsible for product

innovation and adaptation and tooling design. In addition to an initial investment (non-recurring) of Rupees Two Lakhs, the facility will require a recurring expense of approximately Rupees Two Lakhs per year. This has been included in the estimates below.

11. FINANCIAL ANALYSIS

The costs included in this analysis are based on prices of inputs in 1983-84. A provision of 20% cost escalation has to be kept for delays in commissioning the unit.

The production figures are based on 50% installed capacity utilization.

A. Land Building

			(Amount) In Rs.
- Land	:	1200 sq.mt. @ Rs. 120/sq.mt.	144,000
- Covered Area	:	400 sq.mt. @ Rs.1000/sq.m.t	400,000
- Other Expenses:			56,000
Sub-Total			**600,000**

B. Machinery and Equipment

S.No.	Shop & Equipment	Qty.	Cost (Rs.)
I)	**Raw Material Store:**		
	1. Weighing Scales	1	12,000
	2. Miscelleneous Tools	L.S.	200
	3. Storage Racks for boughtout items and Spare Parts	L.S.	5,000
	Sub-Total		**17,200**
II)	**Metal Cutting Shop:**		
	1. Hand Tools	L.S.	2,000
	2. Bench Vice	4	2,000
	3. Power Hacksaw with 1 HP Motor	2	12,000
	4. Hand lever type Shear Cutting Machine 1/4" the M.S. Sheet 10"	1	1,200
	5. Jigs Fixtures Gauges	L.S.	5,000
	6. Circle Cutting Machine Cap. 36" dia.	1	5,000
	Sub-Total		**27,200**

III)	**Machine Shop:**			
	1.	Centre Lathe 5' bed, 2 HP	1	16,000
	2.	Double ended Grinder 300 mm.	2	6,000
	3.	Double ended Hand Grinder 8' Wheel	2	3,000
	4.	Heavy Duty Lathe 7' bed	1	22,000
	5.	Slotting Machine 7-1/2"	1	7,000
		Sub-Total		**54,000**
IV)	**Drilling Shop:**			
	1.	Pillar Drilling Machine 1-1/2" 1 HP Motor and Starter	1	7,000
	2.	Portable Drill 1/2"	1	2,500
	3.	Pillar Drill Machine 1" cap.	1	5,000
		Sub-Total		**14,500**
V)	**Forging Shop:**			
	1.	Spring Hammer 100 Kg. with with 5 HP Motor	1	30,000
	2.	Blacksmith Hearth with Blower and Electric Motor	1	5,000
	3.	Hand Tools	L.S.	6,000
	4.	Blacksmith Forge with Blower and Accessories	1	3,000
	5.	Hand Press No. 12	1	3,000
	6.	Anvil	1	400
		Sub-Total		**47,400**
VI)	**Welding Shop:**			
	1.	Arc Welding Set 250 to 300 amps. with Accessories	1	5,000
	2.	Gas Welding Set with Spare Cylinders and Accessories	1	2,000
		Sub-Total		**7,000**
VII)	**Fabrication Shop:**			
	1.	Sheet metal work Hand tools	L.S.	5,000
	2.	Hand operated Sheet Bending Machine 36" x 16 SWG.	1	3,000
	3.	Hand operated Hydraulic Tube Bending Machine 1/2"x2" cap.	1	3,000
	4.	Rod Bending Fixtures to 8 SWG	1	1,500
	5.	Vertical straight column type Power Press 40 ton cap. with 5 HP Motor & std. Accessories	1	25,000
	6.	Pillar Drill Machine with 2 HP Motor & std. Accessories	1	8,000
	7.	Flexible Grinder	1	2,000
	8.	Hammer type Rivetting Machine	1	7,000
		Sub-Total		**54,500**

