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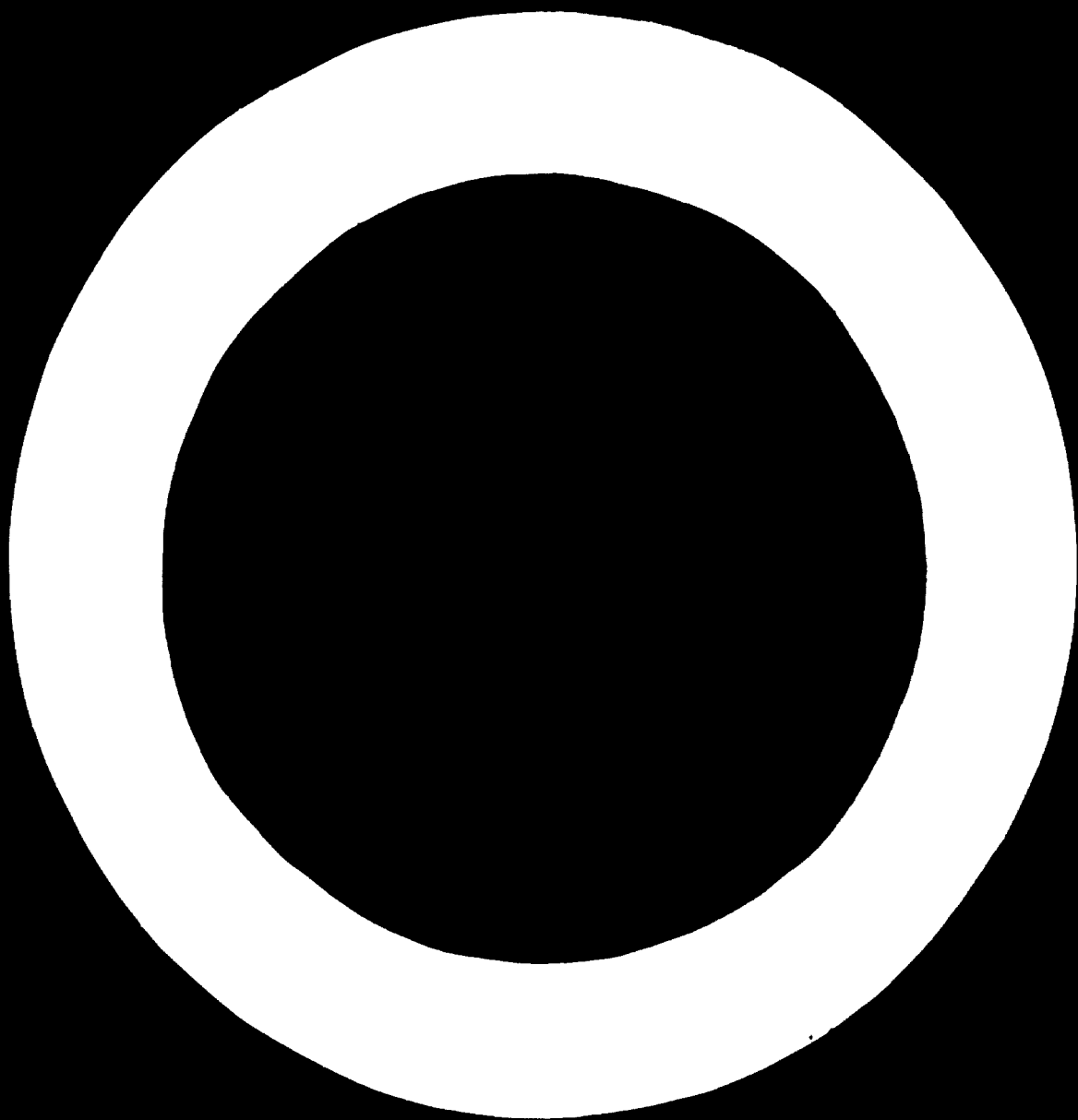
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**ANIMAL-DRAWN  
AGRICULTURAL IMPLEMENTS,  
HAND-OPERATED MACHINES  
AND  
SIMPLE POWER EQUIPMENT  
IN THE LEAST DEVELOPED  
AND OTHER  
DEVELOPING COUNTRIES.**

**Report of a Manufacturing Development Clinic**

**New Delhi, India  
21-30 October 1974 .**

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.



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Explanatory notes

CSIR	Council of Scientific and Industrial Research
FAO	Food and Agriculture Organization of the United Nations
IARI	Indian Agricultural Research Institute
ILO	International Labour Organisation
ISAE	Indian Society of Agricultural Engineers
SIDO	Small Industries Development Organization
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization

## INTRODUCTION

The Manufacturing Development Clinic on Animal-Drawn Agricultural Implements, Hand-Operated Machines and Simple Power Equipment in the Least Developed and Other Developing Countries was held at New Delhi from 21 to 30 October 1974. The Clinic was organized jointly by the United Nations Industrial Development Organization (UNIDO) and the Ministry of Agriculture, Government of India, as one of several projects to be undertaken jointly by UNIDO and the Government of India within the framework of the UNIDO-India Agreement on the Transfer of Technology signed on 12 December 1972.

There were many reasons for choosing to hold the Clinic in India. India has a number of small, medium-sized and large industries engaged in the manufacture of different types of agricultural tools, implements, machines and power equipment ranging from simple hand tools, animal-drawn implements and manually operated machines to tractors and heavy equipment. Many institutions are engaged in research, design and development, quality control, testing and entrepreneur development. Others provide extension services, including special programmes for the development of the neediest areas within the country. India has professional agricultural engineering societies, agro-industrial corporations, agricultural engineering educational institutions and other institutions concerned with agricultural tools and implements.

The general objective of the Manufacturing Development Clinic was to explore ways and means to promote the local manufacture of appropriate agricultural machinery in the least developed and other developing countries of the world. Specific objectives were:

(a) To provide opportunity for the transfer of know-how on the manufacture of simple agricultural implements from a developing country (India) to the least developed and other developing countries, since many of the least developed countries are interested in establishing small and medium-scale manufacturing units;

(b) To bring potential entrepreneurs and government officials of the least developed and other developing countries into contact with the manufacturers of simple, animal-drawn agricultural implements and manually operated tools in India to investigate the possibilities of investment promotion and joint ventures in the manufacture of selected agricultural implements;

(c) To share experience on steps that may be necessary in research, design, development and adaptation of agricultural tools and implements, as well as in manufacture, commercialization, services, maintenance and repair and training;

(d) To identify suitable agricultural implements and tools that are likely to be useful in individual developing countries and to elaborate the potential for introduction, evaluation, engineering adaptation and local manufacture of these implements;

(e) To identify areas of co-operation and co-ordination among UNIDO, the Government of India and participating countries and to formulate specific project proposals for implementation.

The Manufacturing Development Clinic was attended by 80 participants, of whom 22 came from the following countries: Bangladesh, Bhutan, Egypt, Ethiopia, Fiji, Haiti, Indonesia, Kenya, Laos, Lesotho, Malaysia, Mongolia, Nepal, Sri Lanka, Sudan, Uganda, United Republic of Tanzania and Upper Volta; and 11 participants from United Nations agencies and other international organizations: UNIDO; United Nations Development Programme (UNDP); Food and Agriculture Organization of the United Nations (FAO); International Labour Organisation (ILO); Intermediate Technology Development Group (ITDG), United Kingdom of Great Britain and Northern Ireland; and World Federation of Engineering Industries (WFEI). Officials of the Government of India (Ministry of Agriculture and Irrigation, Ministry of Industries and Civil Supplies, Ministry of Science and Technology) and of other government and research organizations such as the Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), Indian Agricultural Research Institute (IARI), Indian Standards Institution (ISI), Small Industries Development Organization (SIDO), and Directorate of Extension participated actively in the Clinic. The Clinic was also attended by 75 manufacturers of agricultural implements and tools and other commercial, banking and financial institutions in India. Some of these organizations and manufacturers displayed for sale technical journals and other publications on agricultural implements and machines. Various types of agricultural tools and implements were also exhibited.

The major emphasis of the Clinic was on the exchange of information, particularly on the potential opportunities for receiving assistance within the framework of the Co-operation among Developing Countries programme, and sharing of experience; on the formulation of follow-up projects in the countries of the participants, with special emphasis on the transfer of appropriate technology; and on drafting recommendations for specific projects for the consideration of the Governments of the participants and UNIDO.



## RECOMMENDATIONS

### A. It was recommended that the Governments of developing countries:

1. Give priority in their national plans to, and allocate funds for, promoting:

(a) The local manufacture of agricultural machinery and implements, including their design, development and testing - specifically, hand tools, animal-drawn implements, simple hand-operated agricultural machines and simple power equipment, since such implements are suitable for manufacture in rural areas;

(b) Maintenance and repair;

(c) Extension services.

