



TOGETHER
for a sustainable future

OCCASION

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



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

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

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

16887-E

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Distr.
LIMITED
PPD.57
14 October 1987
Original: ENGLISH

**GUIDELINES FOR THE DEVELOPMENT
OF THE AGRICULTURAL
MACHINERY AND IMPLEMENTS INDUSTRY
IN LATIN AMERICA**

Volume I

**Sectoral Studies Series
No.38**

**SECTORAL STUDIES BRANCH
STUDIES AND RESEARCH DIVISION**

Main results of the study work on industrial sectors are presented in the Sectoral Studies Series. In addition a series of Sectoral Working Papers is issued.

This document presents major results of work under the element Agricultural Machinery Industries in UNIDO's programme of Industrial Studies 1986/87.

This document has been reproduced without formal editing.

The designations employed and the presentation of material in this document do not imply the expression of any opinion whatsoever on the part of the secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Mention of company names and commercial products does not imply the endorsement of UNIDO.

Preface

For several years now UNIDO's Sectoral Studies programme has given specific attention to the agricultural machinery industry in various developing regions of the world, and in particular, Latin America. This document builds on earlier work undertaken within this programme. In addition, it elaborates specific guidelines for national decision-makers, subregional and regional organizations for concrete programmes of action to stimulate the agricultural machinery industry in the developing countries of Latin America. Three country case studies on Brazil, Venezuela, and Guatemala are issued as volume II of the study.

This study has been carried out in the Sectoral Studies Branch by Mr. George B. Assaf.

UNIDO would like to gratefully acknowledge the valuable information received from Latin American government officials and industry representatives in the preparation of this study.

Contents

	<u>Page</u>
1. INTRODUCTION	1
2. SUMMARY OF FINDINGS AND RECOMMENDATIONS	2
2.1 Findings	2
2.2 Recommendations	4
2.2.1 National programmes of action	4
2.2.2 Subregional programmes of action	5
2.2.3 Regional programmes of action	5
2.2.4 Programmes of action for UNIDO and other international agencies	6
3. SOME BASIC PREREQUISITES: IDENTIFY THE DEMAND FOR AMI AND CURRENT ABILITY TO SATISFY IT	8
3.1 Why the development of AMI is important for Latin America	8
3.2 What is the demand for AMI?	9
3.3 The need to identify appropriate products for agricultural mechanization and rural development	11
3.4 The need to determine the current national capabilities for local production	12
3.5 The need to identify the obstacles to production experienced by each type of production unit	13
3.6 The need to identify existing institutional mechanisms for co-ordination and promotion of the development of AMI production	14
4. THE NEED TO TAKE AN INTEGRATED APPROACH TOWARDS THE MANUFACTURE OF AGRICULTURAL MACHINERY AND IMPLEMENTS	16
4.1 Should uni-product manufacture or multi-product/multi-purpose manufacture be promoted?	17
4.2 The development of an appropriate strategy for agricultural mechanization	19
4.3 An integrated strategy for AMI production requires maximum usage of backward and forward linkages between manufacturing industries, infrastructure and manufacturing processes within firms	21
4.4 The importance of providing an institutional mechanism for an integrated strategy	22

	<u>Page</u>
5. SPECIFIC NATIONAL, REGIONAL AND INTERNATIONAL PROGRAMMES OF ACTION TO FOSTER THE DEVELOPMENT OF THE AGRICULTURAL MACHINERY AND IMPLEMENTS INDUSTRY IN LATIN AMERICA	25
5.1 Programmes of action for national governments	25
5.1.1 Lack of raw materials	25
5.1.2 Small markets	25
5.1.3 Different thresholds of process-complexity	26
5.1.4 Lack of human resources	26
5.1.5 Inadequate financial resources	26
5.1.6 Inadequate infrastructure	29
5.1.7 Lack of information about products	30
5.1.8 Insufficient technical knowledge	32
5.1.9 Inadequate stocks of spare parts, repair and maintenance of AMI	32
5.1.10 Inadequate marketing of products	33
5.1.11 Lack of standardization of products	33
5.1.12 Inappropriate macroeconomic policies	33
5.2 Subregional programmes of action	39
5.2.1 Provision of information	39
5.2.2 Multinational production enterprises and other forms of ECDC/TCDC	41
5.2.3 Implementation of subregional co-operation	42
5.3 Regional programmes of action	43
5.4 Programmes of action for the international agencies	45
5.4.1 New methods of financing and material support	46
5.4.2 Pilot studies of strategies for fostering the development of AMI	46
5.4.3 Pilot rural workshop schemes	48
5.4.4 Operational study of rural workshops	49
5.4.5 Setting-up pilot workshops	49
5.4.6 Creation of a data base of manufacturing plans or drawings	49
5.4.7 Information and studies	49
5.4.8 Technological information	50
5.4.9 Technical assistance	51
5.4.10 International co-operation	54
APPENDIX	
Definitions of mechanization	55
Main types of implements, machinery and equipment used in agriculture	56
REFERENCES	58

Table

Page

- I. Ratio of parallel market exchange rate to official exchange rate in a sample of Latin American countries

34

Boxes

- I. Basic prerequisites in designing a strategy to foster the development of the AMI industry
- II. The need to take an integrated approach towards the manufacture of AMI
- III. Country information required on AMI
- IV. Programmes of action for national governments to remove obstacles to production
- V. Subregional programmes of action
- VI. Regional programmes of action
- VII. Programmes of action for the international agencies

15

24

31

38

43

45

53

EXPLANATORY NOTES

References to dollars (\$) are to United States dollars, unless otherwise stated.

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

Three dots (...) indicate that data are not available or are not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Units (SI), the following abbreviations and contractions have been used in this report:

Economic and technical abbreviations

AMI	Agricultural machinery and implements
GDP	Gross domestic product
LDC	Least developed country
MVA	Manufacturing value added
R and D	Research and development
SITC	Standard International Trade Classification
t/a	Tons per annum
ECDC	Economic co-operation between developing countries
CACM	Central American Common Market
TCDC	Technical co-operation between developing countries
TNC	Transnational corporation

1. INTRODUCTION

This study is concerned with the development of the Agricultural Machinery and Implements (AMI) industry in Latin America. It develops explicit strategies and guidelines at the national, subregional, regional and international levels for the development of the AMI industry in Latin America.

The study consists of two volumes which are issued separately. Volume I presents practical guidelines for promoting the AMI industry in Latin America. It is believed that these guidelines can enable decision makers to implement an appropriate integrated development of AMI in the context of rural development which emphasizes maximum usage of forward and backward linkages in manufacturing industries, agriculture, infrastructure, and also the manufacturing processes within firms. Although the benefits of this strategy are clearly described in the text, the major benefit of the integrated strategy, as developed in this study, is that there is a greater likelihood that programmes and projects that result from use of this strategy will be better suited to the countries of Latin America and hence more likely to meet with long term success.

The practical guidelines elaborated in volume I are drawn from earlier work by the Sectoral Studies Branch on the AMI industry in Latin America and in particular the country case studies presented in volume II.

Volume II should be considered a complementary document to be consulted for specific illustrations of the general observations and guidelines developed in volume I. It presents specific case studies of three Latin American countries - Brazil, Venezuela and Guatemala. These countries were chosen for the case studies since they represent the various levels of development in Latin American countries: an advanced large country (Brazil), an advanced medium-sized country (Venezuela), and a less advanced small country (Guatemala).

The study is directed towards the substantive UNIDO departments and divisions concerned with AMI and capital goods in general, other international agencies, regional and subregional organizations, and finally, decision-makers and researchers in both the private and public sectors in developing and industrialized countries, especially in Latin America.

The study can be used in several different ways. First, it can form a basis for the development of new methods for promoting AMI in developing countries and in Latin America in particular. Second, it can be used as a guide and support for UNIDO's operational projects and programmes relating to AMI and capital goods. Third, it can be used as a contribution to and support for the activities of other UN organizations, the UN regional commissions and subregional bodies. Fourth, it can be used as an instrument by local research and planning institutes in Latin America and elsewhere. Fifth, it can be used as a background document for private sector decision-makers interested in technology transfers, joint and other ventures in Latin America.

2. SUMMARY OF FINDINGS AND RECOMMENDATIONS

2.1 Findings

Latin American countries differ greatly with respect to climate, soil, topography, types of agricultural production, farm size, market size and level of economic development. It is not surprising that there are also great differences between the agricultural machinery and implements industry of the various countries in Latin America. The major difference among the countries is in terms of technological sophistication. Production and foreign trade data show that the three largest countries in the region (Brazil, Argentina and Mexico) and two countries in the Andean group (Columbia and Venezuela) account for nearly 85 per cent of the agricultural machinery produced in Latin America. In general, all the countries of the region produce handtools. However, goods which require more technological sophistication are produced mainly by the larger more advanced countries like Brazil, Argentina and Mexico and the medium-sized countries such as Columbia and Venezuela. But, unlike the larger countries, the medium-sized countries are net importers of more sophisticated agricultural machinery such as tractors and other powered machinery. The small countries of Central America produce mainly handtools - mostly machetes - and are net importers of most agricultural machinery and implements.

For most countries in Latin America the agricultural machinery does not exist as a separate activity. In Brazil, for example, the industry is part of the metallurgical and transport equipment manufacturing industries. In the small countries of Central America, the industry hardly exists at all. In Guatemala, for instance, there are only a handful of firms producing agricultural machinery - mainly machetes - and two or three firms which produce at the national level. In many countries - even in the largest advanced country Brazil - most of the agricultural machinery produced is for domestic markets.

The agricultural machinery and implements industry in Latin America suffers from a major obstacle which greatly hinders the development of the industry. This is the fact that few countries have elaborated clear rationales to justify the establishment and/or the strengthening of an agricultural machinery industry - that is, how the development of an agricultural machinery industry furthers overall national development goals. This has led to the absence of an integrated strategy towards the industry which means that there is not an effective merger at the policy-making level between strategies and programmes of action for the mechanization of agriculture and the construction and/or the development of other related industries and infrastructures. The lack of an integrated strategy towards the industry also implies that less than optimum usage is made of backward and forward linkages in manufacturing industries, agriculture, infrastructure and also in manufacturing processes within firms. Not surprisingly, another consequence of this virtual absence of integrated strategies is that there is a lack of institutional mechanisms to co-ordinate policies and inadequate identification of means of action to implement policies.

