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ROLE OF UNIDO IN THE PROMOTION OF AGRICULTURAL MACHINERY AND IMPLEMENTS INDUSTRY IN THE DEVELOPING COUNTRIES

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ROLE OF UNIDO IN THE PROMOTION OF AGRICULTURAL AND IMPLEMENTS INDUSTRY IN THE DEVELOPING COUNTRIES

I. Introduction

1. The economics of most developing countries are characterised by the predominance of agriculture and the low degree of industrialisation in general, and development of metal working and engineering industries in particular. During the past few years, the changing agricultural pattern has created a demand for industrial inputs for agriculture. At the same time, the aspiration for industrialization necessitates planning of priority sectors. Thus, during the comming years, the development of the agrioultural sector would have to depend to a large extent on the availability of supplies from the industrial sector. Conversely, the development of the industrial sector in general, and the engineering and metal working sector, including the metallurgical sector, in particular, could benefit to a large extent by the potential growth in the agrioultural field. In this situation, agricultural machinery and implements are some of the important industrial inputs for sucoessful agriculture. The agricultural machinery industry is in a special position regarding the choice of technologies appropriate to the condition of industrialization in the developing countries. In most of the developing countries a priority has been awarded to rational agricultural mechanization and local development of agricultural machinery and implements manufacturing industry, since it diffuses technology throughout the countryside and involves a large sector of working population in its activities. The United Nations Industrial Development Organization (UNIDO), in its activities, has placed a significant importance to the promotion of this vital industrial sector.

II. World Trade

2. In 1969, the world trade in engineering products* was approximately 76,000 million US dollars, of which total machinery - non electrical - was around 32,000 million dollars. The agricultural machinery and implements and the closely allied sub-groups accounted to around 5,644 million US dollars,

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* Source: ECE Bulletin of Statistics on World Trade in Engineering Products, 1969 ST/ECE/ENG/10, New York 1970.

or about 20% of the total world trade, described under "machinery - non electric". Out of 2,650 million dollars trade in agricultural machinery, 50% represent the trade in tractors and 40% were concerned with machines for cultivating soil. In addition it is estimated that the world trade was around 1,926 million dollars in pumps and centrifuges, 471 million dollars in engines and 587 million dollars in land development machinery in the agricultural sector.

3. Considering the agricultural machinery and implements export to the developing countries region by region, in 1969 around 127 million dollars worth was exported to Africa, 184 million dollars to Asia and the Far East and 297 million dollars to Latin America. This represents around 23% of the total world trade in agricultural machinery and implements. In all the three regions, the import of tractors accounts for about 70-80% of the trade in agricultural machinery. In fact, imports of tractors into the three regions account for 32% of the world trade in tractors. The volume of trade in agricultural machinery for cultivating the soil was relatively low (about 12%), which is a reflection, partly of the restricted range of equipment which is being employed, and partly of how the regions are satisfying their own needs through local manufacture.

III. Local Manufacture

4. As the agricultural machinery and implements industry deals with a large variety of products - from hand tools, animal drawn implements and hand operated machines, irrigation equipment, crop protection machinery to power machinery and equipment, such as tractors, power tillers, engines, harvesters and threshers - the problems of the industry and the policies needed by the Governments for the development of this sector are varied in nature and magnitude. The agricultural machinery industry covers a wide spectrum of technology from small scale workshops to multi-national corporations. It involves the metal working and metallurgical sector and the automotive and electrical engineering sector at different levels of product ranges. In addition, it incorporates industrial planning and policies at a national and regional level, including financing, investment promotion and export on one hand, and institutional services in the field of research and development, training and management on the other hand, with special reference to the transfer of appropriate technology.

5. The machinery which is needed in agriculture can either be supplied through imports, or the existence of a potential internal market can be used to foster the growth of a local farm machinery manufacturing industry. In most developing countries, a realistic aim is a judicious blend of imports and domestic manufacture with a definite policy for progressively raising the proportion of the market which is satisfied from within. In almost every country it is possible to match a production unit to a local demand for agricultural machinery and at a level of technology which is appropriate, both to the manufacturers and the farmers. In many cases, the manufacturer is only able to handle part of the chain of industrial activities between design and commercialization. Recognizing this limitation and taking steps to assist an agricultural machinery industry within a national plan for development appears to be a realistic approach for accelerating industrialisation while promoting progress in the agricultural sector of the economy.

6. In the manufacture of agricultural machinery and implements it is possible to identify three distinct levels of technology and manufacturing planning.

(i) simple hand tools, hand operated machines and selected animal drawn implements which can be fabricated or manufactured in small workshops with relatively low investment

(ii) the majority of tractor drawn implements, selected irrigation equipment including pumps, crop protection equipment that can be fabricated or manufactured on a batch basis in medium size engineering production plants

(iii) power equipment including tractors, power tillers and engines which require relatively large investment in production facilities and demands a higher volume of production to achieve economy of operation.