2. Hold consultations with the respective resident representatives of the United Nations Development Programme in their countries regarding the inclusion of projects concerned with agricultural machinery in the UNDP country programming and also explore the possibility of securing funds from the voluntary contributions to UNIDO.

3. Explore the possibility of obtaining assistance from India.

4. Consider implementing the following projects within the framework of the programme of Co-operation among Developing Countries:

#### Bangladesh

Assistance to the Bangladesh Machine Tool Factory in product diversification, production expansion, modernization, quality control, industrial engineering services in agricultural machinery, and training of technical personnel in appropriate institutions and manufacturing concerns

Assistance to the Ministry of Agriculture for strengthening and expanding the design and development of agricultural implements, prototype fabrication, testing, extension services and industrial liaison, with special reference to animal-drawn implements, hand tools and simple equipment. Such projects may be located at Comilla and Dacca

#### Bhutan

Assistance in establishing a pilot workshop unit for the evaluation, adaptation, prototype fabrication, maintenance and repair of implements and tools, with special reference to animal-drawn implements and hand-operated tools

### Egypt

Assistance to the Tractor Testing Centre at Alexandria for product performance and evaluation, standardization of testing procedures and expansion of the facilities for the design, development, prototype fabrication of appropriate power implements and tools and expansion of extension services

Short-term training for mechanics and similar personnel in maintenance

### Ethiopia

Establishment of an engineering design and development centre providing extension services and having workshop facilities for the design, development, prototype fabrication, maintenance and repair of hand-operated and animal-drawn implements and equipment and co-operating with the appropriate local agencies

Assistance in establishing rural workshops for fabrication of small implements and for maintenance and repair services

Short-term training of technical personnel

### Fiji

Assistance to the proposed technical centre at Ba in the design and development of agricultural implements and in industrial liaison, including plans for future expansion and provision for training personnel in maintenance

### Haiti

Establishment of a pilot demonstration unit providing extension services and having workshop facilities for prototype fabrication, design and development of implements, product evaluation, maintenance and repair, and training

### Indonesia

Strengthening of facilities of Metalworking Industry Department Centre (MIDC) in the design and development of agricultural machinery, implements and equipment, and industrial liaison with emphasis on local manufacture

Strengthening the facilities of the Agricultural Machinery Institute in the evaluation of product performance

Assistance in the realization of the Government's plans to establish hiring stations for tractors and agricultural equipment with a stationary workshop and mobile units for maintenance and repair

**Laos**

Strengthening of the existing facilities for prototype production and introduction of integrated activities in machinery design and development, fabrication, spare parts manufacture and extension services

**Lesotho**

Establishment of a pilot demonstration unit with workshop facilities for prototype fabrication, spare parts fabrication, and design and development of agricultural machinery and implements

Strengthening of Tractor Service Unit to enable it to include maintenance and repair work

Long and short-term training programmes in agricultural engineering

**Malaysia**

Assistance to the Farmers' Organization Authority in establishing 10 rural workshops for maintenance, repair and training

Assistance to the Department of Agriculture in strengthening design and development, prototype fabrication, product performance evaluation of agricultural implements and equipment and extension services in co-operation with the Agricultural Research and Development Institute and National Industrial Research Development Organization

Investment promotion: manufacturing feasibility study on the establishment of a plant manufacturing hand tools and garden tools

Preparation of a report on seed processing, storage and distribution on a national basis

**Nepal**

Assistance to the Birganj Agricultural Tools Factory in product diversification, production expansion (pumps, threshers, tractor implements, spare parts) and training

Assistance to the Ministry of Agriculture in strengthening the existing facilities for design development, product performance evaluation, prototype fabrication, maintenance and repair and extension services

**Sri Lanka**

Assistance to the State Hardware Corporation in product diversification, production expansion, training in production technology and industrial engineering services

Assistance to Ministry of Planning and Ministry of Agriculture in setting up rural workshops for the production of simple agricultural tools and equipment combined with integrated design, development and prototype fabrication and rural facilities for maintenance and repair

Sudan

Expansion of existing Mechanical Engineering Workshop and Foundry (a UNIDO-assisted project) in manufacture of agricultural hand tools, crop-protection equipment; introduction of a design development and prototype fabrication section; and expansion of product performance analysis, maintenance and repair and extension facilities

Uganda

Supplementary assistance to TESCO Union low-cost farm equipment manufacturing unit (UNDP/UNIDO-assisted programme project) for expansion of workshop facilities and industrial engineering services

Assistance to the Ministry of Agriculture and Animal Resources in establishing a unit for design and development and small rural workshops with facilities for expansion; strengthening the activities of these workshops in prototype fabrication, product performance evaluation, and maintenance and repair; and in sending technical personnel abroad for training

United Republic of Tanzania

Assistance to the Ubungo Farm Implements Factory in product diversification, product technology, industrial engineering services and product expansion

Assistance to Tanzania Agriculture Machinery Testing Unit (TAMTU) in design, development, testing and standardization and training of personnel

Assistance in the establishment of rural workshops for manufacture of small implements, extension and strengthening of maintenance and repair services of the Ministry of Agriculture

Upper Volta

Establishment of pilot demonstration unit with workshop facilities for manufacture of prototypes, fabrication of spare parts, maintenance, design and development in co-operation with appropriate local government and other agencies (Agricultural Research Institute, CNPAR, OPEU)

B. It was recommended that UNIDO:

General

1. Provide assistance in the field of agricultural machinery in the first instance to projects that would:

- Benefit the least developed countries
- Promote co-operation among developing countries
- Provide for transfer of technology
- Promote investment

2. Initiate projects, to be financed from voluntary contributions, to establish central stationary workshops and mobile units for maintenance and repair of agricultural machinery at the request of developing countries.

3. Provide short-term experts (3-6 months) under the Special Industrial Services programme to assist in an evaluation of sample agricultural tools that may be procured from various countries; to work out engineering adaptation techniques; and to recommend manufacturing potential.

4. Assist in promoting investment-oriented programmes and joint ventures that may result from the contacts established between the participants from other developing countries and Indian manufacturers; such assistance might be provided under the programme of Co-operation among Developing Countries.

5. Make available for technical assistance projects experts drawn largely from developing countries.

Regional project

6. Organize similar clinics in other regions of the world, especially in the French-speaking countries of Africa.

Interregional projects

7. Organize an in-plant training programme relating to agricultural implements and machines, to be held in India, preferably during the last quarter of 1975.

8. Send an expert to several developing countries in 1976 to establish priority areas and criteria for a technology transfer project.

9. Initiate an integrated, comprehensive training programme for the period 1977-1981 in the field of agricultural machinery and implements (technology transfer project). The programme, to consist of refresher courses, should cover design and development, testing, manufacturing, marketing, maintenance, agro-industrial extension services, rural credit and finances, government planning and management. Such a programme should emphasize co-operation among developing countries and co-operation among similar institutions.

Global project

10. Commission, in 1975, a technical study on the establishment of a bio-gas plant that would serve as the basis of a global project in this field.

11. Initiate a global project concerned with the installation of standard bio-gas plants in selected rural areas on a pilot basis and installation of bio-gas plants of different sizes in various countries as an extended activity that would be carried out over the period 1977-1981. The project should also include research, provision of extension services and training of personnel.

C. It was recommended that, in 1975, the Government of India:

1. Consider ways and means of supplying to other developing countries engineering drawings, designs, standards and allied technical literature, test reports etc. on implements and equipment identified and selected by participants at the Clinic as useful for their countries.

2. Establish a panel to investigate possible supply of samples of implements and related technical information on a package basis to other developing countries.

3. Establish a panel to investigate available facilities in India in qualitative and quantitative terms to serve as a basis for an interregional training programme (technology transfer).

## I. ORGANIZATION OF THE CLINIC

The Clinic was opened by the Minister of Agriculture and Irrigation, Jagjivan Ram, who, in welcoming the participants, expressed the Government of India's readiness to initiate co-operative programmes in the field of agricultural implements. He pointed out that India had made considerable progress in the manufacture of agricultural implements and machinery and that the industry had an important place in the Indian economy. India was willing to share the experience it had gained with other countries so that they could avoid the pitfalls India had faced. On behalf of the Government, he stated:

"We shall be glad to train students, technicians and engineers from other countries, and if necessary, arrange special courses at some of our specialized institutions to meet their special needs. We shall also be happy to make available services of experts to other countries to help in the preparation of project reports and also for execution of the projects."

In his message to the Clinic, the Executive Director of UNIDO, I. H. Abdel-Rahman, expressed the hope that the discussions during the Clinic would lead to the undertaking of specific activities.