The industry also suffers from additional obstacles to production which are severely constraining the development of the industry. Among the additional obstacles to production, common to the whole of Latin America, are the following:

(a) The uncertainty caused by frequent changes in agricultural and national economic policies which adversely affects production and investment in the industry;

(b) Inappropriate macroeconomic policies;

(c) Inadequate marketing of products;

(d) Inadequate standardization of products and quality control;

(e) Inadequate infrastructure, especially transport and communication;

(f) Inadequate designs;

(g) Inadequate financial resources;

(h) Lack of technical know-how;

(i) Lack of human resources, especially trained personnel at middle-management level;

(j) Inadequate knowledge of associated industries at home and abroad;

(k) Inadequate R&D, testing, evaluation and fabrication of prototype equipment suitable for local conditions;

(l) Inadequate repair and maintenance service facilities, with training facilities and extension services;

(m) Inadequate support for small- and medium-scale production of AMI;

(n) Inadequate supply of raw materials and other inputs;

(o) Lack of information about products or a regional technical and commercial information network on agricultural machinery and implements;

(p) Inadequate stocks of spare parts.

In addition to the above mentioned obstacles to production common to all Latin American countries, the following are obstacles which especially hinder development of the less advanced countries of Latin America, such as the smaller countries of Central America:

(a) Low level of technological sophistication which implies limited successful participation in international markets;

(b) High dependence on imported products and components such as gears, transmissions, valves, tearing, wheels, axes, pumps, and so on.

(c) Low level of horizontal integration as a results of the low level of economic development;

(d) Lack of institutional technical assistance and training;

(e) Small market size which imply small production runs and higher unit costs of production.

2.2 Recommendations

The recommendations of this study relate to concrete programmes of action at the national, subregional, regional and international levels to remove obstacles to the production of AMI and to promote the development of the industry.

2.2.1 National programmes of action

National governments should elaborate concrete programmes of action to remove obstacles to the production of AMI. Among possible candidates are the following:

<u>OBSTACLE</u>	<u>POSSIBLE SOLUTIONS</u>
1. Lack of raw materials	Central purchasing, ensure adequate prices are paid to farmers
2. Small markets	Multi-product production, common markets, exports to neighbouring countries, appropriate designs
3. Lack of human skills	Appropriate designs, de-mechanize and/or de-automatic production, training centres
4. Inadequate financing	Loans, subsidies, grants, tax preferences, tax land, use of consumption and value added taxes, income taxes, export incentives, give income from stabilization schemes to small farmers
5. Inadequate infrastructure	Long-term strategy: build-up; short-medium term: establish better links within the country and to neighbouring countries; designs and products requiring less sophisticated infrastructure
6. Inadequate links between sectors, firms and industries producing, especially, capital goods	Provide better co-ordination and information; establish national agricultural machinery planning board
7. Insufficient technical know-how	National R&D centres, alternative simpler designs, training centres, links with other neighbouring and/or more advanced countries
8. Inadequate marketing	More time and resources for adequate marketing
9. Lack of product standardization	Strong encouragement to standardize products; establish national product standardization institute

- | | |
|---|---|
| 10. Inadequate information about products | Establish a national agricultural machinery information bank |
| 11. Inadequate stocks of spare parts, repair and maintenance of AMI | Adequate training in operation and maintenance of AMI; finance to accumulate adequate quantities of spare parts |
| 12. Inappropriate macro-economic policies | Avoid overvalued exchange rates and frequent changes in national economic policies, careful use - if at all - and monitoring of import controls, control inflation and prevent balance of payments crises |

2.2.2 Subregional programmes of action

Subregional bodies should consider the following programmes of action:

- (a) Provide relevant information to member countries;
- (b) Encourage subregional co-operation in research and development;
- (c) Implement subregional co-operation by means of regular meetings and communications between the various national bodies which co-ordinate policies to aid the development of AMI;
- (d) Assess obstacles to co-operation and identify measures to overcome them;
- (e) Establish a subregional information unit on AMI;
- (f) Establish a subregional network for R&D and specialized training;
- (g) Exchange information and advice on procurement practices;
- (h) Identify partners for joint ventures and other co-operative production arrangements such as Multinational Production Enterprises and other innovative forms of ECDC/TCDC.

2.2.3 Regional programmes of action

Regional bodies in Latin America should consider the following programmes of action:

- (a) Establish regional R&D centres to help make research economical and commercially viable, and to provide prototypes;
- (b) Establish regional AMI information centres;
- (c) Establish regional networks to provide training facilities for R&D;
- (d) Provide travelling rural exhibitions of appropriate AMI;
- (e) Establish regional centres and/or agreements to standardize AMI products;

(f) Encourage agreements for regional specialization in the manufacture of products;

(g) Establish regional centres to provide appropriate product designs for local conditions;

(h) Facilitate agreements to remove trade barriers within the region;

(i) Strengthen or establish co-operative ventures between member states;

(j) Identify existing obstacles facing interregional production units and develop measures to remove these obstacles;

(k) Implement regional programmes of action by means of regular meetings and communications between member states.

2.2.4 Programmes of action for UNIDO and other international agencies

UNIDO and other international agencies should consider the following programmes of action or technical assistance:

(a) Provide new methods of financing and material support;

(b) Undertake pilot studies of strategies for fostering the development of AMI;

(c) Undertake pilot rural workshop schemes; create a data base of appropriate manufacturing plans or drawings;

(d) Provide relevant statistics, sectoral studies and technological information;

(e) Assistance to strengthen the capabilities of local institutes to test, evaluate, design, develop and fabricate prototypes of equipment suitable for local conditions; assistance to establish appropriate methods for testing and evaluation of AMI;

(f) Assistance to establish decentralized repair and maintenance facilities, with appropriate training facilities and extension services;

(g) Assistance to strengthen the R&D capabilities of national institutes by providing consultancy services, training facilities and making available designs and prototypes of appropriate AMI;

(h) Assistance to establish pilot and demonstration units for the small- and medium-scale production of AMI and ultimately in the establishment of commercial production units;

(i) Assistance to explore the possibilities of providing more technical and financial assistance that is in keeping with the social and cultural values of Latin American countries;

(j) Assistance to explore, and where warranted, facilitate "debt-equity" swaps;

(k) Assistance to restructure existing systems of tariffs, taxes, subsidies and other protective measures;

(l) Assistance to assess the costs and benefits of "counter-trades" to the AMI industry;

(m) Assistance to explore the possibilities of more extensive and innovative forms of South-South co-operation such as Multinational Production Enterprises and other forms of ECDC/TCDC;

(n) Assistance to strengthen and/or set-up national systems of metrology, standardization and industrial quality; and, help to plan, design and implement pilot/demonstration programmes in this area;

(o) Assistance to encourage the growth of regionally dispersed small- to medium-scale production of AMI in Latin America;

(p) Assistance to develop expert systems, where appropriate, for the repair and maintenance of AMI;

(q) Assistance to pair sister AMI producing enterprises in Latin America with those in other countries;

(r) Assistance to develop new types of simplified AMI for use and also for manufacture.

3. SOME BASIC PREREQUISITES: IDENTIFY THE DEMAND FOR AMI AND CURRENT ABILITY TO SATISFY IT

This study presents guidelines for the development of the agricultural machinery and implements (AMI) industry in Latin America. In the past in Latin American countries, as in other developing regions, agriculture and industry have been sectors in competition for domestic investment and external technical assistance. However, it has long been UNIDO's position that agriculture and industry are, and must be, complementary sectors in appropriately designed industrialization strategies for developing countries. It has also been UNIDO's position that the absence of comprehensive and integrated industrialization policies are often a major obstacle to the economic and social progress of developing countries. In terms of the agricultural machinery industry, comprehensive and integrated industrialization policies imply the elaboration of an effective merger at the policy making level between strategies and programmes of action for the mechanization of agriculture and the construction and/or the development of other related industries and infrastructures.

An integrated strategy to foster the development of an indigenous AMI industry requires:

- The designation of objectives;
- The identification of the current situation of the sector in the country, policies and mechanisms for developing the industry;
- The identification of constraints to production;
- The evaluation of existing institutional mechanisms to develop and co-ordinate policy actions;
- The identification of means of action to implement policies.

On the basis of the above criteria volume I of this study is divided into five chapters. The third chapter elaborates the objectives and other basic prerequisites for the integrated development of an AMI industry such as the identification of the demand for AMI and a country's current ability to satisfy it. In chapter 4 the need to take an integrated approach towards the manufacture of AMI is discussed. This approach emphasizes the maximum usage of forward and backward linkages in manufacturing industries, agriculture, infrastructure and also the manufacturing processes within the firms.

Finally, specific national, regional and international programmes of action to foster the development of the industry are presented in chapter 5. These programmes of action are designed to produce concrete results and therefore pay special attention to the specific characteristics of developing countries in Latin America.

3.1 Why the development of AMI is important for Latin America

An appropriate strategy for fostering the AMI industry^{1/} in a particular country can only be formulated after the government of that country is absolutely certain as to the precise reasons why the development of the AMI industry is important. For Latin America, these rationales clearly differ

1/ For a definition of the term agricultural machinery, see appendix: Definition of Mechanization.

from country to country. However, all countries have the common goal of economic and social progress. The achievement of economic self-sufficiency in the production of food and the means to industrialize is often considered important for this overall goal by Latin American decision-makers.

However, whether a country should develop an indigenous AMI industry largely depends on comparative advantage and not necessarily the issue of self-sufficiency in food production. After all, as some countries in Latin America have correctly argued, if a country can use its resources more efficiently by developing other industries, or agriculture, it makes little sense to squander its resources by building up an agricultural machinery industry in pursuit of a goal of self-sufficiency in food production. This argument is especially relevant if the goal of self-sufficiency in food may also be achieved more efficiently by importing AMI at less cost than developing a domestic capability in the production of AMI. Each country, therefore, has to make sure that it has, or potentially has, a comparative advantage in the production of AMI - or failing that strong non-economic reasons - before it devotes scarce resources to the promotion of its own AMI industry.