7. Small workshops engaged in manufacture at the first two levels can be found in most developing countries. In most cases they work under great handicaps by comparison with their counterparts in industrialized countries. The only materials available to them are timber and mild steel in a limited range of sheets and sections. There are no design facilities and quality control is frequently absent. Not surprisingly the hand tools and implements produced by such workshops cannot compete in quality with the imports from established manufacturers in the industrialized countries. The main competitive advantage of local workshops is their ability to undersell the

imported machines. A paradox of agricultural machinery manufacture is that even well designed and engineered machinery which is produced locally, but which has to carry development charges, usually faces competition in price from copies produced in small workshops. A characteristic feature of such workshops is that they serve a predominantly local need either by modifying equipment from a national supplier to meet an unconventional demand or by manufacturing a cheap local replacement for a conventional machine. They may also engage extensively in repair work and maintenance. The strength of such workshops is usually that of the owner who combines mechanical ingenuity, local knowledge and a flair for commercial activity. In the developed countries, such workshops flourish and are a source of both new ideas and useful machines. However, in developing countries, the quality of the products is usually unreliable because they lack facilities for quality control, they use a very limited range of steels and their design tends to be either inventive or imitative without too much attention to details. In a developing country, small workshops are likely to function in a similar way to those in the industrial countries, but are relatively more important in the overall context of industrial development. However, in the developing countries, because of the fragmented way in which they operate, it is unlikely that they can solve the problems of producing a range of agricultural machinery unaided. They might be helped in the following ways:

(i) by supplying working drawings of well designed machines which are suitable for the level of mechanization in the country and manufacture with limited facilities

(ii) by offering practical training courses in production technology

(iii) by providing loans for the purchase of equipment

(iv) by providing assistance in co-operative commercialization.

8. Certain agricultural implements are not required in large quantities in a wide range of design, and the demand is seasonal, so that as a result they are produced in batches, mostly in medium size production units. There are obvious advantages in concentrating production on a narrow range of products. It allows economies in the use of machines and jigs, simplifies the stock which has to be kept and reduces the problems in quality control associated with transferring staff from one product to another. The design and production teams increase their effectiveness by mastering the problems in a specialized area of manufacture. However, it is not easy to find

adequate capacity in a small range of machinery. Therefore it may have to be combined with other metal working industry products. In addition the following alternative methods of production and commercialization may be explored:

(i) Concentration on a small number of products with production exceeding national demand. Excess production is exported across national frontiers by developing a regional market. This is a question of balancing the technological advantages of manufacturing a limited range against the marketing disadvantages of spreading over a wide area.

(ii) Concentration of manufacture on a small number of products, probably with exports to a regional market, in order to get the technical advantages of specialization but marketing complementary lines in order to get better utilization of a dealer network. There is an imbalance in many cases between an economic scale of manufacturing and an economic scale of marketing. An obvious solution is for the manufacturer to enter into marketing agreements with manufacturers of complementary lines of agricultural machinery, which can be handled by his dealers and should enhance their turnover and profit.

(iii) Selection of a product mix, which gives an efficient and balanced manufacturing - marketing operation on a predominantly national scale. This is probably the most difficult of the compromises to reach successfully because in order to achieve uniform activity during the whole year, it is necessary to engage in both cultivation and harvesting machinery. Transport, sowing, spraying, drying and storage equipment may be regarded as intermediate between cultivation and harvesting equipment. A suitable product mix is most likely to be based on either cultivation or harvesting machinery as the main line of activity, supplemented by some products of an intermediate kind.

9. Capital-intensive mass-production and assembly plants are found mainly in engine, power tiller and tractor manufacture where the methods and organisation are very similar to those in automobile manufacture. The operations within the parent plant are usually casting and machining of the major parts of the tractor and the final assembly and dispatch. However, the manufacturer usually depends on specialist suppliers for a large number of the components of the tractor. The relationship between the principal and his suppliers requires the closest technical co-operation in design,

materials, quality control and scheduling of production. The principal manufacturer is responsible for the basic design of the vehicle, marketing and service in addition to his own production and assembly operations. The financial and organizational problems in the creation of such a mass production industry are obviously great. Some of the pre-requisites for its success are that there should be a good infra-structure in iron and steel production, skill in metal-working, machining and assembly, experience in marketing and an adequate market to sustain the scale of operation at a level which makes it commercially viable.

IV. Activities of UNIDO

10. Activities of UNIDO in the area of agricultural machinery and implements are within the framework of its total activities in the field of industrialisation in the developing countries. Specifically, at the request of the Governments concerned, UNIDO is engaged in assisting and advising the Governments in all phases of the development of agricultural machinery and implements industry, with special reference to its inter-relationship with metal working sector and agricultural sector as industrialization proceeds. UNIDO, in co-operation with the Regional Economic Commissions and other U.N. agencies in general, and with FAO in particular, is engaged in assisting the developing countries towards self-reliance in manufacture of agricultural machinery and implements, with special reference to the transfer of appropriate technology. UNIDO is in constant liaison with FAO through technical consultation meetings in order to develop integrated technical assistance activities. The details of scope of activities are highlighted below:

(i) Exploratory Missions (Fact Finding or Project Identification or Sectorial Development Missions)

These missions are primarily oriented to have a bird's-eye-view of the overall situation, highlight the major areas that need attention, identify projects for technical assistance and recommend a line of action for implementation of the project. These missions will analyse agricultural mechanization, overall present and future demand, trends in designs and general production specifications, status of existing facilities for design, development, adaptation, testing, repair and maintenance, and the needs for reinforcement of existing facilities, and also preliminary analysis on the scope for local manufacture etc. Based on the above data the mission will

highlight the major areas that need attention in the order of priority and identify suitable projects for further development.

(ii) Market Survey Missions

The objective of these missions is to establish the present demand, future requirements and product specifications and to recommend a suitable programme for manufacture and overall policies. In order to assess these aspects, it is necessary to analyse the existing pattern and future trends in agriculture, land development, irrigation extension, crop pattern, rural economy, agricultural machinery usage, Government plans for mechanisation, rural credit, data on import, sale and existing production of agricultural machinery. It is also necessary, based on the above analysis, to identify the present and future trend in the level of mechanization, designs, production specifications and overall needs and estimate a realistic potential, on an annual basis, of the demand for selected agricultural machinery and implements. This may highlight the basic necessities which influence the demand such as facilities for rural credit, repair, maintenance and product programmes and design adaptations.