The work of the Clinic was carried out in the following sessions:

<u>Session</u>	<u>Number</u>
Technical	5
Exhibition and demonstration	4
Factory visits	2
Project identification and formulation	3
Business	3

## II. SESSIONS OF THE CLINIC

### Technical sessions

#### Summary of country papers

A participant from each of the 18 developing countries represented at the Clinic presented a paper describing the current status of the agricultural implements and machinery industry and the industry's future prospects for development in his country. Emphasis was given to problems that might require technical assistance from United Nations agencies, especially from UNIDO. The country papers also discussed various aspects of agricultural mechanization, the present and future demand for agricultural implements, government plans for local manufacture together with design and development and repair and maintenance programmes. The country papers also suggested specific areas for further discussion at the Clinic with a view to developing co-operative follow-up activities. Common problems that were touched on in many papers are summarized below.

During the past few years, changing agricultural patterns have created a demand for industrial inputs for agriculture. Thus, in the immediate future, the development of the agricultural sector will depend to a large extent on the availability of supplies from the industrial sector. Conversely, the development of the industrial sector, particularly the engineering and metal-working sector, including the metallurgical sector, can also benefit to a large extent from agricultural growth. Agricultural machinery and implements are an important industrial input. The agricultural machinery industry offers a wide choice of technologies appropriate to the level of farm mechanization and industrialization in the developing countries.

In considering the requirements for industrial development of the countries of the third world, the "technology gap" among the developing countries should be taken into account. Therefore, it is not desirable to group all developing countries into one category. Rather, they should be divided into three categories: least developed, intermediate developed and more developed.

A number of least developed and intermediate developing countries are interested in establishing small and medium-scale manufacturing units. Improved implements and simple machines are urgently needed in these countries,



and they could be manufactured locally. However, the main problem is the lack of knowledge about appropriate products, adaptation techniques and methods of manufacture. Therefore, there is a need to secure the co-operation of other countries that have successfully acquired such knowledge and are capable of transferring such technology. Pilot demonstration projects could be established in the least developed and intermediate developing countries, with emphasis on:

Introduction of appropriate agricultural implements

Product performance and consumer acceptance evaluation

Engineering research, design, development and adaptation

Local manufacture, using appropriate production techniques, local raw materials and introducing inventory control, cost and quality control methods

Maintenance and repair

Marketing, service and spare parts supply, extension services

Training of local technical personnel, financial managers and operational managers

#### Papers presented by the Indian experts

The papers presented by the Indian experts described the work done in India to promote agricultural machinery and implements and plans of the Government to initiate co-operative programmes with other developing countries. During the discussion, the participants identified specific areas in which they were interested and also recommended specific action to be taken to implement identified projects co-operatively in the future. The papers are listed below.

Agricultural engineering education in India

B. S. Pathak, Dean, College of Agricultural Engineering, Punjab  
Agricultural University

Research and development of farm implements and machinery in India

C. S. Sridharan, Assistant Director General, Indian Council  
of Agricultural Research

Testing of agricultural machinery and training of personnel in India

P. N. Pangotra, Director, Tractor Training and Testing Station, Budni,  
Ministry of Agriculture

Standardisation of agricultural machinery: experiences of India

Hari Bhagwan and R. N. Sharma, Indian Standard Institution, New Delhi

Agricultural engineering institutions and professional societies  
in India

J. S. Bali, Joint Commissioner (Soil Conservation),  
Ministry of Agriculture

Extension methods and techniques to motivate farmers for adoption of improved agricultural implements

G. S. Baweja, Director, Extension Training, Department of Agriculture

Machinery for the manufacture of agricultural implements and machinery  
Satish Chandra, Development Officer, Director General of Technical Development

Integrated services through agro-industries corporations

J. C. Verma, Joint Commissioner (Agro Industries), Ministry of Agriculture

Technology transfer in agricultural machinery in developing countries

J. C. Srivastava, CSIR

Farm mechanisation in various stages of mechanisation

S. C. Roy, Head, Division of Agricultural Engineering, Indian Agricultural Research Institute

#### Exhibition and field demonstration sessions

One of the most important features of the Clinic was the participation of manufacturers and research institutions in the exhibition and practical field demonstration of improved agricultural tools, implements and machinery. Fifty manufacturers and organizations participated in the exhibition and field demonstration sessions, which covered two full days of the Clinic. During these sessions, the participants established preliminary contacts with the manufacturers and institutions that had exhibited their products and services.

A. P. Shinde, Minister of State for Agriculture and Irrigation, emphasized that greater attention would have to be given to animal-driven and manually operated implements and hand tools in view of the high price and scarcity of fuel. It was important that newly designed implements be standardized with the assistance of the National Standards Institution and the International Organization for Standardization.

He stressed that the Clinic was a means of speeding up the transfer of technology, which usually took place between countries through the established channels of trade, commerce and educational institutions, a rather slow process.

The categories of agricultural tools, implements and machinery exhibited by the manufacturers, agro-industry corporations and the concerned institutions are listed in annex I.

During the field demonstration sessions, hand-operated machines, animal-drawn implements, and tractors and power-driven equipment were shown in operation in the field. A bio-gas plant, poultry equipment, seed-processing

and bag-stitching machines were similarly demonstrated. These demonstrations gave the participants an opportunity to see for themselves how the implements worked, to compare them and to identify the types that were likely to be useful in their own countries. The participants, in consultation with the manufacturers, UNIDO consultants and Indian experts, selected hand tools, animal-drawn implements, hand-operated machinery, simple power equipment and other items that could be introduced into their countries, taking into account product performance, acceptability, and possibilities for engineering adaptation and local manufacture. The participants indicated their specific requirements in a special questionnaire prepared by the Clinic authorities. This questionnaire formed the basis for drawing up projects during the project identification session for follow-up activities in each country.

The participants discussed ways in which India might share its experience in the field of agricultural machinery and implements with other developing countries. It was felt that each of the developing countries should be provided with 10 samples of each of the implements and 3-5 samples of each of the machines that the participants had identified as being of potential use in their countries, together with ISI standards and technical literature. It was suggested that the Government of India might set up a panel to select the best implements of the types identified by the participants and might supply them to the other countries on a package basis.

On the basis of the preliminary contacts established at the Clinic, the participants felt that there was a need to promote visits of Indian manufacturers to other developing countries and visits of government officials in these countries to the appropriate units in India. It was also felt that the Governments of other developing countries might wish to send technicians to factories in India for four to six months' training. It was suggested that such a comprehensive programme could be organized under the Co-operation among Developing Countries financial scheme.

#### Visits to factories

The participants visited four manufacturing units, of which two were small units engaged in manufacturing improved animal-drawn implements and hand-operated machines. The third was a medium-scale unit manufacturing quality hand tools, and the fourth was a large unit manufacturing tractors

and power equipment. The participants observed the various aspects of production technology, quality control and technical training.

The participants expressed keen interest in the technical and managerial aspects of the small units visited. These units, in addition to manufacturing specific animal-drawn implements, also manufactured selected components as subcontractors to larger units manufacturing tractor and power machinery. The small units used simple machine tools, simple jigs, fixtures and dies. Production technology was labour intensive but economic. Local materials were used. Management placed emphasis on achieving the required physical and performance characteristics. In addition to these major points, the participants studied quality control and standardization and managerial aspects.

The participants also showed interest in the operational aspects of the third plant visited. The process planning, use of general-purpose machine tools and several simple machines were noted by the participants. The various aspects of quality control were studied in detail.

The fourth factory, which manufactured tractors, tractor-drawn implements and construction and industrial attachments, gave the participants an opportunity to observe the technical and operational aspects of a large industrial unit. The research and development, quality and cost control, and procurement of components through subcontracting with small and medium-sized manufacturers were of interest to the participants.

Thus, the factory visits gave the participants an opportunity to acquaint themselves with various aspects of manufacturing such as level of production; application of appropriate production technology; use of general-purpose machine tools; development of appropriate jigs, fixtures and dies; optimum employment of labour; cost and quality control; and training of local personnel.

#### Project identification and formulation sessions

During the project identification and formulation sessions, the participants were divided into four groups, each of which met with a panel consisting of a UNIDO consultant, Indian officials and representatives of manufacturers, to discuss the general requirements of their countries and also the areas

offering possibilities for a specific follow-up programme of co-operative activities. The panel members were able to assist the participants in filling out a comprehensive questionnaire that had been distributed in advance. They were also able to discuss questions individually with the participants.

Each participant identified specific areas in which assistance from United Nations agencies and in particular from UNIDO was urgently needed. These areas included pilot programmes in design and development, local manufacture, maintenance and repair; training; and investment promotion for local manufacture.

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

The organizations proposed for participation in a follow-up programme are listed in annex II.

#### Business sessions

During the business sessions, the participants held detailed discussions with manufacturers on product specifications, performance data, field evaluation and test reports, and other related commercial and technical aspects of equipment. They also established contacts for future commercial negotiations and possible collaboration. They discussed the requirements of each country and possible co-operative programmes to be undertaken on an international or interregional basis in product identification, introduction of new items of equipment; dissemination of information; design, development, and testing; training of users; development of prototypes; rural industrialization; and promotion of entrepreneurship. Special emphasis was placed on co-operation among developing countries.