VIII)	**Wood Working:**			
	1. Hand Tools	L.S.		2,000
	Sub-Total			**2,000**
IX)	**Heat Treatment Shop:**			
	1. Oil Quenching Tank	1		4,000
	2. Hand Tools	L.S.		3,000
	3. Oil fired Salt Bath Heat Treatment Furnace 300 mm. dia. complete with Pyro-Meter	1		24,000
	Sub-Total			**31,000**
X)	**Assembly Shop:**			
	1. Bench Vice 2. Set of Hand Tools, Spaners Wrenches, Screw-drivers, Hammers, Pliers, Oilcan, Grease Gun, etc.	)	L.S.	10,000
	Sub-Total			**10,000**
XI)	**Paint Shop:**			
	1. Air Compressor with Spray Gun and Accessories	1		8,000
	Sub-Total			**8,000**
XII)	**Inspection Shop:**			
	1. Weighing Scales			4,000
	2. Measuring Tools, Gauges, etc.			1,000
	3. Hardness Testing Machine (Rockwell)			12,000
	Sub-Total			**17,000**
XIII)	**Marking and Packing Shop:**			
	1. Marking Tools, Templates, etc.	)	L.S.	1,000
	Sub-Total			**1,000**
XIV)	**Transport:**			
	1. Pick-up Van with Tools & Accessories	1		100,000
	2. Trolleys			2,000
	3. Hand Carts			3,000
	4. Car			90,000
	Sub-Total			**195,000**

	TOTAL COST OF MACHINERY	485,800
XV)	Installation and Erection	35,000
XVI)	Office Equipment & Workshop Furniture	20,000
XVII)	Preoperative expenses including Project Report	25,000
XVIII)	Management Consultancy	80,000
XIX)	R&D Facilities	200,000

Total Non-Recurring

A. Salaries & Wages ~~per M~~

S.No.	Designation	Nos.	Salary/Month (Rs.)
1.	Deputy General Manager (Prodn.)	1	3,000
2.	Quality Control Engineer	1	2,500
3.	Foreman	2	3,000
4.	Assistant Foreman	2	2,000
5.	Mechanics, Turners and Welders	18	16,200
6.	Helpers	18	10,800
7.	Accountant	1	1,000
8.	Office Assistant	1	800
9.	Store keeper	1	900
10.	Watchmen	2	1,000
11.	Peons	2	1,000
12.	Driver	1	600
		50	42,700
	Staff Welfare 30%		1,300
	TOTAL PER MONTH		44,000

B. Other Expenses - Per Month

		Cost (Rs.)
1.	Stationery & Postage	500
2.	Repair & Maintenance	200
3.	Transport	1,000
4.	Travelling, Advertisement	1,200
5.	Electricity & Water	1,000
6.	Telephone	300
7.	Consumable Tools	400
8.	Sales Expenses	5,000
9.	Miscellaneous	500
	TOTAL PER MONTH	10,100

C Raw Materials

Total PER ANNUM MONTH 42,000

(See Annex)

E.	**R&D Expenses (per annum)**	**200,000**

F. **Working Capital for 6 Months***

1.	Raw Materials	612,200
2.	Salaries	264,000
3.	Other Expenses	60,600
4.	R&D Expenses	100,000
	TOTAL	**1,036,800**

* Since agricultural machines have seasonal sales related to major crops i.e. Rabi & Kharif, Working Capital has been accounted for six months.

FINANCIAL ANALYSIS.

G. **Total Capital Investment**

1.	Land & Building	500,000
2.	Machinery & Equipment	485,800
3.	Installation	35,000
4.	Office Furniture	20,000
5.	Preoperative Expenses	25,000
6.	Management Consultancy	80,000
7.	R&D Facilities	200,000
8.	Working Capital for 6 months	1,036,800
	TOTAL	**2,482,600**

H. **Cost of Production (Per Annum)**

1.	Raw Materials (Annex 2)		1,224,400
2.	Salaries & Wages (Section C)		528,000
3.	Other Expenses (Section D)		121,200
4.	R&D Expenses (Section E)		200,000
5.	Interest on Capital	15%	372,400
6.	Depreciation on Machinery	10%	82,600
7.	Depreciation on Furniture	25%	5,000
8.	Depreciation on Building	5%	22,800
	TOTAL		**2,556,400**