(iii) Manufacturing Feasibility Study

This study is to be carried out when the demand of a product or a group of products is identified and established. However, it may be desirable to re-examine the information available on existing demand, design, specifications and data available on future requirements and design trends in order to establish the basis for the manufacturing study. It may be necessary to evaluate already existing proposals for manufacture. The study involves also an analysis of the raw material availability and the status of supporting and ancillary industries as well as the level of technical skill available. With this background, the study aims at establishing the criteria for manufacture taking into account the production volume, product mix, installed and expansion capacity, cost of manufacture, finances and the overall economic aspects.

(iv) Preinvestment Analysis

The range of activities includes formulation of a manufacturing programme based on data available, analysis of production volume, manufacturing schedule, techniques, machine tool requirements, raw material availability, man-power needs, and financial analysis of the manufacturing proposal.

(v) Rationalisation in Manufacturing Programme

This involves analysis of proposals for manufacture, analysis of existing manufacturing facilities (including supporting and ancillary industry), establishing co-relation between demand figures and production volume and capacity, in-plants, analysis of raw material, local substitution of materials and phased manufacture programme, etc.

(vi) Establishment of Manufacturing Unit: Planning

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

(vii) Design, Development and Adaptation

This activity is oriented primarily towards a manufacturing programme suited to local conditions. This is a step to assist local small and medium scale industries and encourage local entrepreneurs towards industrialization. This activity is directed towards self-reliance in engineering design and development capabilities, and adaptation for an effective transfer of technology. It is to be pointed out that the availability of basic designs in terms of actual implements in developing countries is entirely different from the design specifications and engineering development from the manufacturing aspects. Modifications and adaptations of designs themselves may be a major task, especially from the point of view of strength of material, material selection and development engineering in any industrial activity. Even when technical know-how is available, adaptation of designs from local substitution of material and manufacturing processes and techniques involves design and development. Thus, overall activity in this field consists in establishing design, development and adaptation facilities together with the necessary programme for training local personnel in engineering techniques. These activities may include, at the preliminary stages, analysis of the existing facilities, identification of the future trends in design and requirements, analysis of items manufactured or items with manufacturing potential and formulation of a project programme. Design, development and adaptation is a

continuous process which aims at the development of local engineering design talents. Such a programme may be integrated with a manufacturing set up or treated as an independent unit or activity depending upon the needs of the country concerned.

(viii) Testing, Quality Control, Product Performance Evaluation

This is an integral activity of any industrialization programme. It is directly connected to development and adaptation activities and manufacture both from product quality control and product diversification aspects. This may involve both laboratory and field activities, and is carried out on a limited basis, with a view to improve or analyse the product acceptability and quality, and assist the manufacturer on the one hand and protect the interest of the end user on the other. The preliminary work in such activities may involve an analysis of the existing facilities available, and assist the reinforcement or establishment of new facilities. This includes provision of equipment and instruments, physical facilities, test codes and procedures, quality control, inspection and performance evaluation techniques and introduction of engineering approach towards analysis of design, metallurgy, strength of materials and performance rating.

(ix) Repair and Maintenance

The overall activity in this field includes reinforcement of existing or establishment of new facilities in repair and maintenance with emphasis both on mobile and stationary workshops and formulating an integrated programme for workshop operations and technology, major overhauls, spare parts manufacture and training of local personnel. This also involves analysis, selection installation and operation of machine tools, special equipment, tools and instruments needed and formulation of spare parts inventory control and technical organization. It may be desirable in certain cases that such activity regarding tractors and implements include not only other items such as pumps, engines, crop protection equipment etc., but also allied products such as crawler tractors, heavy earth-moving and road-construction equipment. The preliminary activity in this field may include analysis of the existing status of the facilities for repair and maintenance, identification of products, spare parts and overall problems in order to formulate an effective programme.

(x) Marketing, Sales, Service, Commercialization

This is a broad based but integral aspect of a manufacturing activity. This is a link between production and product design and adaptation. The popularization with the necessary demonstration of the product (agricultural machinery and implements) is a part of the marketing division of any manufacturing organization or set-up. It is only by encouraging manufacturers to be directly involved in this important continuous phase of the overall industrial activity, it would be possible to build up an integrated service and design performance feed-back system. It is to be pointed out the ultimate consumer in this field happens to be the farmer, but the product in question is basically an engineering product. It is also to be accepted that due to various reasons (imported products, introduction of new products for experimentation and mechanization, lack of effective dealership, etc.) it may incorporate activities by non-manufacturing sector. In such a case, the objective of the programme may lay more emphasis on accepting mechanization than on exploring possibilities for local manufacture.

(xi) Plant Level Activities

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

(xii) Pilot Demonstration Manufacturing Units

Establishment of pilot demonstration plants, with the primary view of training in engineering and production aspects with special reference to the transfer of appropriate technology, is essential.

(xiii) Development of Institutions

Establishment of new or upgrading of existing institutions dealing with various aspects of agricultural machinery and implements such as planning, development, design and adaptation, repair and maintenance with special reference to engineering institutions in the metal working sector.

(xiv) Fellowships

Individual fellowships as well as group fellowship for inplant training and other related activities for candidates from the developing countries are included in this programme.