On the other hand, the promotion of a domestic capability in AMI production does have a number of strong attractions. In the short term this would allow individual countries to produce the same amount of food more cheaply, and in the longer term to produce more food at the least possible cost. Indeed, if Latin America's agricultural potential is to be fully realized, the linkages between agriculture and industry must be strengthened. In this regard, the provision of agricultural tools and implements through the development of an indigenous AMI industry could play a pivotal role. Furthermore, the development of local agricultural machinery industries in Latin American countries can help alleviate the external debt problems of the region by promoting the local production of currently imported goods which account for significant amounts of the region's foreign exchange. More importantly, the development of the AMI industry would ultimately allow individual countries to release scarce resources to help satisfy other legitimate development goals.

For some countries, the production of AMI can also be a springboard for the production of other capital goods. This is because the production of AMI requires similar processes, tools, and production equipment as other capital goods. The production of AMI also requires similar technology, methods of organization of production, skills, professional qualifications and raw materials as capital goods production. In addition, the production of AMI can be the foundation from which manufacturing skills and industrial traditions could develop.

Given an appropriate strategy for the development of the AMI industry the production of AMI can create additional employment in rural non-agricultural sectors and also in agriculture.

3.2 What is the demand for AMI?

In order to formulate an appropriate strategy for the development of AMI it is important to identify the existing structure of the AMI industry in terms of the demand and supply of AMI. This requires that the demand for AMI be identified along with the current capability to satisfy it. We begin with guidelines to establish the demand for AMI.

The first stage of a programme for promoting the development of AMI should be a forecast of the demand for these products. That is, to establish which machines and equipment will enable particular production units to achieve an effective increase in production and income; and also to define appropriate strategies for agricultural mechanization compatible with the objectives of national industrial strategies.

Giving expression to the demands of the agricultural community is a major element in a mechanization strategy. Evaluations are usually based on extrapolations of past import statistics and expressed exclusively in terms of products - for example 100 tractors, 2,000 ploughs, and so on. However, this neglects the social and geographical aspects of agricultural development. It also perpetuates the dominant technology patterns of the past--excluding, for example, all the equipment not usually thought of as agricultural machinery. Thus, an agricultural development plan may be drawn up in terms of the direct requirements for harvesters, tractors, threshers, and so on but neglect other items whose absence will lead to fundamental bottlenecks, such as transportation networks, raw materials, energy, and storage facilities.

Determining the demand for agricultural and rural equipment needs is a three-stage process:

The first step is to analyse the basic parameters in the patterns of mechanization: the characteristics of the agro-socio-ecological system (crops, soils, rain conditions, land systems, types of farms, the manpower density, the level of farmers' revenues, the present state of mechanization and the equipment currently used). This gives a background technical map of mechanization needs, which can be used as the base line for future planning.

The second step is to translate the objectives of food production and food self-sufficiency into short, medium and long-term scenarios focused on the demand for equipment by farmers and rural communities. Modernization of traditional agriculture is therefore expressed as the demand for agricultural machinery by social groups such as rural families, villages, towns or groups of towns and villages.

The third step consists of ascertaining the gap between the technological level of mechanization required and that which is available to meet the demands identified. Here it is important to consider the whole range of technological alternatives that are open and not be blinkered by what is currently used. For example, if transport is identified as a key bottleneck, the priority will be to find an adequate transport system. The answer is not necessarily a conventional tractor.

It cannot be emphasized too often that the structural changes expected from a long-term mechanization strategy will not materialize if a passive attitude towards technology is adopted. The results of past and present technologies are already known: they have rarely succeeded in meeting their main objective of increasing agricultural output, and have even brought new problems.

The final step in demand estimation is the quantitative evaluation of demand in terms of how much equipment of each type is demanded in a given period. In every situation this evaluation will have two aspects:

(a) The technical requirement: nature of product, technical performances, conditions of use, costs, energy source, maintenance problems;

(b) The social requirement: which users—individual families, whole villages, or towns—are involved?

Quantitative assessment of final demand must be related to the objectives identified in the step I: food self-sufficiency and food production targets, the level of investment in agriculture, the level of employment, and a desired standard of living for rural people.

3.3 The need to identify appropriate products for agricultural mechanization and rural development

To be able to forecast the demand for AMI requires that national governments clearly identify which machinery and equipment are appropriate for the envisioned agricultural mechanization and rural development, or for the achievement of any other additional national objectives. In other words, individual governments should have a specific product specification and demand list. Since this depends on the particular development objectives of a country, one can only give general criteria for guidance in the selection of "suitable products" for individual countries. Products should be chosen in accordance with the following criteria:

- Which crops are to be produced;
- The particular soil conditions of the country;
- What pieces of machinery and equipment farmers can effectively demand - demand that is backed by sufficient income;
- What raw materials (inputs) are required;
- Sizes of farms in the country;
- Existing land ownership arrangements;
- What ancillary and supporting industries are required;
- What supporting infrastructure is required;
- The amount of labour required relative to capital;
- What supporting marketing, after sales service/repair and maintenance is required;
- The complexity of the products given the technological level of the particular country;

UNIDO has elaborated a typology for establishing the technological level of a country.^{2/}

^{2/} Monographs on Appropriate Industrial Technology, No. 4, Appropriate Industrial Technology for Agricultural Machinery and Implements, UNIDO, United Nations, New York, 1979.

The UNIDO classification of technological levels is as follows:

- (i) Technological Level I - produces mainly agricultural hand tools and manually operated equipment;
- (ii) Technological Level II - produces mainly animal-drawn machinery and implements;
- (iii) Technological Level III - produces mainly agricultural power-operated machinery and equipment.

Obviously, the choice of suitable items for production depends on a wide range of criteria, which will vary from country to country. Nonetheless, general guidance for the choice of appropriate products is possible. UNIDO has also developed a list of products suitable for the particular types of production units in various developing countries.^{3/}

3.4 The need to determine the current national capabilities for local production

Having established the demand for AMI in a country according to the major systems of agricultural production, the next stage is to find out what local means are available to meet this demand. The first priority is to determine the current national capabilities for local production of AMI.

A census may be used to ascertain national capabilities for local production of AMI. In addition, an analysis should be made of different national AMI production units to assess their capabilities, their past and present achievements, and their problems. The analysis of domestic industrial supply should break down domestic supply into units capable of producing the major categories of machines and equipment demanded.

There are three distinct types of production units found in Latin America: rural workshops, small to medium scale firms and large scale firms. For example, the AMI industry in Guatemala and El Salvador consists mainly of rural workshops. In Venezuela, most production units are small-to-medium sized firms. Brazil has all types of production units but more large scale firms than any other country in Latin America.

The classification of production units varies from country to country but as an approximation the following scheme is commonly used. A rural workshop is a production unit located in rural areas, is usually a family owned unit and employs one to five people. Production is usually carried out by manual operation, with little or no application of power operated machines. In addition, production is undertaken in self-contained simple facilities, and except for raw materials, nothing is purchased from the outside.

A small sized firm is generally located on the border of urban and rural areas and employs between six and one hundred people. These firms use a mixture of manually-operated machine tools and power-operated simple production machinery. They produce selected basic products on a continuous basis and provide a variety of services, such as repair and maintenance, ad hoc outside jobs and spare parts. Small firms have limited supporting facilities such as foundries and forges, and besides basic raw materials purchase selected components and hardware from the outside.

3/ Ibid.

Medium to large firms are based in urban areas and employ at least 100 people, and generally considerably more. They produce specific products or groups of products in large volume using semi-automatic and automatic special purpose machines. They normally have, or have access to, specialized supporting facilities such as foundries, forge shops, heat-treatment facilities, tool rooms, and quality control laboratories. The manufacturing programme of such firms is based on imports of selected components and local purchases of components through ancillary industries.

3.5 The need to identify the obstacles to production experienced by each type of production unit

Having determined current national capabilities for local production, the next step should be to identify major obstacles to production experienced by the production units. These obstacles naturally differ from country to country, but in general the following have been identified as problems for the AMI industry in Latin America.^{4/}

(a) Family-owned rural workshops have encountered problems with:

- Lack of raw materials;
- Inadequate designs;
- Inadequate financial resources;
- Lack of technical know-how;
- Inadequate quality control and marketing.

(b) Small to large firms generally face problems due to:

- Domestic markets of small size;
- Inappropriate designs;
- Uncertain availability of spare parts and maintenance;
- Lack of standardized products;
- Rising raw material prices;
- Lack of trained personnel at middle-management level;
- Insufficient financial resources;
- Inadequate infrastructure;
- Inadequate knowledge of associated industries at home and abroad.

^{4/} See, "The Multipurpose Approach to Agricultural Machinery Manufacturing", sectoral working paper series No. 46, UNIDO/IS.607, 12 February 1986, and "A Survey of the Latin American Agricultural Machinery Industry", sectoral studies series No. 6, UNIDO/IS.407, 16 September 1983.

3.6 The need to identify existing institutional mechanisms for co-ordination and promotion of the development of AMI production

It is important to take stock of existing mechanisms for co-ordination and promotion of the development of AMI in order to assess their adequacy. To make this assessment one must first identify what institutional mechanisms exist to co-ordinate policies to aid the development of AMI - for example, a national agricultural machinery planning board or committee. Examples of such boards are Venezuela's National Commission on the Mechanization of Agriculture and Brazil's National System of Metrology, Standardization and Industrial Quality - SINMETRO. However, Brazil's SINMETRO system encompasses more than just the AMI industry.^{5/}

Next, relevant decision-makers must identify and assess which institutional mechanisms exist to ensure:

- That technology is selected and/or adapted so that it is suitable for local conditions;
- A continuous flow of information on products and process improvement;
- A scheduled supply of raw materials, finance and manpower;
- That research and development can be made commercially viable;
- Adequate prototype support;
- An adequate supply of spare parts and maintenance services;
- Adequate engineering/technical back-up (or technical assistance) and institutional support.

In sum, an evaluation of the current situation of the AMI industry in a particular country requires methodical performance of all the steps detailed in the previous subsections - that is, subsections 1-6. This accomplished, it is important to develop an integrated approach towards the manufacture of AMI. Why an integrated approach must be taken is the subject of the next section.

^{5/} For details, see the country studies in volume II of this study.

BOX I

Basic prerequisites in designing a strategy to foster the development of the AMI industry

1. Decide why the development of AMI is important for your country.
2. Analyse the current situation of the production of agricultural produce.
3. Identify the demand for AMI.
4. Break down the demand for AMI according to major systems of agricultural production (i.e. types of farms).
5. Quantify the demand for AMI as a function of the major categories of machines, equipment and implements.
6. Identify appropriate products for agricultural mechanization and rural development.
7. Analyse domestic supply in terms of the current ability to satisfy existing demand.
8. Break down industrial production as a function of the major categories of AMI demanded.
9. Compare existing demand and supply of AMI; highlight deficits and surpluses.
10. Identify the obstacles to production experienced by each type of production unit.
11. Identify existing institutional mechanisms for co-ordination and promotion of the development of AMI production.
12. Evaluate the current situation of the AMI industry in your country.