Observers from United Nations agencies and other international organizations also presented their views. The representative of UNDP explained UNDP procedures for requesting technical assistance and described the various aspects of country programming. He explained the procedure for carrying out regional, interregional and global projects. He described UNDP support for specific projects concerned with agricultural implements, technology transfer

and development of local expertise in manufacturing. The ILO representative presented a summary of a paper entitled "Some organisational aspects and production and use of farm equipment and implements". It stressed the importance of local manufacture at a technological level appropriate to the circumstances of the country. The representative from ITDG described the work of his organization and stressed the need for integrated efforts to collect and disseminate information on improved agricultural tools, implements and machines that have been successfully used and manufactured in several developing countries. The observers from Kenya (Rockefeller Foundation, University of Nairobi and National Christian Council of Kenya) stressed the importance of clinics similar to the present Clinic and the need for future co-operation among developing countries.

The discussion centred on a follow-up programme for each of the participating countries. Such a follow-up programme was to include dissemination of information, sharing of experience, training, expansion of existing industries, establishment of new units, promotion of engineering design capabilities and expansion of maintenance and repair facilities.

#### Fields in which India could provide assistance

The participants discussed ways in which India could assist other developing countries by sharing with them its experience in the fields described below.

##### Agricultural engineering education

The 10 universities in India offering agricultural engineering degrees could introduce industry-oriented refresher courses for participants from other developing countries.

##### Research and development

In co-operation with SIDO, manufacturers, research and development institutions, an integrated programme for the transfer of technology concerning farm implements and machinery to other developing countries could be initiated. This would mean provision of engineering drawings with engineering and materials specifications, templates, simple jigs, fixtures, dies, moulds, prototype agricultural

machinery and implements to other developing countries. In this connexion, a specific programme could be established in which national research and development corporations and research institutions of other developing countries would co-operate with similar institutions in India under the auspices of a co-ordinating agency receiving international support.

#### Testing

In view of the facilities and programmes for testing agricultural machinery and implements available at Bundi, Hissar and at other institutions in India, there is considerable scope for training engineers from other developing countries in testing. In addition, a co-operative programme for establishing national agricultural machinery testing stations in other developing countries could be set up. Such a programme would include making available testing procedures, codes and equipment; providing experts; and organizing training programmes at the field and laboratory levels.

#### Agricultural machinery extension services

A training programme concerned with community development and agricultural machinery extension services could be set up in India for technical personnel of other developing countries.

#### Standardization

ISI has done considerable work in evolving standards for agricultural machinery and implements, test codes and an integrated quality control system with guidelines for manufacturers. It could assist developing countries in (a) establishing an agricultural machinery and implements standards section in their national standard institutions, where they exist; (b) making available ISI standards to relevant institutions in other developing countries; and (c) developing an integrated programme for standardization and quality control.

#### Agro-industrial corporations

To make available all industrial inputs for agriculture as well as credit and extension services, the Government of India, together with State Governments, has formed 17 agro-industrial corporations. In view of the need for

developing countries to establish agencies for making available all inputs through a single channel, the agro-industrial corporations in India should co-operate with similar institutions in other developing countries.

#### Manufacturing techniques and workshop facilities

India produces several basic machine tools required for industrial purposes, including those for the manufacture of agricultural tools and implements and inspection and testing equipment. Information on techniques used in the manufacture of these tools should be disseminated among developing countries.

#### Agricultural engineering societies

Taking into account the work done by the Indian Society of Agricultural Engineers (ISAE) and the need in developing countries to establish agricultural engineering professional societies, a co-operative programme could be established between ISAE and similar societies in other developing countries. ISAE could invite members from other agricultural engineering societies to attend ISAE conferences. An international society of agricultural engineers in developing countries could also be established. ISAE could initiate action in this respect in consultation with the Government of India and UNIDO.

#### Transfer of technology

An international technology transfer centre for the transfer of technology concerned with agricultural machinery should be established to provide drawings, designs, prototypes, industrial engineering services and manufacturing promotion services.

#### Maintenance and repair centres

A co-operative programme to establish maintenance and repair centres, tractor and agricultural equipment hiring stations, workshops and mobile units, spare parts manufacture and training should be initiated between India and other countries.



Annex I

LIST OF AGRICULTURAL TOOLS, IMPLEMENTS AND MACHINERY

A. Exhibited at clinic

Hand tools

Spades; shovels; pickaxes; steel baskets; rakes; hoes; weeders; sickles and grader tools.

Hand-operated machinery

Hand pumps; dusters; sprayers; maize shellers; groundnut decorticators; foot-operated threshers; seed treaters; chaff cutters.

Animal-drawn equipment

Mould-board ploughs, cultivators; harrows; ridgers; seed drills with fertilizer distributors; planters with fertilizer distributors; toolbars; levellers; harrow threshers; yokes.

Power machinery

Automotive units: rubber wheel riding tractors - 15-25 hp, 25-45 hp, 45-65 hp; power tillers - 5-10 hp.

Irrigation equipment: pump - centrifugal, volume type; turbine/submersible 6-12 in.; low head pumps; sprinkler irrigation units.

Diesel engines: 5-15 hp, 12-30 hp, above 30 hp.

Petrol engines: 1-2 hp, 2-5 hp, 5-15 hp.

Agricultural implements and equipment (tractor-drawn)

Tillage equipment: mould-board ploughs; disc ploughs; cultivators; ridgers; harrows; subsoilers; post-hole diggers; levellers; land planers.

Seeding and fertilizer equipment: seed/fertilizer drills; planter/fertilizer distributors; special fertilizer applicators; special crop-planting equipment.

Plant-protection equipment

Dusters; sprayers; low-volume sprayers; knapsack, boom-type sprayers.

Processing equipment

Seed cleaners; seed treaters; grain driers; shellers and huskers; milling equipment.

Grain-handling equipment: grain bins; blowers; driers; bag-closing machines.

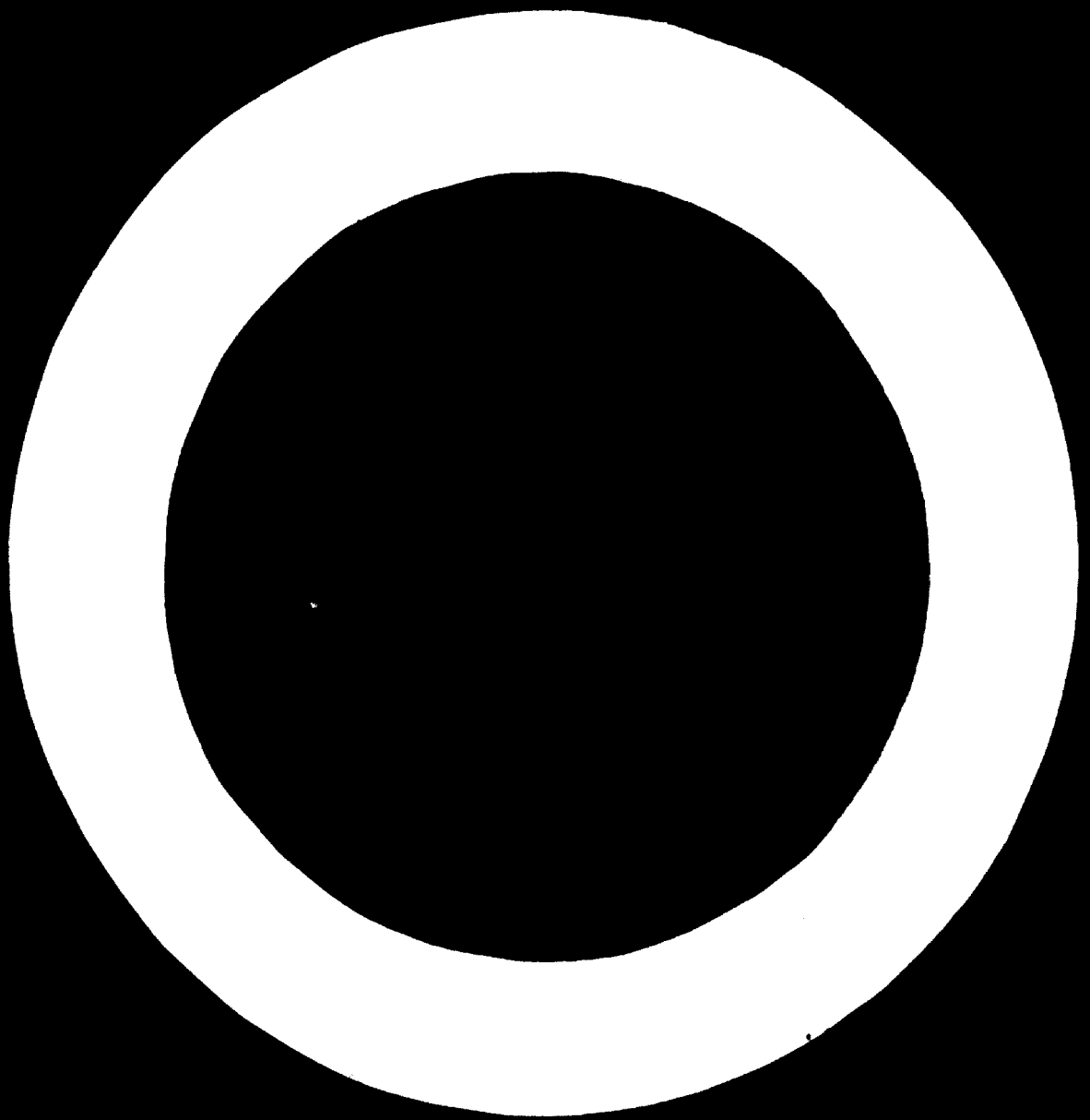
Transport equipment: trailers; transport boxes.