(xv) Seminars, Workshops and Expert Group Meetings

These are organized with the primary view of exchanging information and to assist the UNIDO as well as developing countries in formulating suitable line of action.

(xvi) Publications

In order to disseminate technology information, technical literature, documents and reports are prepared and published.

V. Past and Present Activities of UNIDO

11. Supporting Activities

In order to secure detailed information on the status of agricultural machinery industry in the developing countries, to promote exchange of information and dissemination of technological innovations, to formulate UNIDO programme, to assist the developing countries in identifying major areas of development and to make aware the developing countries regarding the activities of UNIDO, UNIDO has undertaken a number of supporting activities in the field of agricultural machinery and implement. The following are the highlights of such supporting activities:

12. During 1968 - 1969 the "UNIDO-ECAFE"* Fact Finding Mission on Industries Manufacturing Agricultural Machinery and Implements" visited 12 countries in the region. For the first time, the status of the agricultural machinery industry, its problems, future plans, demand and need for expansion were analysed, and recommendations regarding the development of this industrial sector at a country level and regional level were submitted to the Governments concerned. In 1969, UNIDO organized an "Expert Group Meeting on Agricultural Machinery Industry in Developing Countries" at Vienna. The meeting, which was attended by participants, representing 31 developing and developed countries, discussed various aspects of agricultural mechanization and

* ECAFE : Economic Commission for Asia and Far East, Bangkok, Thailand

machinery and implements manufacture, and recommended a number of guidelines for the development of this industrial sector. The meeting specifically recommended that UNIDO should initiate fact finding missions on agricultural machinery and implements industry in various regions of developing countries with a view to analysing the status of the industry and recommending suitable actions for its development.

In 1970, a joint "UNIDO-UNESOB*Mission on Agricultural Machinery Industry" visited six countries in the Middle East and identified areas which may be developed.

In 1971, UNIDO, in co-operation with the Industrial Development Council for Arab States (IDCAS) extended the survey in the Middle East to five countries in the North African region. The "UNIDO-IDCAS Agricultural Machinery Mission" analysed the problems of these countries with special reference to regional co-operation. UNIDO also assisted IDCAS in the preparation of their report on "Industrial Branch Studies on Lorries, Tractors and Prime Movers". In addition to the review of the IDCAS report, a paper prepared by UNIDO staff on "Agricultural Machinery and Implements Industry in the Arab States (October 1971) was discussed. In continuation of the regional development of the agricultural machinery industry, the "Agricultural Machinery and Implements Mission" to the countries of the Andean Group in Latin America has been organized in 1971 in co-operation with the Acuerdo de Cartagena and ECLA**. The mission started its visit in December 1971, and completed in early 1972.

In 1971, in addition, UNIDO has commissioned five studies in selected areas to assess the"Agricultural Machinery and Implements Requirements, including Storage and Transportation in the ECAFE Region" as an industrial input contributing to the "Green Revolution". The studies are in the field of design and development; repair and maintenance; storage and transportation, agricultural engineering professional societies, and the activities of manufacturers' associations in the promotion of the industry. In addition, in 1971, a UNIDO staff member presented a technical paper on "Agricultural Machinery and Implements Industry in South East Asia and Related Activities of UNIDO" for publication by the Farm Machinery Industrial Research Corporation of Japan in 1971. In early 1972, a UNIDO staff has presented a paper on the "Role of UNIDO in Promoting the Manufacture of Rice Mechanization Machinery in the Developing Countries" at the 1972 International Conference on Tropical and

* UNESOB : United Nations Economic and Social Office in Beirut, Lebanon
** ECLA : Economic Commission for Latin America, Chile

Sub-Tropical Agriculture, organized by the American Society of Agricultural Engineers. In 1971, UNIDO has commissioned a comprehensive "Industrial Branch Report on Agricultural Machinery Industry in the Developing Countries", which is anticipated to be published in 1972.

13. In 1972 - 1973, UNIDO will carry out a regional study and convene an Expert Group Meeting on the "Design and Manufacture of Wet-land (Rice) Harvesting and Threshing Machinery in the Developing Countries". UNIDO will implement this activity at the Agricultural Machinery Division of the International Rice Research Institute, the Philippines (IRRI) as a joint UNIDO-IRRI project, in co-operation with ECAFE and FAO. The 1972 study will analyse the specific problems of development of local manufacture of agricultural machinery and implements, including storage, transport and handling equipment in relation to the needs generated by the "Green Revolution". The study will also identify local manufacturers who may be interested in participating in product diversification and expansion of manufacturing facilities. The participation in the proposed 1973 Expert Group Meeting will primarily be by such small and medium scale entrepreneurs from the developing countries, manufacturing organizations from the industrialised countries and representatives of the financial institutions. Based on the above, the meeting will formulate a programme for development, adaptation and manufacture of suitable machinery and equipment in selected developing countries. As a follow-up on this meeting, UNIDO proposes to explore the possibilities of supplying suitable machinery and implements to the developing countries and assist further in prototype fabrication and adaptation with the eventual objective of local manufacture.

14. In 1972, subject to availability of funds, UNIDO proposes to organize a joint "UNIDO-ECA Agricultural Machinery and Implements Mission" in co-operation with OACM.