4. THE NEED TO TAKE AN INTEGRATED APPROACH TOWARDS THE MANUFACTURE OF AGRICULTURAL MACHINERY AND IMPLEMENTS

High rates of growth in the agricultural machinery industries of Latin American countries cannot occur without the implementation of dynamic and deliberate development strategies. As was stressed in chapter 2, since to increase the production of agricultural machines is not an end in itself but rather a means to achieve the objectives of agricultural and general economic and social development, the development of AMI production must follow an integrated strategy of developing industry in conjunction with the mechanization of agriculture. That is, an integrated strategy involves the integration of agricultural mechanization strategies with those for developing the agricultural machinery industry. As FAO has appropriately stated:

Most developing countries are primarily agrarian societies in which agriculture is the main source of wealth. Thus, an increase in agricultural productivity is the primary requirement for setting the whole rural development process in motion, and for the overall economic development of these countries. However, agricultural production does not take place in isolation, but is a part of the whole of rural society. Rural development, therefore, goes beyond agricultural development alone. It encompasses all the people and resources in the rural setting and emphasizes improvement in the level of living of the rural poor and involvement of all rural people in the development process, with the ultimate aims of reducing hunger and poverty and of improving the quality of life.^{6/}

In addition, changes in agricultural technology should also reflect the need to:

- Distribute food from surplus to deficit areas;
- Develop adequate storage facilities to prevent spoilage and "stretch out" the season;
- Pay the farmers adequately for their production;
- Ensure timely and adequate supplies of such inputs as seeds and fertilizers.

The above considerations emphasize the important linkage between agriculture, industry and all other rural activities performed both by farmers and their families and by rural communities as a whole.

The major elements required to develop an integrated approach can only be defined after it is clearly known what strategy towards agricultural mechanization will be followed, what the demand is for specific agricultural machinery and equipment, and what products can be manufactured locally. In other words, the question of "how to produce" should be considered only after answering the question "what is to be produced?". In the previous chapter

^{6/} FAO, "Agricultural Mechanization in Development: Guidelines for Strategy Formulation", FAO Agricultural Services Bulletin 45, Rome, 1981.

guidelines were provided to help answer the question: "what is to be produced?". We now need to provide guidance on "how to produce in an integrated manner?". To do this, we need to address the following questions:

- Should encouragement be given to uni-product manufacture or to multi-product/multi-purpose manufacture?
- What strategy should be followed towards agricultural mechanization?
- How can the maximum use be made of backward and forward linkages in manufacture, between manufacturing industries and infrastructure?
- What institutional mechanism should there be for co-ordinating an integrated or linked approach?

4.1 Should uni-product manufacture or multi-product/multi-purpose manufacture be promoted?

In formulating an integrated strategy for AMI the developing nations of Latin America must decide between the promotion of uni-product manufacture and multi-product/multi-purpose manufacture. A major obstacle for all but the largest and most technologically advanced Latin American countries - Brazil, Argentina, Mexico - in developing a thriving AMI industry is the fact that most countries especially those in Central America like Guatemala and El Salvador, because of the small size of domestic markets, cannot have long enough production runs to enable them to reap the scale economies of high volume production. One method of overcoming this obstacle is to promote multi-product/multi-purpose manufacture, where appropriate.

The multi-product/multi-purpose approach, though conceptually appealing, is not necessarily easy to implement. Multi-product manufacturing requires the development not only of multi-production plants but also the establishment and/or co-ordination of a range of groups of industries, products and processes so that the benefits of the approach can be fully utilized. Thus, the difficulty with the multi-purpose approach is that it requires a careful analysis and matching of two major aspects:^{2/} what products are to be manufactured and what technology is to be used. Products which are similar to produce should be chosen so that many different short production runs amount to a long production run with consequent cost savings. Production should be based on plants which use only a few technological processes but which are flexible enough to permit the manufacture of several products. Obviously, matching these aspects of multi-production is not necessarily straight-forward. There are a number of more specific requirements for the successful implementation of a multi-product approach.

In this connection, it should be emphasized that the successful implementation of uni-production also has to meet these requirements but the difference is that for multi-purpose production these constraints are more binding. A multi-product approach requires that:

- Small and medium manufacturers produce implements and equipment suited to the local conditions and for which a market exists or can be developed;

^{2/} "The Multipurpose Approach to Agricultural Machinery Manufacturing in Latin America", sectoral working paper series No. 46, UNIDO/IS.607, op. cit.

- There must be an adequate, effective demand for the products produced;
- A regular supply of good quality raw materials and spare parts be available;
- Sufficient foreign exchange be available to import raw materials and spare parts where this is required;
- Adequate supplies of skilled labour be available;
- Energy supplies be reliable and available at reasonable cost;
- Adequate credit facilities be available to farmers to purchase equipment;
- Extensive training and advice on the correct operation of equipment be provided so that equipment may be used efficiently and profitably.

If the above requirements are met, the multi-product approach can be successfully implemented. However, the multi-product approach does have several possibly undesirable implications which should be considered:

- The greater the degree of product diversification the less efficient is the manufacture of each product;
- Product markets differ and have their own unique characteristics;
- Components and parts are often different for each product and thus require several suppliers;
- Because markets are small, it is difficult to plan ahead for the various products made;
- A successful experience with existing products is necessary before extending the range of products made;
- Because of the risk of overproduction of existing products, there must be a continual development of new ones;
- The distribution of certain products is often done through different channels, thus making the sale of the complete range difficult;
- The technologies used to manufacture the products, even if similar in some cases, can be extremely complicated.

Thus, before adopting a multi-product approach to AMI production individual countries must make a careful assessment of the costs and benefits of this approach with respect to their own specific circumstances. Large plants in Latin America designed for the mass production of one product have in many cases failed to adapt their production processes to the changing demand for variety and quality. In such circumstances, the multi-purpose plant may be what is required to meet the diversified requirements of farmers and their related agricultural activities. For countries such as those in Central America and Colombia, however, where most tools produced are simple and low in cost, the prospect of developing a viable multi-purpose approach

for the production of AMI is remote. However, the multi-purpose approach is being tried with some success in Venezuela and Brazil.^{8/}

4.2 The development of an appropriate strategy for agricultural mechanization

Mechanization is often falsely associated with large-scale tractorization of farming. This has led to the erroneous impression that an appropriate strategy for agricultural mechanization should focus solely on the decision to buy tractors - and subsequently on what type of tractors - instead of exploring the whole range of alternative packages of mechanical technology. The early mechanization policies of Brazil, Venezuela and Columbia are good examples of this. An agricultural mechanization policy for any country is only appropriate when directed towards the demands of the farmers of that country. It must aim at complementing man with machines (and animals where their use is possible) instead of being simply a way of substituting mechanical energy for human labour in order to maximize farmer productivity. It must be developed with respect to the specific characteristics of the social and economic system of agriculture in a country. An appropriate mechanization strategy would therefore reflect a country's agricultural system and farming methods, the relative priorities between food crops and export crops, the nature of each crop, the technological development of the country, and of course the nature of the farmers themselves, who will ultimately use the machines - their interests, their values and their abilities. To simply equate an appropriate mechanization strategy with tractorization is to ignore the myriad social and economic characteristics of individual Latin American countries, in which many farmers are poorly educated and have little training in use or maintenance of sophisticated tractors even if they could afford them, which many cannot. For these reasons, a tractorization policy - a policy of mass tractorization - may be appropriate for Brazil but is clearly not so for El Salvador or Guatemala. Past experience of the tractorization strategy of mechanization in Latin America - for example, in Brazil - is that it is mainly suitable for larger, more affluent, modern farms and thus is largely to the benefit of the rich. Tractorization in Latin America, because of its expense, has often claimed most of the available funds for the purchase of agricultural machinery to the detriment of the small rural farmer, who is often insolvent. A crucial issue for many Latin American countries that must be addressed in an appropriate strategy for agricultural mechanization is how to equip low-income farmers, who live in many cases in a subsistence economy and are by normal criteria insolvent. This is especially important for countries like Guatemala and the other small countries of Central America.

In Brazil the policy has been to support mechanization where it has already been introduced but to encourage greater absorption of labour elsewhere, especially in the Northeast and in settlements along the Amazon

8/ See, the country case studies in volume II; "The Multipurpose Approach to Agricultural Machinery Manufacturing in Latin America", *op. cit.*; UNIDO/PC.133, "Expert Group Meeting on the Establishment of Multinational Production Enterprises in Developing Countries", 13 February 1986, p.4; UNIDO/PC.99, "Enterprise to Enterprise Co-operation among Developing Countries: Elements for a Global Strategy", 17 April 1984; and UNIDO/PC.121, "Multinational Production Enterprises: A Preliminary Overview", 10 September 1985.

river. Priority is given for loans for machinery to cultivate cotton, groundnuts, maize, rice, soya-beans, wheat and artificial pastures in the Centre-South. Unfortunately the policy to encourage labour intensive agriculture in Amazonia is unlikely to be effective. This is because many of the settlers come from the heavily mechanized Centre-South and it is difficult to prevent them from exercising their know-how. Also, since the domestic tractor industry is often working at below capacity levels and relies heavily on government subsidies it is likely to call for a change in policy.^{9/}

In Chile, agricultural mechanization, in all its aspects, has been studied intensely. A particularly important study made recommendations for mechanization policy in six separate zones.^{10/} These recommendations were based on the need to overcome labour bottlenecks at certain times during the year and to maximize the demand for labour at other times. The recommendations covered all facets of mechanization policy especially credit, imports and training.

Mechanization has been studied closely in Colombia as in other countries. Recommendations from studies undertaken in Columbia are based on the premise that strong emphasis should be placed on mechanization which is the most effective complement to yield-increasing improvements. In Colombia this means encouraging mechanization of soil preparation and planting and of the harvesting of rice. Increased tractorization in Colombia has been justified by the fact that rapid harvesting of rice frees labour for double cropping in the tropical irrigated areas. It is also argued that most of the negative effects on employment this encourages should be tolerated because of the greatly increased production that is possible with mechanization.