Other items: dozer attachments; loader attachments; poultry equipment; bio-gas plants and dairy equipment.

B. Identified by participants from developing countries as items with potential for local introduction, engineering adaptation and local manufacture

Bangladesh	Rajasthan plough (for hand soil); three-tined cultivator/toolbar; power tiller (Krishi); hand sprayer (ASPEE BARPAK) hand seed drill-cum-wheel hoe; rotary paddy weeder (ASPEE).
Bhutan	Mould-board plough (animal drawn); maize sheller (power and manual); paddy and wheat thresher (power); mould-board plough, bottom mould plough, cultivator, disc (tractor driven); sprayer and dusters (Marut); clod crusher (animal drawn).
Egypt	Mould-board plough (tractor drawn); disc plough (tractor drawn); cultivator, heavy type (tractor drawn); tiller (tractor drawn); seed-cum-fertilizer drill (tractor drawn); leveller or grader (tractor drawn); trailer (tractor drawn); seed-processing machines; power wheat threshers; power sprayers.
Ethiopia	Thresher; seed-cum-fertilizer drill; mould-board plough, toolbar type; sprayer and dusters; gas producers; bund former; ridger; disc harrow.
Fiji	Seed drill-cum-fertilizer (hand and animal drawn).
Haiti	Mould-board ploughs (animal drawn); mould-board harrows (animal drawn); cultivators (animal drawn); land levellers (animal drawn); corn storage facilities (storage bins); power tiller; small plant protection equipment; peanut sheller; maize sheller; bio-gas plant; circular chaff-cutter; sugar-cane crushers; corn planters; nagairi yoke.

- Indonesia**      Animal-drawn puddler; chaffcutter (hand and power); animal-drawn fertilizer-cum-seed drill; bag closer (power).
- Kenya**          Disc harrow (ox-driven); maize shellers; wheat threshers; ridgers; mould-board ploughs; bund formers; soil scoops; leveller with prongs; seed-cum-fertilizer drill; dusters; sprayer; power tiller; chaffcutter; bio-gas plant.
- Laos**            Wheel hoe with all attachments including seed drills (duster orient type); sprayers (manual multitype); Singh hand hoe; three-pronged hand hoe; levelling blade with prongs and four feet long; soil scoop, small size; three-pronged cultivator; light mould-board plough; light ridger plough.
- Lesotho**        Wheat planter (3 and 8 rows); disc (6) harrow; power tiller (T4K) with implements; wheat- and rice-threshing machine (power) (UT40 and 90).
- Malaysia**      Power tillers; power paddy thresher; seed-cleaning machines; seed-treating machines; maize sheller; groundnut decorticator; groundnut digger; paddy thresher; hand tools.
- Nepal**          Power wheat thresher (UT90); tractor drawn implements (disc harrow, cultivator); centrifugal pumps-cum-diesel engine; plant-protection sprayers.
- Sri Lanka**     Mould-board plough (animal drawn); disc harrows; digging forks; tiller blades; power threshers; power spray.
- Sudan**          Spades; shovels; shears; axes; rakes; wheel hoe with attachments; pickaxe; digging fork; Singh hand hoe; Sharma hand hoe.
- Uganda**        Seed-cum-fertilizer drill; knapsack sprayer, hand rotary duster; hand compression duster, paddy thresher; paddy winnower; groundnut decorticator; wheat paddy thresher; bullock-drawn disc harrow; seed cleaner; maize sheller; three-pronged hoe; bladed hoe; wheel hoe with attachments; ox-weeder.
- United Republic of Tanzania**      Power wheat threshers; seed-cum-fertilizer drill (IARI type); toolbar (Krishi Seva); mould-board plough (IARI type); sprayers (manually operated); dusters (manually operated); bund formers; bio-gas plant; disc harrow; ridger plough.
- Upper Volta**    Shellers; threshers; sprayers (manual); dusters (manual); disc harrows; poultry equipment; hand pump; animal ploughs; sprinklers; shovels; pickaxes; cultivators.



Annex II

ORGANIZATIONS PROPOSED FOR PARTICIPATION IN FOLLOW-UP  
ACTIVITIES IN EACH COUNTRY

Bangladesh	Bangladesh Machine Tool Factory Joydevpur, District Dacca
Bhutan	Directorate of Agriculture Ministry of Development Royal Government of Bhutan, Thimpu
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
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, Jakarta Metal Industry Development Centre P.O. Box 113, Bandung
Kenya	Agricultural Faculty, University of Nairobi
Laos	LAO-Commercial Industry 117, Phone Kheng Road, Vientiane Ministry of Planning and Co-operation
Lesotho	Thaba Bosiu Project Private Bag, Maseru
Malaysia	Farmers Organisation Authority, No.6 Jalan 21/30, Petaling Jaya, Kuala Lumpur
Nepal	Agricultural Tools Factory Ltd, Birganj
Sri Lanka	State Hardware Corporation 9, 47th Lane A, Wellawatte, Colombo-6
Sudan	Ministry of Industry and Mining P.O. Box 2184, Khartoum