15. The proposed 1973 activities are provisional and are subject to the approval by the relevant policy making authorities and also subject to the availability of funds. In 1973, UNIDO proposes to organize a "Manufacturing Development Clinic for Animal Drawn Implements and Hand Operated Agricultural Machines". A number of least developed countries are interested in establishing small and medium scale units for the manufacture of simple tools and implements. The project is to bring potential entrepreneurs and Government officials (Ministry of Agriculture and the Ministry of Industry) in contact

with medium scale manufacturers to select product lines which may be appropriate to their country. This meeting may be held in a developing country, for example, India. In addition, the UNIDO commissioned "1970 Report on Plant Requirements for Production of Specific Animal Drawn Agricultural Implements" will be reviewed to formulate appropriate manufacturing facilities. As a follow-up to this meeting, UNIDO is considering to supply to these countries a set of selected items and critical components that are needed for prototype fabrication. In addition, UNIDO proposes to assist them in product performance analysis and in the fabrication of a number of prototypes.

16. In 1973, UNIDO proposes to conduct a "Workshop on Selection of Stationary and Mobile Maintenanoe and Repair Workshops for Agricultural Machinery and Implements". The project as proposed consists of a meeting (a workshop), possibly in Moscow, USSR, at the occasion of an International Exhibition on "Organization of Technical Service and Repair of Automotive Equipment", at which the exhibition authorities would be requested by UNIDO to include special repair and maintenance equipment for tractors, agricultural machinery and implements. Participants from the developing countries will be those who have expressed a desire to establish national repair and maintenance programmes. During the workshop, the representatives from the developing countries will discuss with U.N. experts various aspects of organization and operation of repair and maintenance programmes. They will, with the assistance of the present experts, select equipment and machinery suitable for their needs and formulate a preliminary programme on the establishment of stationary repair and maintenanoe workshops including mobile units and technical training,

17. Also in 1973, UNIDO proposes, subject to availability of finances, to organize a "Manufacturing Promotion Meeting on Small Low Cost Agricultural Tractors and Power Tillers". During 1971, UNIDO has contacted a number of developing countries to ascertain their interest in introducing more mechanical power through a small low cost tractor. Additionally, UNIDO has requested the countries to forward details of their concept of such a tractor. UNIDO proposes to analyse these reactions and the interest of the Governments in early 1972, and investigate the feasibility of further developing this project. As a pre-project activity in 1972, the UNIDO staff will secure all information on product specification as

outlined by the developing countries, development and adaptation work undertaken by agricultural engineering professional institutions and products - specification of small and low cost tractors that were produced, or are being produced, or in the process of being developed by selected manufacturers in the industrialized countries. During the proposed 1973 meeting, product specifications, necessary adaptation work and possibilities of further specific manufacturing activity in close co-operation with selected manufacturers in developing countries will be discussed, and an action-orientated programme will be formulated. This manufacturing promotion meeting would be organized with the participation of selected manufacturers who have indicated their interest in exploring the possibilities of developing or adapting their existing products to meet the needs of the developing countries; representatives of selected Agricultural Machinery Research and Development Institutes who have undertaken active work to develop a small tractor; representatives of selected developing countries who have indicated their interest in exploring the possibilities of local manufacture of such small tractors. It is proposed to invite the co-operation and participation of the International Commission of Agricultural Engineering in this activity.

18. Operational Technical Assistance Activities

In the field of agricultural machinery and implements a number of countries have requested technical assistance aimed at the establishment and development of manufacturing and service facilities for agricultural machinery and implements, with special reference to their linkage to the metalworking sector. These requests are the result of the awareness of the developing countries of the need to manufacture equipment suitable for the local soil conditions and crop patterns, and to utilize the locally available resources to the fullest extent. At the same time, the developing countries are also interested in enhancing the local engineering capabilities in the design and adaptation and in establishing suitable testing facilities for product performance evaluation. It is also evident that the developing countries have placed emphasis on national repair and maintenance programmes. UNIDO is in liaison with FAO, where ever appropriate in implementing these technical assistance activities. As of the middle of October 1971, the 41 specific requests for technical assistance are in the following categories:

(a) Manufacturing feasibility study:
13 requests for a duration of 52 man/months expert assistance

(b) Design, development, adaptation and testing:
4 requests, 34 man/months

(c) Manufacture of hand tools and animal drawn equipment:
7 requests, 30 man/months

(d) Manufacture of tractors, power tillers, engines and tractor implements:
8 requests, 40 man/months

(e) Repair and Maintenance:
7 requests, 39 man/months

(f) Commericialization, marketing and sales distribution:
2 requests, 9 man/months.

18. In addition, UNIDO has conducted a number of regional meetings to promote industrial projects in Asia, and Africa, during the past two years. A few projects in the agricultural machinery and implements field (tractors, engines, implements and hand tools) were also discussed in these meetings by investors from industrialized countries with counterparts from developing countries. Such meetings to promote industrial projects on national and regional basis are a continuous activity of UNIDO.

VI. Magnitude of the Requirements, Demand and Investment

19. In attemting to forecast the demand for agricultural machinery and implements, two different, but very simplified market situations can be distinguished - static and dynamic. In a static agricultural production situation, whatever is its level of sophistication, the market is largely a replacement one. The agricultural production situation and rate of industrialization, envisaged for the developing countries, is strongly dynamic, if they are to attain the levels of output which have been postulated by the Indicative World Plan (IWP), both for the period to 1975 and later until 1985. The figure of 0.5 horsepower per hectare is widely used as a threshold value of the specific mechanical power which is required for agricultural mechanization. The available power in all the developing countries is far below the desired norm. The existing h.p/ha is estimated to be 0.27 in Latin America, 0.20 in Asia and 0.05 in Africa. The Report of the UNIDO Expert Group Meeting on Agricultural Machinery Industries estimates that in order to meet the desired horse power per hectare, 1.2 million tractors and 0.27 million power tillers in Latin America by 1986, 2.56 million tractors and 1.9 million power tillers in Asia by 1998, and 2.47 million tractors and 0.047 million power tillers in Africa by 1998 are to be manufactured, when a realistic

manufacturing programme (6% compound production growth and 7% on-the-farm depreciation rate) is considered. It is estimated that the sales value of these tractors will be around 26,000 million dollars and an estimated capital investment of at least 900 million dollars is required for large scale assembly/manufacturing level of operation with emphasis on component subcontracting.