On the other hand, there are exceptions to this general principle. The recommendations also discourage mechanization of post-planting operations and harvesting of crops besides rice as it is argued that this displaces too much labour.

Other recommendations are that mechanization should be complemented by encouraging use of improved seed varieties, fertilizers and pesticides. To add perspective to the above at discussion one should note that the above proposals have been attacked by the major importers of agricultural machinery. Similar protests may occur in other countries which adopt Columbia's approach to agricultural mechanization.^{11/}

In sum, appropriate mechanization must be selective, dynamic and forward-looking. It must not be intended to "freeze Latin American agricultural technology at an 'inferior level', but to ensure that the technology introduced is more in line with the current stage of development of the region and that its benefits are more widely spread than at present through the whole farming community" and not just the rich, large farms.^{12/}

9/ See K.C. Abercrombie, "Agricultural Mechanization in Latin America", International Labour Review, Vol. 106, (July 1972), pp.11-45.

10/ See, CORFO, Mechanización agrícola en Chile: diagnóstico a 1963, cited in Abercrombie, op. cit., p.41.

11/ Ibid.

12/ Abercrombie, op. cit., p.39.

Selective or appropriate mechanization is not or cannot be "an all-out pursuit of labour intensity".^{13/} It is important that for the operations, crops, regions or subsectors where mechanization should be limited that an alternative technological basis be provided. For example, if mechanization is de-emphasized then this should release resources for improved irrigation, use of better seeds, fertilizers and pesticides.

It is probable that a strategy of mixed mechanization is more appropriate than tractorization for most Latin American countries, excepting the large advanced countries like Brazil, Argentina and Mexico. Though the specifics of such a strategy will depend on the individual characteristics of each country, it is clear from the preceding discussion that an appropriate agricultural mechanization strategy should provide equipment that should at a minimum meet four criteria:

- It should perform required tasks in actual conditions of use, not only in test programmes;
- It should be generally able to act as a complement to human labour (and as far as possible not substitute for it);
- It should correspond to the financial and technical capabilities of users;
- It should be suited to local repair and maintenance so that users receive full-time benefit without dependance on external suppliers of maintenance services.

As the case studies in volume II point out in detail, these considerations suggest, for example, that the production of hand tools such as machets and big hoes would be a more appropriate mechanization policy for the smaller countries of Latin America such as El Salvador and Guatemala.

4.3 An integrated strategy for AMI production requires maximum usage of backward and forward linkages between manufacturing industries, infrastructure and manufacturing processes within firms

When formulating a strategy for local manufacture of appropriate AMI many economic benefits can be gained from the maximum usage of forward and backward linkages between manufacturing industries, infrastructure and manufacturing processes within firms.

The agricultural machinery industry has forward and backward linkages with other sectors of the economy. It has a forward linkage with the agricultural sector which uses its products, and a backward linkage with the industrial sector - for example, the metal working and metallurgical industries - which supplies inputs to be used in the production of agricultural machinery. These linkages also extend to existing infrastructure such as roads, transport and financial systems.

13/ Ibid.

How backward and forward linkages can be maximized obviously depends on the specific industries, economic institutions and infrastructures that exist in individual countries. However, general guidelines can be given that are pertinent to many countries in Latin America. It is important that:

- Local manufacture of suitable AMI be promoted to meet the requirements of agriculture and rural industrialization;
- Production of AMI be incorporated, to the greatest extent possible, with other appropriate engineering and metallurgical products that also could be manufactured locally to meet the needs of sectors (these are likely to be the needs for transport, land development, irrigation, construction, and equipment for mining, forestry, energy exploration and the industrial sector);
- Optimum usage be made of factory capacity through rationalization in manufacture;
- Maximum possible usage be made of existing raw material processing plants such as iron and steel mills, re-rolling plants, general foundries and forges and wood-working plants;
- Maximum possible attention be given to the development of basic facilities and spare parts manufacture, and to the promotion of ancillary industries and subcontracting between ancillary industries and manufacturing plants;
- Existing engineering industries be upgraded and their production diversified;
- Linkages be created or strengthened between production units and engineering design and development institutes;
- Institutional facilities be established or strengthened to provide back-up support to help adapt foreign technology to local conditions;
- Where appropriate, multi-purpose product designs, and production techniques and facilities be promoted.

The concept of linkage is therefore an important aspect to be considered before any actual production programme is elaborated. These linkages in the production of AMI can be established by creating new production units and/or upgrading existing ones.

4.4 The importance of providing an institutional mechanism for an integrated strategy

An integrated strategy for the development of AMI production requires an institutional mechanism for national planning and co-ordination of policies. One possible institutional mechanism is a National Agricultural Machinery Planning Board. It would be a high-powered body with representatives from the national ministries of agriculture, industry, maybe health, planning and employment; private industry, agriculture (professional associations), and consumer associations. The board should have a chairperson who will have overall responsibility for the board's activities. The chairperson should be chosen from any of the representatives of the various groups on the board.

This person should have the full backing of the relevant groups to formulate and co-ordinate policies to foster the development of AMI. The major role of the board would be to gather information and co-ordinate policy to promote and facilitate the production of AMI. Thus the board would be the institutional setting where all those concerned with AMI - government, private industry, farmers, consumer groups - would help formulate appropriate national policy. The board would be the institutional mechanism where the supply and demand for AMI could be assessed and production of appropriate AMI could be facilitated by government information, financial inducements and guarantees, and technical assistance.

Few countries in Latin America, with the obvious exceptions of Brazil, Venezuela, and Argentina have national institutional mechanisms to co-ordinate the national development of the AMI industry.

The board would formulate programmes to aid the development of AMI production. The technical aspects of such programmes would include:

- Guidance on the choice of appropriate products to produce;
- Advice on the selection and adaptation of technology suitable for local conditions;
- Specifications of what basic facilities should be established and services required;
- Establishment of an Information Bank on agricultural machinery to ensure a continuous flow of information to interested parties on products and process improvement;
- Help to ensure a scheduled supply of raw materials, finance and skilled manpower;
- Identification of areas for research and development and turning research into commercial profitability.

The policy aspects of such programmes would also include:

- Promotion of basic facilities and services in the rural industrial sector;
- Promotion of basic infrastructure to encourage backward and forward linkages in the production of AMI;
- Exploring strategies for horizontal and vertical integration of domestic industry and, where appropriate, establish links with similar industry in neighbouring countries.

BOX II

The need to take an integrated approach towards the manufacture of AMI

1. Take an integrated approach towards the manufacture of AMI.
2. Decide whether to promote uni-product or multi-product manufacture.
3. Develop an appropriate strategy for agricultural mechanization.
4. Make maximum usage of backward and forward linkages between manufacturing industries, infrastructure and manufacturing processes within firms.
5. Provide an institutional mechanism for an integrated strategy.

5. SPECIFIC NATIONAL, REGIONAL AND INTERNATIONAL PROGRAMMES OF ACTION TO FOSTER THE DEVELOPMENT OF THE AGRICULTURAL MACHINERY AND IMPLEMENTS INDUSTRY IN LATIN AMERICA

Because of the scale of the problems of AMI industries in Latin America and the fact that they operate at the interface of agriculture and industry, solutions have to be found not only at the national level, but at the subregional, regional and international levels as well. What this means is that many obstacles which hinder the development of local production of AMI in Latin America call for regional and international solution not just national ones. For example, for many countries of Central America the problems posed by small market size are formidable at the national level but may not be so at the regional or international levels. This observation also applies to the acquisition of appropriate technology and know-how in many countries in Latin America.

5.1 Programmes of action for national governments

In this section, the intention is to provide general prescriptions that may be adapted to the specific conditions of a particular country.^{14/} The remedies offered below are clearly inappropriate for some countries. In view of this, each country should weigh these suggestions carefully with respect to their own specific circumstances and the experiences of others.

Having identified the real demand for agricultural machinery using the guidelines detailed in chapter 3, government policy should be to help facilitate an appropriate supply of AMI. To do this, governments need to identify what production units are available or could be available in the country (i.e. rural/family owner small workshops, small to medium sized firms, large firms) and what obstacles hinder the development of production in these units, and then design appropriate programmes of action to help remove these obstacles.

5.1.1 Lack of raw materials

Lack of raw materials is a common complaint of manufacturers of AMI in Latin America, especially in Central America. Production units cannot function efficiently without a regular supply of raw materials adequate for their purposes. One method to overcome the obstacle to production created by inadequate supplies of raw materials is for the government to encourage central purchasing of supplies of raw materials by firms. By collectively buying raw materials, producers can ensure more adequate supplies and pay lower prices, especially in international markets.

Another way to encourage regular supplies of raw materials would be for the government to ensure that adequate prices are paid to domestic suppliers of raw materials.

5.1.2 Small markets

Small markets present a constant problem for many producers of AMI and particularly for the smaller countries of Central America such as Guatemala. Small markets imply small production runs and higher unit costs of

^{14/} We do, however, give specific suggestions for specific countries in volume II of this study.

production. As mentioned earlier, carefully designed multi-product production may offer some solution to this problem. This would be a short term solution. A longer term solution may be to export to neighbouring countries organized into a common market. Unfortunately, previous experience with common markets in Latin America have not always been successful. A good example is the fate of the now defunct Central American Common Market (CACM).

5.1.3 Different thresholds of process-complexity

It is often not a smooth transition to go from one process to another. There are frequently technological jumps which act as constraints to technological advancement. These technological jumps are sometimes called thresholds of process-complexity; an example would be the difficulties of production units in Venezuela making the transition from assembly operations to full scale local manufacture of tractors.

There are a number of methods that may be used to overcome the problem of different thresholds of process-complexity:

- Develop alternative design technologies - for example, more use of designs aimed at local conditions and not those originally intended for developed countries;
- Design products so that they can be manufactured locally;
- De-mechanize and de-automate production processes so that they increase the use of labour; and automate certain processes which require highly qualified technicians that are often not available in sufficient numbers in Latin America.

5.1.4 Lack of human resources

Both the mechanization of agriculture and the development of the AMI industry require skilled manpower. Unfortunately many countries lack an adequate supply. The only real solution to this problem is to train the required manpower. This could be done through training schemes and the provision of training centres. Inevitably, training which imparts more sophisticated skills is a long term procedure. In the shorter term, a lack of human skills can be overcome, or at least alleviated, by exactly the same procedures that were advocated to remove the obstacles caused by different thresholds of process-complexity.