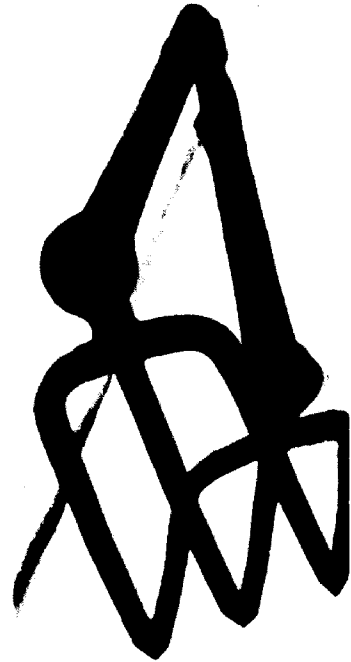
Annex III

PHOTOGRAPHS OF SELECTED AGRICULTURAL TOOLS, IMPLEMENTS, AND  
MACHINES EXHIBITED AND DEMONSTRATED AT THE CLINIC

(1) Hand tools and manually operated implements



1.1 Pickaxe



1.2 Digging fork



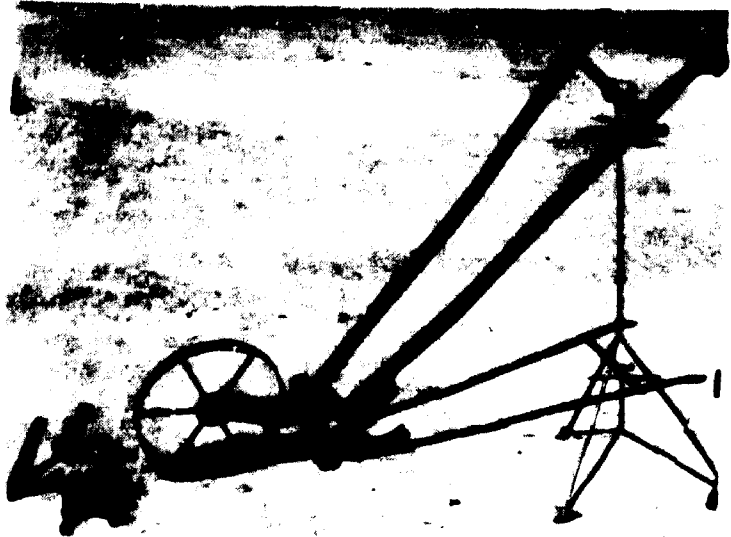
1.3 Bladed hand hoe



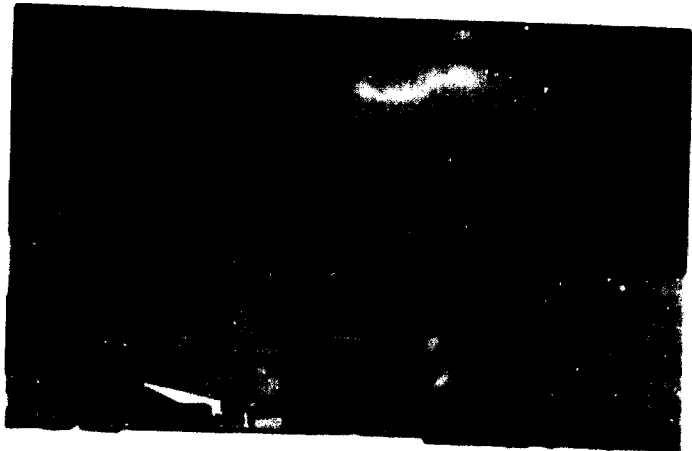
1.4 Three-pronged hand hoe



1.5 A set of garden tools



1.6 Wheel hoe with attachments

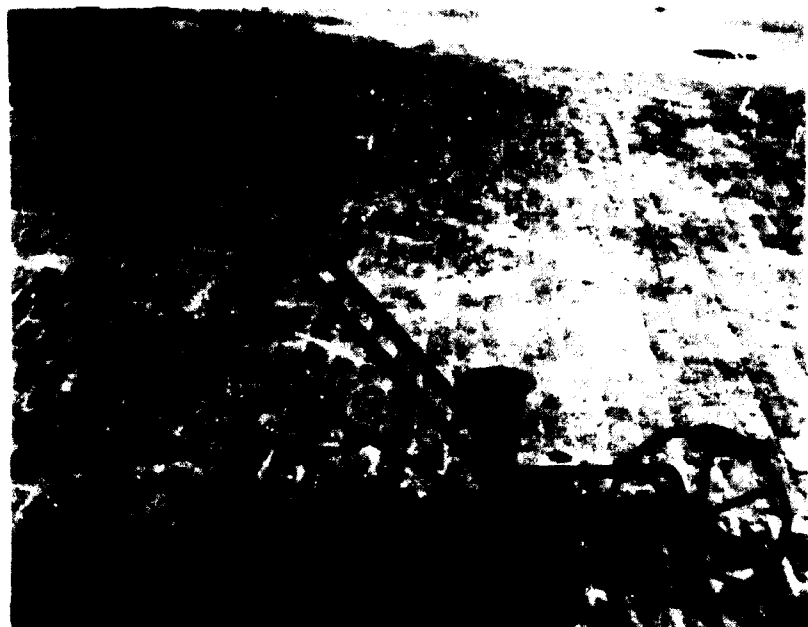


1.7 Back-pack sprayer





1.8.a Rotary weeder



1.9 Hand-operated seed drill



1.8.b Hand weeder,  
different types



1.10 Hand-operated chaff or  
fodder cutter



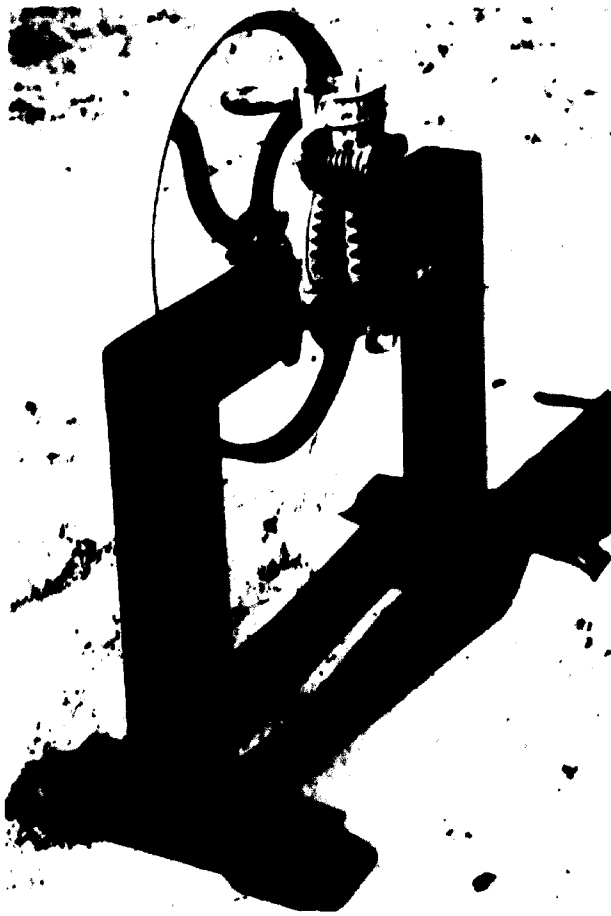
1.11 Hand-operated groundnut  
sheller



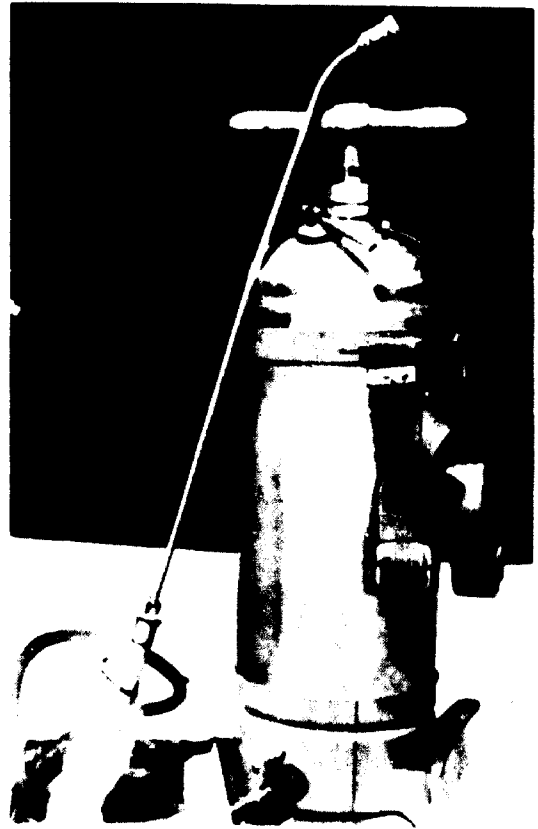
1.12 Knapsack sprayer



1.13 Side-pack sprayer



1.11 Hand-operated maize sheller

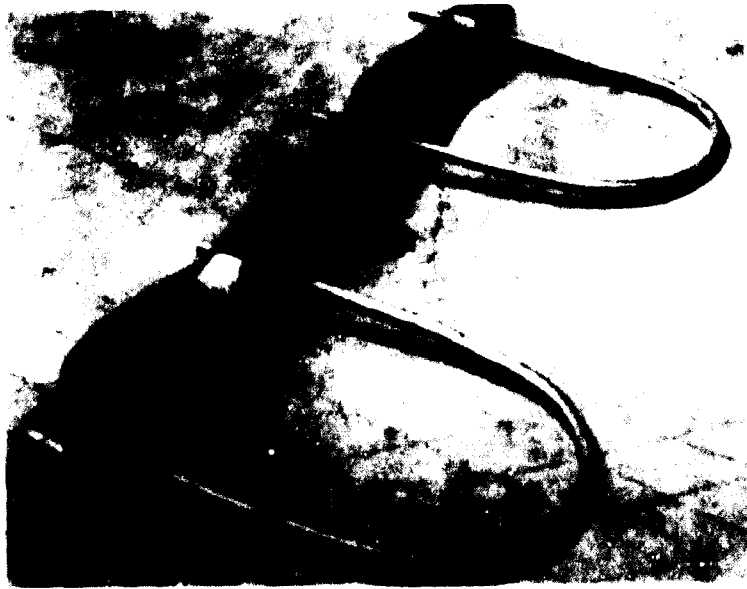