20. The UNIDO-ECAFE mission has estimated that in selected 12 countries of Asia and Far East region, the annual demand by 1975 may be as follows: tractors: 118,000; power tillers: 102,000; all type of engines: 1002,000; (petrol: 1-2 Hp: 186,000, 3-5 Hp: 161,000; diesel: 3-15 Hp: 472,000, 12-36 Hp: 63,000 and 25-75 Hp: 117,000); power pumps (3-15 Hp): 820,000; deep well pumps: 135,000; power wheat threshers: 65,000; power paddy threshers: 148,000; knapsack sprayers: 204,000; hand pumps: 418,000; hand sprayers: 640,000 paddle paddy threshers: 203,000. The actual existing production capacity as well as known planned capacity by 1975 in this region is far below the anticipated demand.

21. Based on UNIDO-UNESCO-IDCAS mission to 12 selected Arab countries of the Middle East and North Africa, it is estimated that by 1973-74 alone, the annual demand in this region will be around 25,000 tractors, 35,000 implements, 25,000 seed drills and fertilizer distributors, 8,000 threshers and harvesters, and 10,000 trailers plus a large number of small engines, crop protection equipment and other implements. Again, the existing manufacturing capacity and the known plans for new units may not meet the anticipated demand.

22. In India alone, during the IVth Five Year Plan (1969 - 1974) it is estimated that a total cumulative demand exists, as follows: 385,000 tractors, 230,000 power tillers, 5,000 crawler tractors and 1,430,000 implements and equipment of 46 types, 1,460,000 all types of engines (3-100 Hp) out of which 1,305,000 are 3-10 Hp engines, 2,100,000 pumps for irrigation, 303,000 power plant protection equipment, 1,700,000 hand operated crop protection equipment,

23. Therefore, it can be seen that agricultural machinery and implements industry occupies a very significant place in the total industrial sector in general, and that in engineering industries in particular. FAO has estimated in its Indicative World Plan(IWP) that investments in mechanization of machines and machinery for agriculture in the period of 1962 - 1985 should amount to US$ 40,000 million at 1962 prices.

VII. Outline of Projections in the 1970's in Developing Countries

24. There is going to be continuous and growing awareness that proper management of the application of inputs is essential for successful agricultural production. In turn, the developing countries will be conscious that efficiency of inputs is a combination of the mode of application and the availability of power and techniques. With more emphasis on timeliness of agricultural operations and lack of human labour power required, it will be evident that agricultural machinery and implements are among the most important media for enhancing agricultural production through efficient and economic application of inputs. With emphasis on industrialization, the developing countries will give priority to products for local manufacture which will result in import substitution, foreign exchange conservation, ancillary industry development and labour intensive diversified production programmes with emphasis on economic manufacturing level. Agricultural machinery and implements constitute a such broad spectrum of product lines.

25. The least developed countries among the developing will emphasize on product lines which will involve small-scale production and intermediate technology. Such countries will continue import of tractors, engines, pumps and power equipment on a limited scale. They will give more emphasis to local production of hand-tools such as shovels, spades, rakes, pick axes, matchets, etc; simple hand-operated machines such as corn shellers, chaff-cutters, winnowers, peanut shellers, threshers, hand pumps, hand sprayers, and on animal-drawn implements such as plows, cultivators, harrows, bullock carts, seed drills, etc. There will be more flow of information and assistance from more developed countries among the developing to the least developed countries in the manufacture of these items as most of the industrialized countries have discontinued hand-operated machines and animal-drawn equipment.

26. In intermediate developed countries among the developing countries in addition to hand-tools, hand-operated machines and improved animal-drawn implements, there will be emphasis for the local manufacture of certain simple tractor-drawn implements; irrigation pumps, power threshers, small engines and selected crop protection equipment. Import of tractors and other power equipment will be continued. The countries will look for foreign collaboration in the manufacture of small engines and, in some cases, of pumps. The countries will put emphasis on the improvement

of existing metal working industry and diversified production programmes, including agricultural machinery and implements production. These countries will continue to import steel, and will use mostly mild steel or in some cases medium carbon steel. However, existing or new small foundries will meet the requirement for grey iron castings. These countries will also give emphasis to the development, adaptation, prototype fabrication of hand-operated machines and animal-drawn as well as simple tractor-drawn implements. Therefore, the facilities of the existing institutions in this field will be reinforced. These countries will also encourage co-operative usage and hiring stations for tractors and power machinery, give emphasis to the establishment of repair and maintenance workshops, utilization of mobile units and training of mechanics.