I.	**Sales Proceeds (Per Annum)**	Qty.	Rate	Amount
1.	Ploughs	600	300	180,000
2.	Shares	600	50	30,000
3.	Disc Harrows	300	550	165,000
4.	Cultivators	300	350	105,000
5.	Seed Drill	300	130	39,000
6.	Bullock drawn Seed Drill	500	3500	1,050,000
7.	Wheel Hoes	1500	130	195,000
8.	Hand Hoes	9000	25	225,000
9.	Sickle	15000	15	225,000
10.	Thresher	150	4000	600,000
11.	Winnowers	30	800	24,000
12.	Seed Treater	30	250	7,500
13.	Chaff Cutter Blades	5000	10	50,000
14.	Ghemelas	40000	8	320,000
15.	By sale of Scrap	-	-	50,000
	TOTAL			**3,265,500**

J. **Profitability**

1. Profit before Taxes 3,265,500 - 2,556,400 = 7,09,100

2. Percentage Profit on Sales = $\frac{709,100 \times 100}{3,265,500}$ = 21.7%

3. Percentage Profit on Investment = $\frac{709,100 \times 100}{2,492,600}$ = 28.6%

K. **Breakeven Analysis**

Fixed Cost

1.	Depreciation (Total)	110,400
2.	Interest on total Capital Investment 15%	372,400
3.	40% Salaries	211,200
4.	40% Other Expenses	48,500
5.	50% R&D Expenses	100,000
	TOTAL	**842,500**

BREAKEVEN POINT: 54.3% of Projected Sales.

(i.e. of 50% capacity).

ANNEXURE 1

SEQUENCE OF AGRICULTURAL OPERATIONS

1. Seed treatment.
2. Soil treatment.
3. Land layout for seed bed.
4. Land preparation for seed bed.
   - Ploughing.
   - Harrowing.
   - Levelling.
   - Puddling (for paddy only).
5. Manuring, Sowing, Fertilizing.
6. Irrigation.
7. Weeding, Interculture.
8. Plant protection.
   - Spraying.
   - Dusting.
   - Rat control.
   - Birds control.
9. Harvesting.
10. Drying.
11. Threshing, Winnowing, Shelling.
12. Processing.
    - Crop processing.
    - Seed processing.
13. Transport.
14. Storage.

ANNEXURE 2

RAW MATERIALS

Product-wise Raw Materials requirement per month

S.No.	Raw Material	Rate (In Rs)	Ploughs & Plough Share Qty. (Kg)	Ploughs & Plough Share Cost (Rs)	Disc Harrows and Cultivators Qty.	Disc Harrows and Cultivators Cost (Rs)	Seed Drill Qty.	Seed Drill Cost (Rs)	Wheel Hoes and Hand Hoes Qty.	Wheel Hoes and Hand Hoes Cost (Rs)
1.	Castings	6/Kg.	300	1800	–	–	–	–	–	–
2.	Carbon Tool Steel	9/Kg.	700	6300	–	–	750Kg	6750	500Kg	4500
3.	M.S. Rods, Angles, Sheets, Pipes	5/Kg.	300	1500	350Kg	1750	3 Ton	15000	6 Ton	30000
4.	G.P. Sheets	7000Ton	–	–	300Kg	2100	–	–	–	–
5.	EN42 Spring Steel	10/Kg.	–	–	150Kg	1500	–	–	–	–
6.	Discs 450 Nos.	50/Ea.	–	–	450Nos	22500	–	–	–	–
7.	Sprockets, Chain, Tubing, etc.	50/ Unit	–	–	–	–	100 Units	5000	–	–
8.	Seasoned Wood	–	–	2000	–	–	–	–	–	–
9.	Wooden packing cases	–	–	200	–	–	–	–	–	–
10.	Wooden Handles	–	–	–	–	–	–	–	–	2500
11.	Bearings	–	–	–	–	–	–	–	–	–
12.	Welding Electrodes	–	–	–	–	200	–	200	–	200
13.	Quenching Oil	–	–	–	–	200	–	–	–	200
14.	Oil, Grease, Cotton Waste, etc.	–	–	–	–	50	–	50	–	50
15.	Paint	–	–	–	–	200	–	100	–	250
16.	Hard Coke	–	–	–	–	200	–	–	–	200
17.	Empty Oil barrels	80/Ea.	–	–	–	–	–	–	–	–
18.	Misc. Stores	–	–	300	–	300	–	300	–	500
19.	Furnace Oil	–	–	200	–	–	–	–	–	200
	Total	–	–	12300	–	29000	–	27400	–	38600