1.15 Sprayer

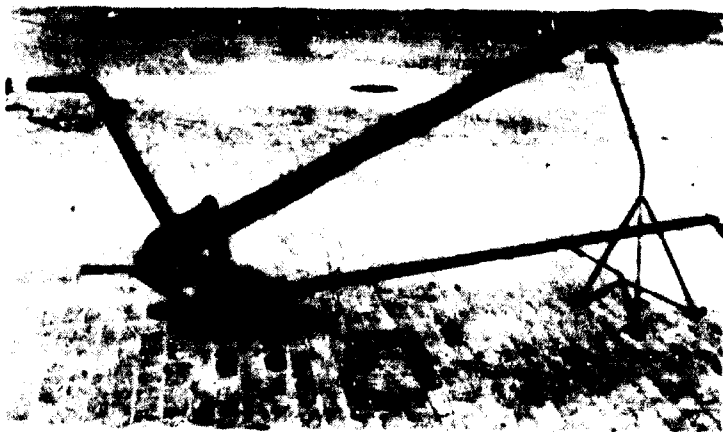


1.16 Hand-operated duster

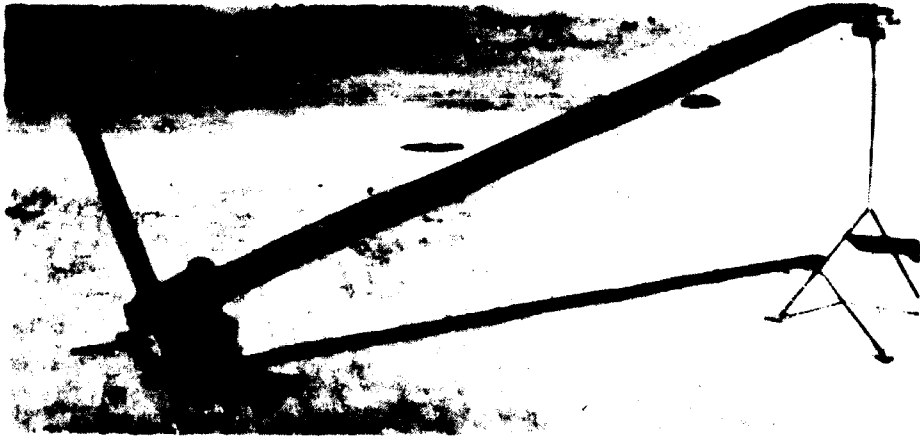
(2) Animal-driven implements and accessories



2.1 Improved yoke for two bullocks



2.2 Light mould-board plough with wooden beam



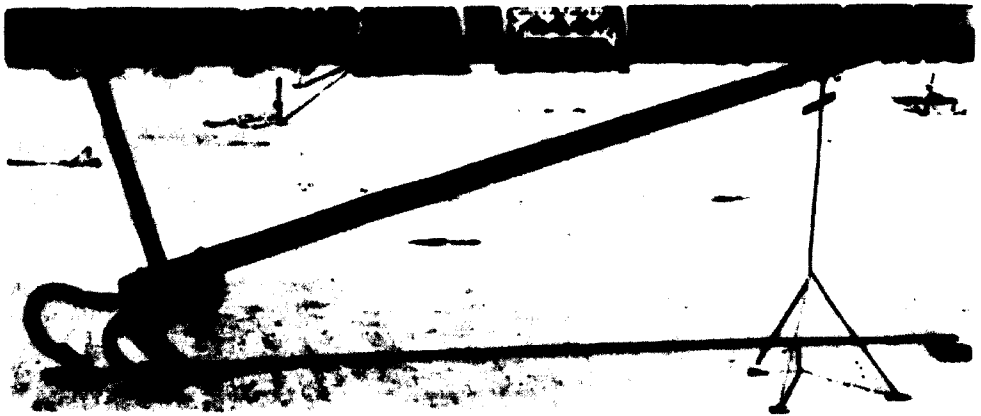
2.3 CARE medium mould-board plough with wooden beam



2.4 A sweep and a cultivator on toolbar



2.5 Cultivator with steel frame



2.6 Three-tined cultivator with wooden beam



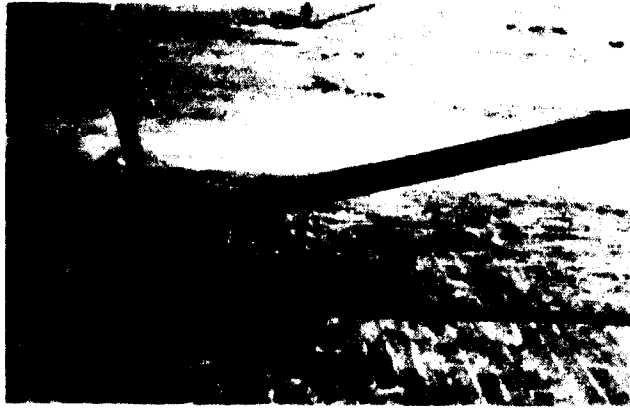
2.7 Ridger plough  
with double handle  
and a steel beam



2.8 Mould-board  
plough with double  
handle and a  
steel beam



2.9 A set of  
multipurpose  
implements and  
attachments

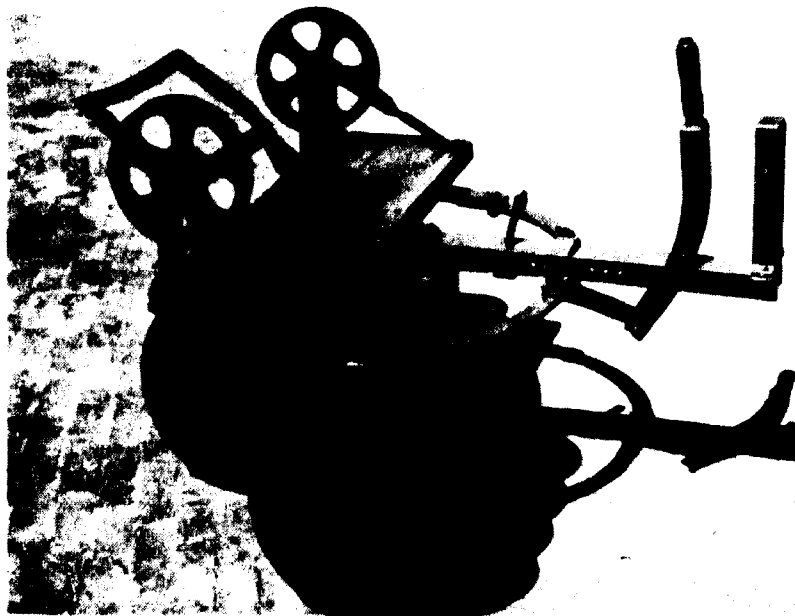


2.10 Bund former



2.11 Tandem disc harrow

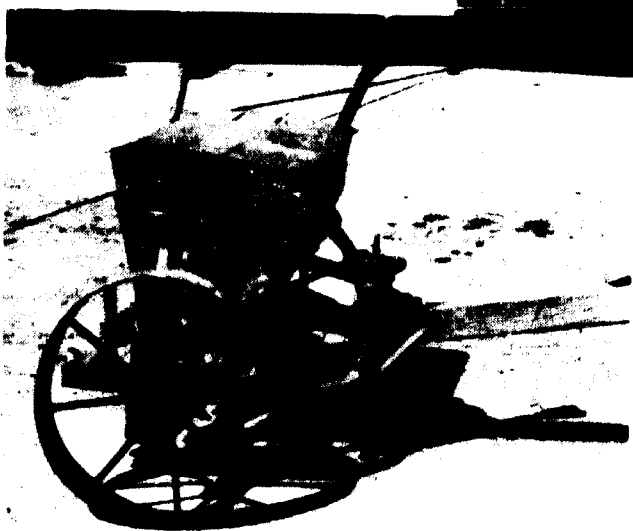
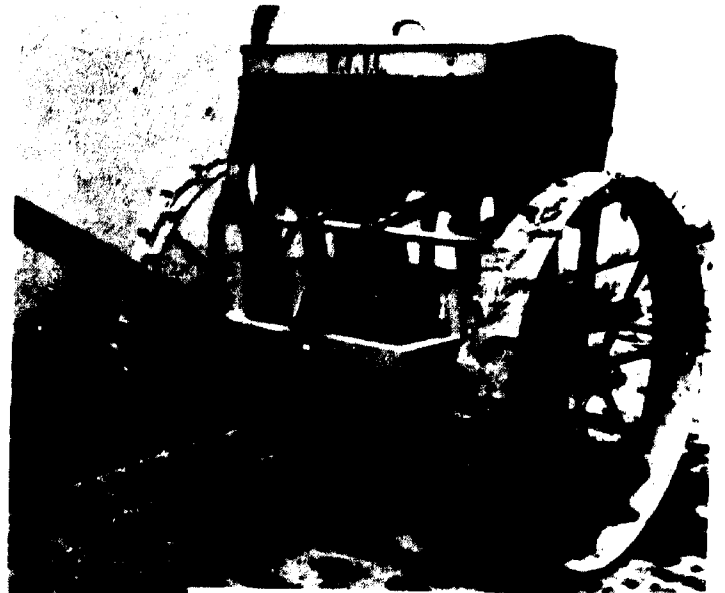