27. In the more developed among developing countries, emphasis will be given in general to local assembly and manufacture of full range agrioultural machinery and implements except combine harvesters, bailers, mowers, hay conditioners, etc. Most of these countries will continue to put emphasis on the production of hand tools, hand-operated and animal-drawn implements in the small-scale industry sector with protection. However, selected hand tools which require special steel, forging and heat treatment facilities, will be manufactured in larger manufacturing units. Due to the increased demand, the countries will emphasize the expansion of production facilities or the establishment of additional manufacturing facilities for pumps, small engines for agricultural usage, power crop protection equipment and tractor-drawn implements. Foreign collaboration will be sought only for the manufacture of small engines and power crop protection equipment. In addition to expanding the existing production volume of tractor-drawn implements such as cultivators, harrows and mould board plows, emphasis will be given to the manufacture of disc-plows, multi-seed drills and fertilizer distributors, row crop planters and specialized equipment for beet, sugarcane, potato and seed treaters, dryers as well a storage bins and grain handling equipment and trailers. Most of these countries will also put great emphasis on the development and local manufacture of machinery for wet-land rice production. For example, puddlers, rotovators, transplanters, broadcasters, harvesters will be manufactured. In addition, in selected countries two-wheel walking tractors will also be assembled or manufactured. There is going to be maximum attention paid to the local assembly and manufacture of tractors. In this connexion, although 40 and 60 Hp four-wheel standard tractors will

be assembled and manufactured with foreign collaboration, serious attention will be given to the development or identification of small low-cost tractors for local manufacture. This is because the larger tractors may be economical on larger private holdings and through co-operative usage or hiring systems. Certain selected countries will introduce local manufacture of side-mounted combined harvesters and self-propelled combined harvesters. It is to be recognized that all these countries will reserve their foreign exchange for collaboration in the local manufacture of combined harvesters, tractors, power tillers, engines and, in very few cases, specialized implements. Therefore, more attention will be paid to the local development, adaptation and, in some cases, design of all required agricultural activities in the overall metal working, electrical and automobile industry sector. In this connexion, importance will be given to the development of ancillary industry to facilitate phased local manufacturing programme. Such facilities will be included in the industrial estates. Although, initially, the manufacture of agricultural machinery may commence under one roof, in order to increase the local content, subcontracting of components will be undertaken at a later stage. In addition, attention will be paid to the development of foundry to produce malleable and white iron castings, as well as agricultural discs with imported steel. Also forging, heat treatment facilities will be further developed. The existing steel mills which normally produce only mild steel rods may explore the possibilities of producing mild steel section, angles and sheets as well as steel with specifications of EN-1A, EN-3, EN-8, EN-9, EN-42, EN-45. However, special steels such as EN-16, EN-18, EN-34, EN-43, SAE-5140, SAE-8620 and steels required for discs, mould boards, gears, shafts, etc. will be imported.

28. These relatively more developed among developing countries will give emphasis to the management aspects of industries, especially purchase, quality control, tool engineering and marketing. Special emphasis will be given to plant maintenance as well as overall marketing including repair and maintenance. The Governments in general and the manufacturers will establish central and regional repair and maintenance workshops, and to spare parts production and supply will be given importance. In these countries, there will be growing awareness for formulating professional agricultural engineering societies, manufacturers associations, national agricultural machinery and implements research, design, development, adaptation, prototype fabrication and testing centres, national repair and maintenance activities, training and higher education in agricultural engineering field. It is difficult

to forsee any positive regional or interregional co-operation in manufacture or ancillary component subcontracting among these countries in the 1970's. However, there is going to be a positive regional and interregional co-operation in activities involving group inplant training, market survey, exchange of information and more than all in establishing regional development adaptation and prototype fabrication centres for agricultural implements, regional centres for training in organization and operation in repair and maintenance, and in regional agricultural engineering professional and technical societies.

VIII. Role of UNIDO in the 1970's

29. General

With this basic background information, the logical steps to be followed to promote the development of agricultural machinery and implements industries may be summarised as follows:

(i) It is necessary to analyse the specific needs of the individual countries with respect to specific products in order to project the present and future demands and trends in design specification. Based on this preliminary analysis, pre-investment studies on specific product lines which may include the economic volume of production and investment analysis are to be carried out. In addition, ways and means of how to expand the existing agricultural machinery and implements industry and product diversification in other metal working sectors are to be explored in order to assist in the optimum utilization of existing manufacturing capacities. It is also necessary to identify and encourage local entrepreneurs to invest in the feasible manufacturing projects in the public sector. To assist the local manufacturers in a rational policy, a programme in design, development, adaptation and testing has to be undertaken. Above all, an active investment promotion programme to encourage judicious licensing arrangements, is recommended.

(ii) In addition, the following institutional activities will have to be promoted:

(a) Formulation of national and regional, professional, agricultural engineering institutions;

(b) Creation of regional centres for agricultural machinery and implements design, development, adaptation and service;

(c) Formulation of national and regional agricultural machinery and implements and allied equipment manufacturers associations;

(d) Establishment of permanent development agency for farm mechanization and promotion of local manufacture in the regions.

30. In the least developed countries:

(i) Assistance in manufacture of hand tools, hand operated machines and animal drawn implements;

(ii) Transfer of products and technology from developing countries to the least developed countries;

(iii) National repair and maintenance activities.

31. In the intermediate developed countries:

(i) Assistance in expansion of existing production in hand tools, hand operated machines and animal drawn implements;

(ii) Assistance in establishing manufacturing units for pumps, threshers, crop protection equipment and selected tractor drawn implements and simple parts;

(iii) Licencing and foreign collaboration promotion for the manufacture of pumps and small engines;

(iv) Re-inforcing existing facilities in development, adaptation and testing, repair and maintenance and commercialization.