RAW MATERIALS

Product-wise Raw Materials requirement per month

S.No.	Raw Material	Rate (In Rs)	Sickles Qty. (Kg)	Sickles Cost (Rs)	Threshers Qty.	Threshers Cost (Rs)	Winnower and Seed Treater Qty.	Winnower and Seed Treater Cost (Rs)	Chaff Cutter Blade Qty.	Chaff Cutter Blade Cost (Rs)	Ghamelas Qty.	Ghamelas Cost (Rs)
1.	Castings	6/Kg.	–	–	–	–	–	–	–	–	–	–
2.	Carbon Tool Steel	9/Kg.	1 Ton	9000	–	–	–	–	1 Ton	9000	–	–
3.	M.S. Rods, Angles Sheets, Pipes	5/Kg.	200	1000	7 Ton	35000	500	2500	–	–	8.5	42500
4.	G.P. Sheets	7000/Ton	–	–	5 Ton	35000	2 Ton	14000	–	–	–	–
5.	EN42 Spring Steel	10/Kg.	–	–	–	–	–	–	–	–	–	–
6.	Discs 450 Nos.	50/Ea.	–	–	–	–	–	–	–	–	–	–
7.	Sprockets, Chain, Tubing, etc.	500/ Unit	–	–	–	–	–	–	–	–	–	–
8.	Seasoned Wood	–	–	–	–	–	–	–	–	–	–	–
9.	Wooden packing cases	–	–	200	–	–	–	–	–	200	–	200
10.	Wooden Handles	–	–	2500	–	–	–	–	–	–	–	–
11.	Bearings	–	–	–	–	10000	–	1000	–	–	–	–
12.	Welding Electrodes	–	–	–	–	2000	–	200	–	–	–	–
13.	Quenching Oil	–	–	200	–	–	–	–	–	200	–	–
14.	Oil, Grease, Cotton Waste, etc.	–	–	–	–	200	–	200	–	–	–	–
15.	Paint	–	–	–	–	1000	–	400	–	500	–	100
16.	Hard Coke	–	–	200	–	–	–	–	–	–	–	–
17.	Empty Oil barrels	80/Ea.	–	–	–	–	20Nos	1600	–	–	–	–
18.	Misc. Store	–	–	300	–	2000	–	500	–	–	–	–
19.	Furnace Oil	–	–	100	–	–	–	–	–	300	–	–
	Total	–	–	13500	–	85200	–	20400	–	10200	–	42000

Total Monthly Requirements of Raw Materials (In Rupees)

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Ploughs and Plough Shares	–	–	12300	12300	12300	–	–	12300	12300	12300	–	–
Disc Harrows & Cultivators	–	–	29000	29000	29000	–	–	29000	29000	29000	–	–
Seed Drill	–	–	–	–	–	–	–	27400	27400	27400	–	–
Wheel Hoe & Hand Hoe	–	–	–	38600	38600	38600	38600	–	–	38600	38600	–
Sickle	13500	–	–	–	–	13500	13500	13500	–	–	13500	13500
Thresher	85200	85200	–	–	–	–	–	–	–	–	–	85200
Winnowers & Seed Treater	–	20400	20400	20400	–	–	–	–	–	–	–	–
Chaff Cutter & Blade	–	–	10200	10200	10200	–	10200	10200	–	–	–	–
Ghamelas	–	–	42800	–	–	42800	42800	–	42800	–	42800	–
Total	98700	105600	114700	110500	90100	94900	105100	92400	111500	107300	94900	98700