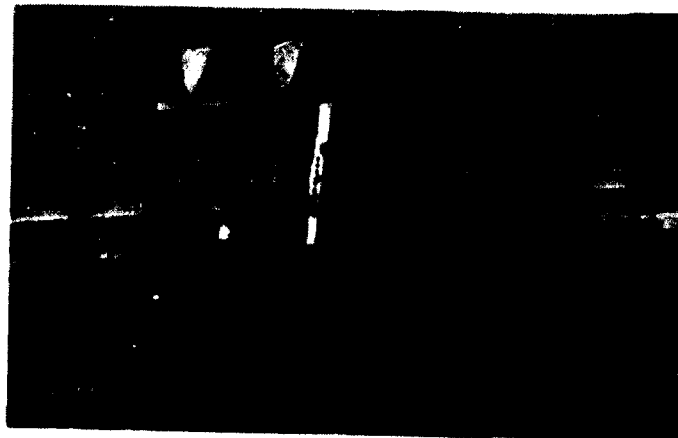
2.12 Offset disc harrow - animal-driven



2.13 Puddler for paddy fields



2.14 Two types of seed  
drill/fertilizer  
distributor

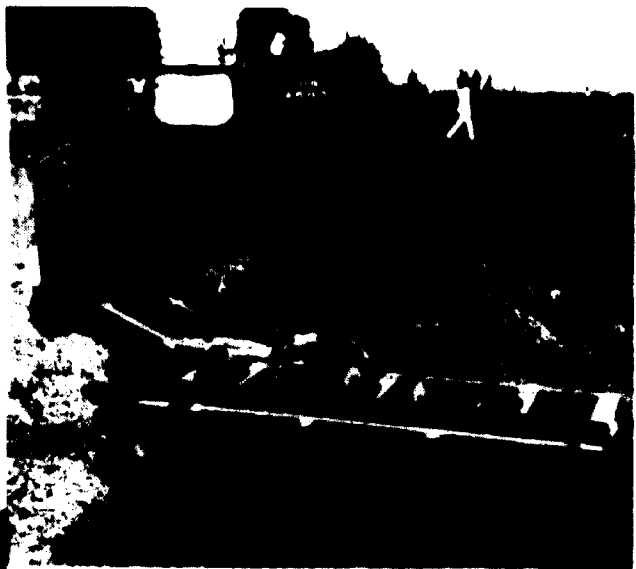


2.15 Seed drill

(3) Tractor and power-operated implements



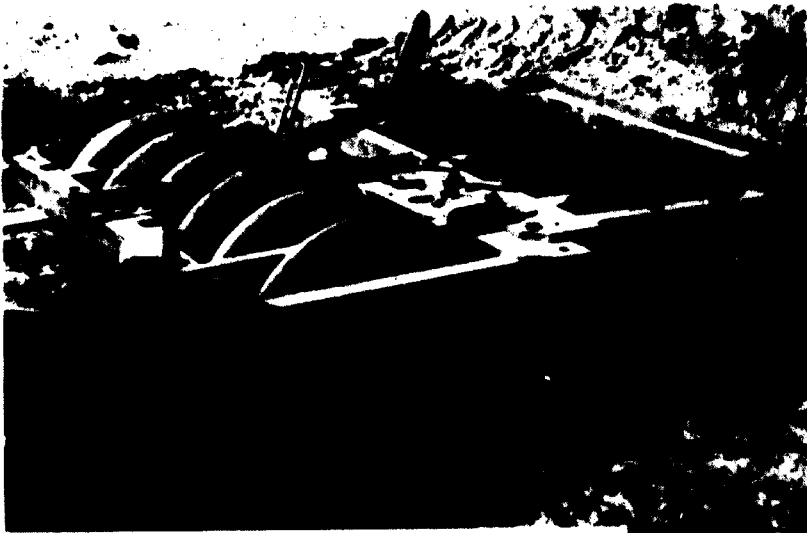
3.1 Five-bottom mould-board plough



3.2 Offset disc harrow



3.3 Nine-tined cultivator



3.4 Offset disc harrow



3.5 Power tiller with trailer



3.6 Power tiller



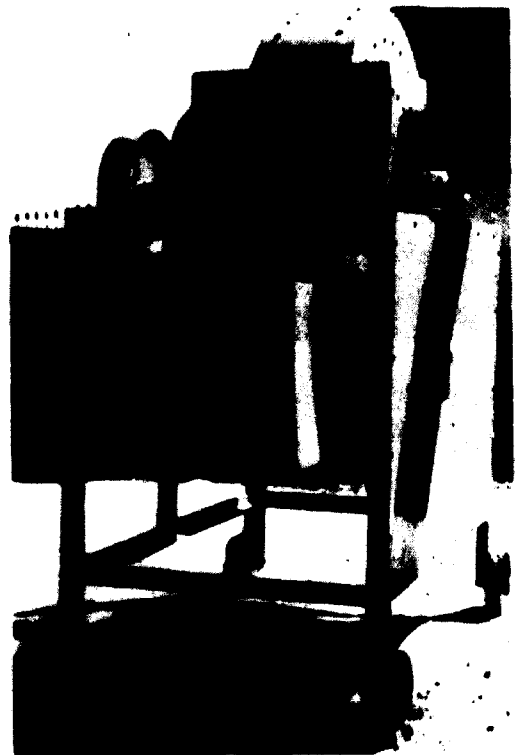
3.7 Seed drill



3.8 Grader blade



3.9 Portable power wheat thresher



3.10 Drummy-type wheat thresher

(4) Other equipment



4.1 Bio-gas plant



4.2 Bio-gas plant  
(laboratory type)

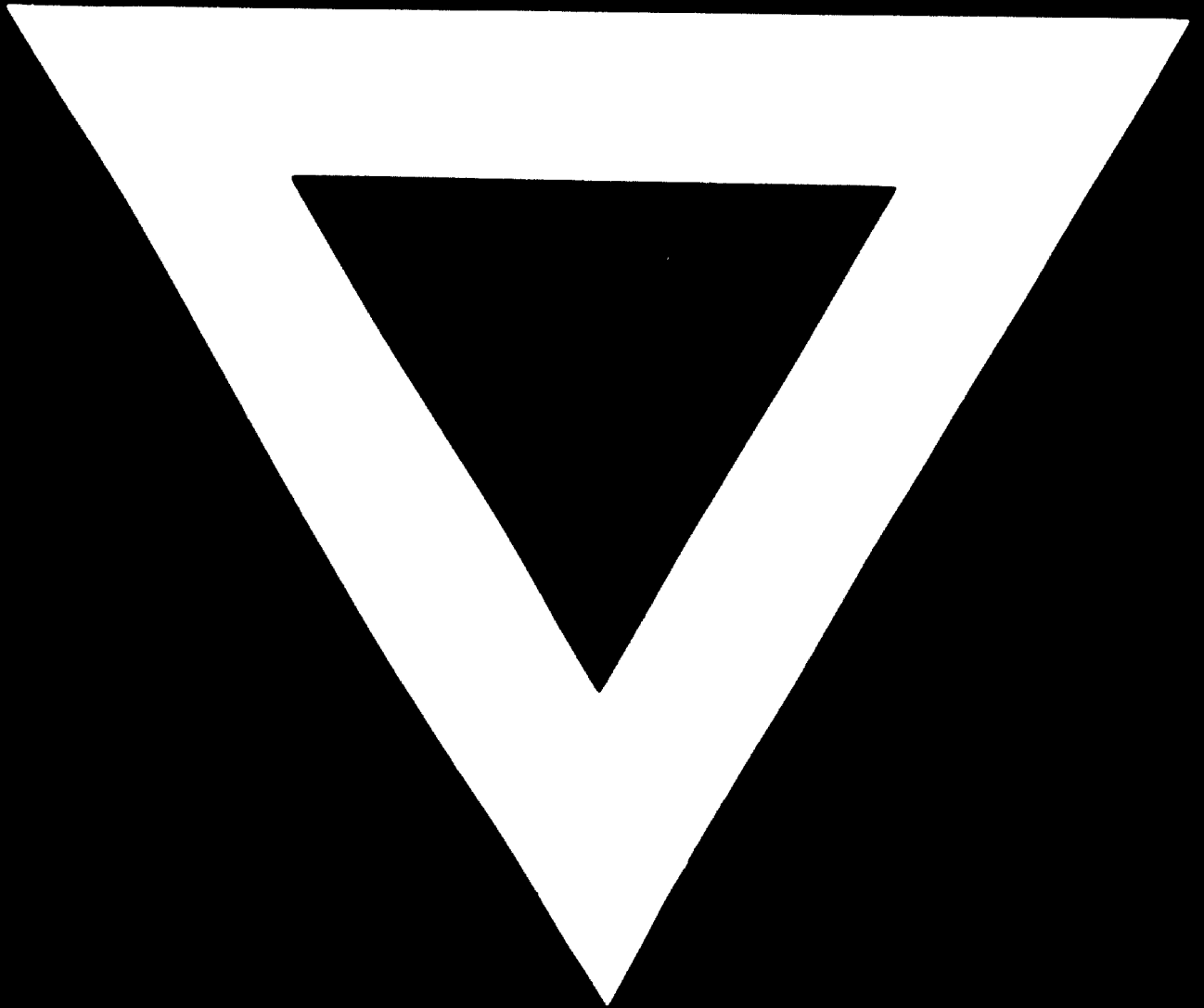


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