32. In more developed countries among developing countires:

(i) Expansion of existing facilities for manufacture of high quality hand tools, pumps, engines, implements, crop protection equipment, trailers and in some cases tractors and power tillers;

(ii) Licencing and foreign collaboration promotion for the local manufacture of tractors, power tillers, engines, combine harvesters, dryers and crop handling equipment and transplanters and special implements for selected crops;

(iii) Manufacturing promotion for low cost small tractors and power tillers;

(iv) Ancillary industry development, agricultural diso manufacture, patents and licencing for proprietary items manufacture;

(v) Institutional assistance: design development and prototype fabrication, repair and maintenance, manufacturers association, and agricultural engineering professional societies.

(vi) Plant level assistance and management development;

(vii) Incorporation of agricultural machinery and implements manufacturing sector in metal working, electrical, automotive, and metallurgical industrial sector;

(viii) Development of foundry and steel manufacture for agricultural tractors, machinery and implements;

(ix) Regional co-operation and exchange of information.

IX. Conclusion

33. Through these field action orientated programmes in manufacturing agricultural machinery and implements, it is anticipated to assist the developing countries towards self-reliance in manufacture with special emphasis on adaptations of large-scale technology to the medium and small scale sector. The policies and activities of UNIDO in this field are specifically orientated to contribute - in a modest way - to the success of the "Green Revolution" in developing countries, through a rational development of suitable, locally produced agricultural machinery and implements in addition to the local production of required industrial inputs of agricultural production and equipment, and technology for industrial processing of agricultural outputs. In this important field of activity, UNIDO welcomes co-operation from manufacturers, research, design and development institutions and other national and international organizations, both from industrialized and developing countries.

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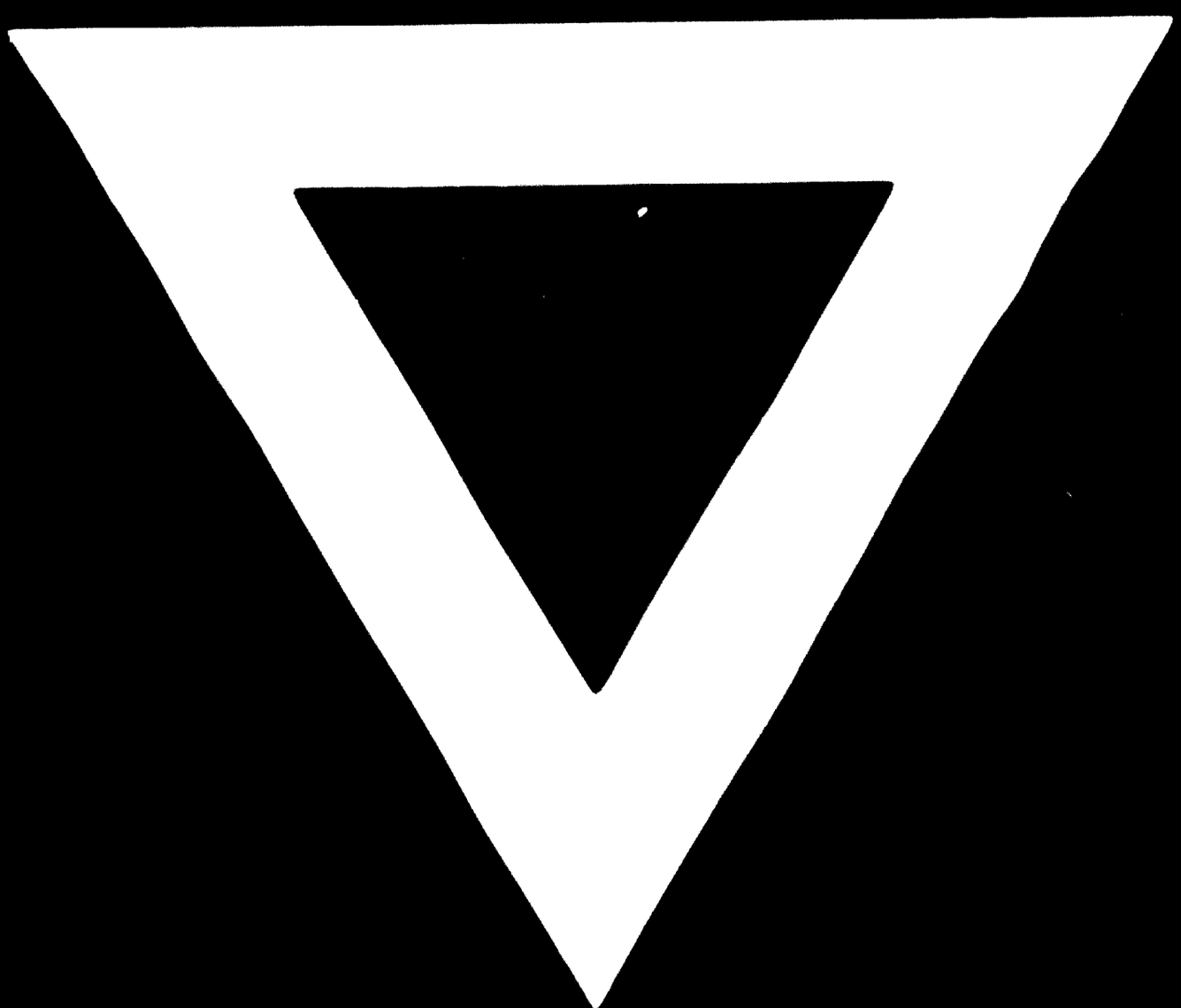

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