- Appropriate design of products;
- De-automate and de-mechanize production processes; and automate processes which require highly qualified technicians that are usually not available.

5.1.5 Inadequate financial resources

A major obstacle to the development of AMI in many countries is the fact that many farmers do not have the income to buy the AMI in order to increase

productivity. There are several approaches that can be used to help farmers purchase appropriate agricultural equipment^{15/}:

- Pay farmers adequate (market) prices for their products;
- Impose financial levies on the modern agricultural sector (large private estates, state farms and so on), if it does not greatly affect export growth; tax land as this does not discourage increases in productivity; and tax the distributors and importers of luxury food products (that is, tax the service sector related to food and agriculture);
- Introduce economy-wide consumption taxes such as specific commodity taxes or value added taxes with a wide base;
- Redistribute the funds obtained from agricultural stabilization schemes - funds built up from the difference between the prices paid to farmers and prices received for exports; redistribute these funds to rural small farmers;
- Use the personal income tax, as in Brazil, to give special treatment to rural farmers; allow farmers to deduct the expenses of acquiring AMI from their taxable incomes; encourage farmers to purchase appropriate AMI by the incentive of higher tax deductions;^{16/}
- Set up agricultural credit banks in rural areas, making sure that not all the money is taken by the rich, modern farmers.

It should be explicitly stated here that, in general, there are usually extremely good reasons to doubt the effectiveness of schemes to subsidize agricultural credit. These schemes often encourage usage of inappropriate capital-intensive techniques and AMI when there are large numbers of unemployed in rural areas. They are difficult to administer and often mainly benefit the large rich farms; and they tend to increase existing inequalities in wealth. This has been the experience especially in Brazil.^{17/} Nonetheless, a good argument on social grounds can be made for limited and carefully monitored credit schemes for poor small farmers. In addition, a case could also be made that subsidized credit is one way to overcome the natural risk-aversion of small farmers to adopting new machinery and technology. It can also be a good counter to the traditional vulnerability of poor small farmers, with no access to crop insurance, to high interest rates on seasonal credit.

^{15/} The following discussion draws heavily on "Agricultural machinery and rural equipment in Africa. A new approach to a growing crisis", sectoral studies series No. 1, UNIDO/IS.377; World Bank, Accelerated Development in Sub-Saharan Africa, The World Bank, 1981; World Bank, World Development Report 1986, The World Bank, 1986; FAO, Op. cit., 1981; and, A. Killick, "Economic Environment and Agricultural Development: The Importance of Macroeconomic Policy", Food Policy, February 1985, pp. 29-40.

^{16/} But note the reservations expressed about such schemes in the Brazil case study in volume II.

^{17/} See Brazil case study, op. cit.

As with many policy instruments, subsidized credit is not the panacea of all ills. If it is not carefully controlled and monitored to prevent the possible adverse effects mentioned above, it can cause more harm than good. It is therefore imperative that any country that wishes to adopt such schemes consider their benefits and costs with respect to their own unique characteristics, the experience of others similarly situated, and make regular assessments to determine whether these schemes are achieving their avowed purpose of helping poor small farmers. Some general guidance can be given to help ensure that subsidized schemes meet their desired objectives.^{18/}

First, credit schemes should be designed to accommodate the special needs of small farmers - that is, with respect to the rate and duration of credit, the cost of acquiring animals to help farm, and the need to delay payments in bad weather and natural calamities. It is important to remember that farmers often can only meet principal and interest rate payments after they have sold their crops.

Second, rural credit programmes need to be designed with an appropriate balance within and between the different types of inputs used in the production process. For example, it is ill-advised to provide credit to encourage the use of fertilizers but not for harvesting and threshing machines when an obstacle to increased production is a shortage of labour at harvest time.

Third, in designing credit schemes, it is also important to try to obtain a sensible balance between the private cost of capital and its social opportunity cost. For example, when credit is made available at below market rates for the purchase of labour saving technology, capital becomes artificially cheap. This may cause a balance towards the acquisition of capital intensive technology which may not be appropriate for many countries. Sadly, this appears to be the effect of subsidized credit in Brazil.^{19/}

Fourth, it is difficult to channel low-interest credit to low income groups. Low interest rates encourage a heavy demand for loans when there is only a limited amount of credit to go round. It is common to have excess demand for credit. This leads to the need for rationing of some sort and adds to the cost of credit. Low income farmers tend to be excluded by the rationing process. For example, small farmers often cannot meet requirements to hold collateral or compensating balances.

Also, because the transactions cost of loans frequently vary according to the size of the loan, smaller amounts tend to be rationed first - again, to the detriment of the small farmer. Governments can help small farmers by removing the obstacles to commercial credit. For example, governments can deal with problems to small farmers caused by land titles. Land titles often determine credit, since land is one of the few things farmers can use as collateral. Governments can help by trying to improve the quality of land titles.^{20/}

^{18/} See FAO, op. cit., 1981.

^{19/} See the Brazil case study, op. cit.

^{20/} See World Bank, op. cit., 1986.

Fifth, inadequate provision of credit usually arises from imperfections in capital markets: inadequate information, high transaction costs of loans, and requirements for collateral. Governments can help identify these frictions in the market and design policies to eliminate these problems so that credit markets can function properly and reach the small farmer.^{21/}

Sixth, a credit policy should be designed so as to eliminate the gains from inflation to those who get cheap government loans to purchase agricultural machinery. Unfortunately those countries which have tried to adjust loans according to the rate of inflation have not been completely successful. The problem is that it is not clear which index of inflation is appropriate. Ideally the rate of inflation should be calculated separately for each type of crop. But in practice it is difficult to use more than one overall index of inflation. This causes discontent among those producers whose own economic situation is not in step with the rest of the country.

Finally, it is probably best to relate a credit with respect to particular crops, regions or subsectors.

The development of the AMI industry is also slowed due to the inadequate financial resources of AMI producers. Subject to the previous qualifications, credit on generous terms should be given to AMI producers. Rural credit should provide financial help for current expenditures, marketing, and investment. Credit for investment purposes is necessary to encourage agricultural mechanization. It should be provided for a variety of purposes, such as irrigation, electric power, construction, remodeling or enlargement of permanent facilities; and, among other things, the acquisition of specialized facilities and equipment for the production of AMI.

5.1.6 Inadequate infrastructure

An integrated development of AMI requires an adequate infrastructure. Frequently, the infrastructure in many countries is woefully inadequate, or in some cases, hardly exists at all. For example, in Venezuela the roads are often of poor quality or do not exist at all. In Guatemala, good roads are the exception rather than the rule.^{22/}

There is no escaping a commitment to build up a suitable infrastructure for an integrated development of AMI production. This, however, must be a long-term strategy. In the short term one can:

- Use appropriate designs, products and manufacturing techniques which require less sophisticated infrastructure.

In the long term one can:

- Try to establish better infrastructure to integrate the production of AMI; determine the appropriate linkages between sectors, the current shortcomings of existing infrastructure and thus the appropriate future development of infrastructure.

^{21/} Ibid.

^{22/} See the case studies in volume II.

5.1.7 Lack of information about products

Information about any products, let alone AMI, is not costless. Nonetheless, many parties concerned with the production of AMI do not acquire relevant information when it would be efficient for them to do so. Suppliers often lack information about the demand for their products. Farmers often do not know what equipment and technology to use and how to use it. Government departments frequently do not know what farmers and industry require for efficient production, nor indeed the impact of their efforts on these groups. It is not even unusual for national research centres to lack relevant information about what is happening in their own countries. Inadequate information about AMI products, manufacturing techniques and suitable technology is endemic in many countries. Even the most advanced countries - Brazil, Mexico and Argentina - suffer from this problem to some extent. High priority, therefore, should be given to the establishment of a national AMI information centre. The information centre should be within the compass of the AMI board described earlier, and should be an essential tool to guide national policy towards AMI. The information centre should:

- Evaluate existing supply or manufacturing capability, their supporting infrastructure and their ability to assimilate technology;

The centre should also gather information on the items listed in box III. An example of an attempt to provide an information centre as described above is Brazil's PADCT system.^{23/}

^{23/} See the Brazil case study, op. cit.

BOX III

Country information required on AMI

1. Data on manufacturers of AMI and associated products
 - names and numbers
 - geographical location
 - level of technology used
2. Unit data on:
 - production
 - imports
 - exports
 - installed base of units in use
3. Value data on:
 - production
 - imports
 - exports
4. Numbers and types of AMI currently used:
 - tractors (1 axle, 4 wheels) of the following specifications:
 - (i) 10-40 Hp
 - (ii) 41-80 Hp
 - (iii) greater than 80 Hp
 - combine harvesters
 - seed drills
 - fertilizer spreaders
 - mowers
 - rakes and tedders
 - forage harvesters
 - balers
 - sprayers
 - machetes and other hand implements
 - types and numbers of animal drawn machinery used
5. Types, numbers and sizes of farming units:
 - state farms
 - privately owned farms
 - contract farms
 - co-operative farms
6. Products produced:
 - type (e.g. grain, potato, sugar-beet, soya bean, forage-grass, alfalfa, corn)
 - area devoted to crops
 - crop yields
 - geographical areas where crops are grown
7. Companies interested in and government ministries responsible for:
 - assembly of imported parts
 - licensing technology
 - joint ventures
 - technical co-operation
8. With reference to a five year basic period, names and addresses of relevant authorities and decision makers concerning policies and programmes of action towards:
 - the development of AMI
 - farm mechanization
 - imports and exports
9. Names and addresses of those authorities responsible for long-term planning of policy towards AMI:
 - assessment of what goods are imported and the reasons for this
 - assessment of technology suitable for local conditions
 - evaluation of current national AMI investment projects
 - assessment of the demand for AMI in the country

5.1.8 Insufficient technical knowledge

Without question most countries have insufficient technical knowledge about suitable products, technology, and production techniques in the sense that with more appropriate information they could produce AMI at less cost. There is no easy solution to this problem; it requires time, money and a considerable expenditure of human resources. National R and D centres should be established, or existing centres should be strengthened; alternative simpler AMI designs should be used; technical assistance should be sought from other more advanced developing countries; links should be forged with other neighbouring countries to share technical knowledge and the expenses incurred to acquire it. Since R and D, as well as design and engineering capabilities, are difficult for small and medium-scale production units to develop, there is a role for government sponsorship of national R and D centres. These centres would have the following functions:

- Testing, selection, design and development of suitable equipment to meet local conditions;
- Fabrication of prototype equipment to meet local manufacturing conditions;
- Adaptation of machinery for local manufacture;
- Organization of training centres.

As the above activities have to be co-ordinated, it is important that these centres be directed by a central body such as the national agricultural machinery planning board. This role is played in Venezuela by the Venezuelan National Council for the Development of the Capital Goods Industry, and the National Commission for the Mechanization of Agriculture. A similar role is played in Brazil by Brazil's SINMETRO system and in particular its Basic Nucleus for Information on Technical Standards (SINORTEC) and the Agricultural Machinery Sectorial Information Nucleus (NSI/MA).^{24/}

5.1.9 Inadequate stocks of spare parts, repair and maintenance of AMI

In many countries machinery and equipment are usually very poorly maintained; there are often inadequate stocks of spare parts for machinery; and there are seldom suitable repair facilities or trained personnel to carry out the repairs. These problems are easy to state but difficult to solve. What is required is adequate training in the operation and maintenance of AMI and finance to accumulate sufficient quantities of spare parts. Clearly these problems will remain in the short term and in the long-term will require considerable time and organization to solve. The role of training centres and credit facilities will be crucial in this regard.

^{24/} See volume II for details.

5.1.10 Inadequate marketing of products

Producers of AMI face considerable difficulty in successfully marketing their products. This is especially a problem for Guatemala.^{25/} In many cases this is simply because they have not given much attention to the marketing of their products; as a consequence their sales growth has suffered. The obvious solution to this problem is to devote more time, resources and attention to marketing. In addition, firms can also:

- Establish co-operative marketing schemes;
- Establish sales centres;
- Promote sales exhibitions;
- Create a joint marketing advisory board;
- Establish centres where products can be displayed;
- Prepare a directory of manufacturers and sellers.

5.1.11 Lack of standardization of products

Lack of standardization of products is a considerable impediment to the development of AMI industries. In Central America especially, there are a large number of manufacturers of AMI producing similar products but of very different lengths, widths, gauges, volumes and weights.^{26/} Lack of standardization makes it difficult to acquire spare parts and increases maintenance and repair problems; and difficult also to maintain the general quality of products. A national standardization institute should be formed to deal with this problem such as in Brazil's SINMETRO system. The institute should contain representatives from all government ministries concerned with agricultural machinery (planning, agriculture, employment and industry), all major producers of AMI, farmers, and consumer groups. Assurances of quality standards and standardization of products by manufacturers could be encouraged, where possible, by government guarantees of markets, credit, help on R and D and specialized training. But the real guarantors of the success of a standardization programme are the producers themselves: they will have to be aware that standardization of products is very much in their own long term interests.

5.1.12 Inappropriate macroeconomic policies^{27/}

It is important to emphasize that the policies that are designed to equilibrate the macroeconomy also determine to a large extent the scope for effective micro policies toward AMI, agriculture and rural development. If the macroeconomy is not in balance due to inappropriate macroeconomic

^{25/} See the Guatemala case study in volume II.

^{26/} See "A Survey of the Agricultural Machinery Industry in Latin America", op. cit.

^{27/} This section is based on Killick, op. cit., 1985 and World Bank, op. cit., 1981 and 1986.

policies - for example, when there are balance of payments problems and/or inflation - then micro policies directed towards AMI are considerably less effective. This reduces agricultural output and the demand for AMI. The country case study for Brazil in volume II vividly illustrates this phenomena.

In response to balance of payments crises, exchange controls have often been used to restrain aggregate demand. These controls can lead to reduced supplies of capital and intermediate goods with serious effects on agriculture and the AMI industry. If capital is unavailable or available in insufficient quantities, this will retard the development of infrastructure and, in time, reduce the stock of motor vehicles. Storage facilities will also be adversely affected along with spare parts to maintain existing AMI.

Although it is not so obvious, exchange controls which lead to reduced supplies of manufactured consumer goods also can lead to reduced agricultural output and hence demand for AMI. It has often been documented in developing countries that the rural population puts a great store in its ability to buy manufactured consumer goods. In a sense these goods are viewed as incentive goods in that they provide the necessary incentive for increased agricultural output. Recent experience has shown that farmers are less likely to increase marketable output and hence usage of AMI when there are no attractive consumer goods in the stores to spend their money on.

(a) Overvalued exchange rates

As part of their general strategy of import substitution many countries have let their foreign exchange rates become overvalued in order to encourage domestic manufacturing industries through the importation of cheap capital and intermediate goods. Table 1 gives an indication of the extent that exchange rates have been overvalued in a sample of Latin American countries.

Table 1. Ratio of parallel market exchange rate to official exchange rate in a sample of Latin American countries

Country	1965-70	1970-75	1975-80	1980-83
Ecuador	1.18	1.09	1.09	1.59
Mexico	1.00	1.00	1.00	1.30
Bolivia	1.14	1.32	1.08	3.02
Brazil	1.09	1.17	1.20	1.50
Chile	1.41	2.02	1.07	1.23
Argentina	...	1.75	1.05	1.42
El Salvador	1.12	1.18	1.26	2.02
Peru	1.15	1.63	1.11	1.04

Source: World Bank, "Agricultural Mechanization: Issues and Policies", Report No. 6470, 30 October 1986, p. 88.

Overvalued exchange rates in a country have the effect of raising the price of exports and lowering the price of imports in terms of the local currency. For example if the free market exchange rate between Brazilian cruzados and U.S. dollars is 20 to 1 but the official government exchange rate is 10 to 1, a product which cost \$10 in the U.S. could be imported into Brazil for 100 cruzados (excluding transport and other service charges). This same item would be valued at 200 cruzados if the free market exchange rate - the exchange rate which is determined by the supply and demand of Brazilian cruzados in terms of U.S. dollars - prevailed. Thus, by overvaluing exchange rates governments can, in effect, lower the domestic currency price of their imports. Concomitantly, an overvalued exchange rate also raises export prices.

The result of overvalued exchange rates when used in conjunction with import substitution policies, as has been used by many Latin American countries, is that capital-intensive production methods are encouraged. This is because the price of imported capital goods is artificially lowered. Indeed, this has been the case in Brazil. Therefore overvalued exchange rates harm the agricultural export sector by artificially raising the price of exports in terms of foreign currencies. This overvaluation makes local export products less attractive on world markets, and penalizes the small farmer but benefits the owners of capital both at home and abroad. Thus overvalued exchange rates have the undesirable effect of taxing agriculture goods at home and at the same time, discouraging agricultural exports.

(b) Import controls^{28/}

As with credit schemes, there are good general reasons to be sceptical of the effectiveness of import control systems. Overvalued exchange rates have commonly led to a scarcity of foreign exchange as they encourage imports and discourage exports. In the face of a foreign exchange constraint governments have increasingly resorted to import controls rather than devaluations. A notable exception to this tendency is Brazil which has used import controls and small devaluations together.

In addition to trying to conserve scarce foreign exchange, import controls have been used to protect local infant industries against potentially harmful foreign competition. These controls usually have the following characteristics:

- Licensing of many, if not the majority of, imports;
- Quotas or outright prohibition of imports that compete with domestic production;
- Protection for any import-competing industry or sector;
- Priority given to essential imports of capital goods and raw materials and inputs for domestic production.

Overvalued exchange rates coupled with the use of import controls is harmful to agriculture and the development of AMI production in several ways. First, it makes farmers buy high-cost local implements. Second, it raises the cost of manufactured consumer goods which are often the rewards or inducement

^{28/} See, especially, the Brazilian case study in volume II.

for higher agricultural productivity. Third, and probably most important, overvalued exchange rates used in conjunction with import controls tend to restrain the prices that farmers receive for their export crops. Fourth, these policies in general encourage import-intensive industries and discourage the development of industries that use local materials and labour, such as the AMI industry.

As with all generalizations there are exceptions to the rule that import controls are harmful to agriculture and hence the development of a domestic AMI industry. As is discussed in volume II of this study, there is some substance to the claim by some commentators that Brazil's comprehensive system of import controls has been especially helpful to the development of Brazilian industry and especially the AMI industry. These controls have effectively stopped competition from foreign imports. As a result, it is claimed, the Brazilian AMI has developed such that almost all the technology it uses (approximately 80 per cent) is produced locally. This has had the major benefit of encouraging the development of a local capacity in advanced technology and associated skills which may otherwise have taken much longer to obtain, if at all.

The controls have been successful in that they have not forced firms to close or decrease production because they cannot compete with foreign products, as happened in Chile, Uruguay and especially Argentina.

Companies have reacted to Brazil's import controls by finding local supply sources; and many have been successful in doing this. But it is not obvious that firms in other countries, particularly in the smaller countries of Latin America, could find adequate alternative local sources of supply. Moreover, the process of finding alternative local suppliers, even if possible, is costly and can take a considerable length of time. Also, the Brazilian import control system has made it difficult for firms to bring in needed raw materials. It has led to a large amount of extra paperwork for firms, and the long delays before permission is granted to import goods has sometimes caused production bottlenecks and increased costs of production. In addition, the Brazilian system of import controls appears to have led to a bias against the export of manufactured products. Under present economic conditions it is doubtful that Brazil's import control system continues to benefit the AMI industry.^{29/}

What should we conclude from the previous discussion. First, and most important, there are not unique paths to development: for some countries import controls may be beneficial if used appropriately and monitored carefully; for many countries, if recent experience in Latin America has any lessons for us, they can be particularly harmful. One result of these policies is that infant AMI industries have remained infants and have not grown up.

On the other hand, import controls can be a sound policy; they do have a role in the development of AMI industries - for both economic and non-economic reasons - but as a tool of economic policy they need to be applied wisely with due regard to the unique conditions of each individual country and to the possible undesirable effects previously mentioned or they can exacerbate the problems they seek to cure.

^{29/} See the Brazilian case study, op. cit.

(c) Inflation

Many Latin American countries suffer from rampant inflation - recent examples, would include Brazil, Mexico, and Argentina in particular. Inflation can have very adverse effects on rural savings and investment. It will reduce the incentive to save and/or change the form of saving by eroding the real value of monetary assets. It will have an adverse effect on investment by engendering uncertainty and thus making it difficult to make rational decisions. It will bias investment towards short-term, quick-return investment. In particular it will hinder agricultural and rural development by slowing the use of money as store of value and means of exchange. This will arrest the monetization of agricultural activities and can have serious consequences for future development.

(d) Uncertainty caused by frequent changes in national economic policies

One of the major obstacles hindering the development of the AMI industry in Latin America is the uncertainty caused by frequent changes in national economic policies, irrespective of the nature of these policies. This has been a particular obstacle in Brazil and Argentina. Frequent changes in policies have seriously hampered decision-making at all levels of the AMI industry in Latin America. There is no easy solution to this problem. However, governments can take concrete steps to assist the industry by intensifying their efforts to provide a stable economic environment conducive to the future development of the AMI industry.

To conclude our discussion on inappropriate macroeconomic policies: much of what we have said about the effects of inappropriate macroeconomic policies on agriculture and hence the demand for AMI, can be summarized as follows. Agriculture is a very important part of the economy of many countries. Changes in macro policies necessarily affect agriculture and the derived demand for AMI. It follows that macroeconomic disequilibria caused by balance of payments crises, overvalued exchange rates, import controls, uncertainty caused by frequent changes in national economic policies, and inflation can have a serious disruptive influence on the development of an indigenous AMI industry. It also follows that without appropriate macroeconomic policies, microeconomic policies directed specifically towards fostering the production of AMI may not have the desired effects.

BOX IV

Programmes of action for national governments to remove obstacles to production

OBSTACLE	POSSIBLE SOLUTIONS
1. Lack of raw materials	Central purchasing, ensure adequate prices are paid to farmers
2. Small markets	Multi-product production, common markets, exports to neighbouring countries, appropriate designs
3. Lack of human skills	Appropriate designs, de-mechanize and/or de-automate production, training centres
4. Inadequate financing	Loans, subsidies, grants, tax preferences, tax land, use of consumption and value added taxes, income taxes, export incentives, give income from stabilization schemes to small farmers
5. Inadequate infrastructure	Long-term strategy: build-up; short-medium term: establish better links within the country and to neighbouring countries; designs and products requiring less sophisticated infrastructure
6. Inadequate links between sectors, firms and industries producing, especially, capital goods	Provide better co-ordination and information; establish national agricultural machinery planning board
7. Insufficient technical know-how	National R and D centres, alternative simpler designs, training centres, links with other neighbouring and/or more advanced countries
8. Inadequate marketing	More time and resources for adequate marketing
9. Lack of product standardization	Strong encouragement to standardize products; establish national product standardization institute
10. Inadequate information about products	Establish a national agricultural machinery information bank
11. Inadequate stocks of spare parts, repair and maintenance of AMI	Adequate training in operation and maintenance of AMI; finance to accumulate adequate quantities of spare parts
12. Inappropriate macro-economic policies	Avoid overvalued exchange rates and frequent changes in national economic policies, careful use - if at all - and monitoring of import controls, control inflation and prevent balance of payments crises

5.2 Subregional programmes of action

There are already some policies, programmes of action and ongoing projects at the subregional level. For example, in the Andean Group, consisting of Bolivia, Colombia, Ecuador, Peru and Venezuela through Decision 57 and later Decision 146 in 1972, a Sectoral Programme of Development of the Metal-Working and Metallurgical Sector was approved. The main objective of this programme is to promote the development of efficient metal-working and metallurgical industries in member countries by the creation of a common basic technological infrastructure. This will give a base for the member countries of the Andean Group to strengthen their industrial sectors, improve their capacity to adapt modern technology to local conditions, and create possibilities for further specialization. As an outcome of the Andean Group's Sectoral Programme, until the end of 1984 Colombia and Venezuela were given the responsibility to share the manufacture of harvesting machinery, cultivators, pasturing equipment and pulverizers. These products could be sold without restrictions in all member countries and were eligible for all the benefits of various industrial promotion schemes and soft credits.

Given the existence of subregional policies, projects and programmes of action, future effort should be directed towards harmonization and strengthening of these ongoing programmes to eliminate the constraints that obstruct further subregional co-operation.

5.2.1 Provision of information

An important function of a subregional body should be to provide relevant information to member countries. Information is required in the following areas:

- A comparison of research programmes and previous research achievements at the national level;
- An assessment of procurement practices for new materials, equipment, technology and services;
- A comparison of national production programmes.

Priority should be given to collecting and disseminating the above information to national enterprises, research centres, private firms, and relevant government ministries. Lack of appropriate information not only is a major obstacle to the development of co-operation, but also reduces the quality of decision making. Access to good information is essential for aiding the flow of products, technology, expertise and finance in a subregion.

The aim should be to try and meet the demand for AMI information by the various member countries. This should be the responsibility of a subregional information unit which at present does not exist in Latin America in an adequate form. Basically the information required relates to the following questions:

- What are the requirements for information by individual countries?
- What are the existing sources of information?
- How could the existing quality of information be improved?

Using information provided by individual countries, subregional bodies would circulate information concerning the characteristics of agricultural mechanization, subregional markets for equipment, lists of subregional firms producing AMI, the activities of subregional research and development institutions, and ongoing projects.

An associated task of the subregional information unit would be to draw up two maps: one showing the demand for AMI and approaches to agricultural mechanization, and the other, available subregional productive capacity. Each map would contain data at the national and subregional level. By comparing the two maps one could identify potential:

- Markets;
- Sites for subregional industrial projects;
- Zones of specialization within the region;
- Areas of co-operation between subregional firms.

The compilation of the data could be done with the help of UNIDO and other international organizations.

The case for subregional co-operation -for example in the Andean Pact countries and the countries of Central America- in research and development is extremely strong. Countries within the subregion often face similar problems. Solutions to problems in one country can therefore quickly be utilized in another - but only if they are more widely known than at present. Research, design and prototype development are expensive undertakings, as such it is sensible for neighbouring countries to co-operate on economic as well as technical matters.

Training and procurement of raw materials are other areas for possible co-operation especially for the smaller countries of Central America such as Guatemala and El Salvador. Cooperation could lead to more effective and less costly training in the design, development, manufacture and use of AMI. Information could be shared about procurement practices, to mutual benefit, without involving a large commitment of resources by individual nation states. By sharing information on prices and sources of raw materials member countries can help their respective buying agencies and production units obtain stronger negotiating positions. Pooling orders and buying steel, equipment and components in bulk will also lead to lower prices being paid for these products.

Pooling information on the best sources for raw materials and particular products can be advantageous to all member states. It can provide opportunities to co-ordinate production within a country or between countries so firms could specialize in certain products or simply extend their market areas. This could lead to co-operation on trade and tariffs - for example, tariffs on goods from within the region could be lower than goods coming from the outside as was the case in CACM. New subregional producers could therefore be protected for a certain period of time against potentially fatal competition from more established producers. For this protection to achieve its desired aim to aid infant industries and not itself be harmful to future prosperity, it must be temporary and not a permanent feature of the subregion.

5.2.2 Multinational production enterprises and other forms of ECDC/TCDC

There are good reasons, when co-operation has reached a more advanced level such as in Brazil, Argentina, Mexico and Venezuela, to study the possibilities of two or more countries pooling their resources in common facilities and/or establishing multinational production enterprises.

Multinational production enterprises

are undertakings essentially confined to equity arrangements among two or more developing countries or their nationals to increase their industrial manufacturing output and/or encouraging national resources development through a process of mutual and concerted actions for creation, expansion and/or better utilization of their production potentials as well as fostering their intra-trade flows and bargaining position in the world market. They should guarantee reciprocal benefits from economies of scale, specialization and resource complementarities.^{30/}

Subregional bodies with the help of international organizations such as UNIDO could help instigate such co-operation ventures among countries. Because of the complexities involved, such co-operation would have to be considered extremely carefully. If, after due consideration they are deemed to be mutually beneficial, co-operative ventures would take some time to establish, though preparatory work could start immediately. UNIDO has developed guidelines to facilitate such ventures.^{31/}

Multinational production enterprises are a specific form of economic and technical co-operation among developing countries (ECDC/TCDC). The Second General Conference of UNIDO, held at Lima, Peru, in March 1975 stressed the need for greater ECDC/TCDC among developing countries and called on the international community to redouble its efforts to help developing countries gain a larger share of world industrial output by greater South-South co-operation. The Caracas Plan of Action which was adopted by the High-Level Conference on Economic Co-operation among Developing Countries, held at Caracas, Venezuela, 13 to 19 May 1981, reaffirmed the recommendations contained in the Buenos Aires Plan of Action for promoting and carrying out TCDC. It also recommended that support to ECDC/TCDC projects should pay particular attention to the utilization of technology, skills and resources available in developing countries.

Sub-regional bodies in conjunction with international agencies such as UNIDO should also explore other innovative means of ECDC/TCDC to foster the development of the AMI industry in Latin America. One potentially fruitful form of ECDC/TCDC is the Round-Table Ministerial Meeting on AMI. These types of meeting aim to assist developing countries to develop their AMI industries and ultimately to expand their production of food by promoting long-term co-operative arrangements among developing countries. At these meetings, participants:

30/ UNIDO/PC. 121, "Multinational Production Enterprises: A Preliminary Overview", op. cit.

31/ Ibid.

- Exchange experience and information on the current situation and trends of the AMI industry in their countries;
- Discuss specific AMI co-operation projects and how they might successfully be implemented by matching specific needs with existing capabilities;
- Initiate a dialogue and identify areas for further co-operation.

Round-Table Ministerial Meetings are best organized in co-operation with bodies such as UNIDO. Indeed, such a meeting has recently been held in Latin America. UNIDO, in conjunction with the Government of Argentina, organized a Round-Table Ministerial Meeting on co-operation among a selected group of developing countries in the field of AMI. The meeting was held in Buenos Aires, Argentina, from 3 to 7 November 1986. The meeting identified approximately 90 projects in the area of AMI for implementation by the participants of the meeting in the near future.

5.2.3 Implementation of subregional co-operation

Subregional co-operation could evolve by means of regular meetings and communications between the various national bodies which co-ordinate policies to aid the development of AMI - for example, the various national agricultural machinery planning boards discussed earlier - research institutes and representatives from international organizations. The forum for these meetings would be a subregional committee. This committee would meet regularly and act as a focal-point for each subregion by designing their programmes, initiating new co-operative arrangements and monitoring existing ones.

In light of the previous discussion, the specific functions of the subregional committee should include:

- Co-ordinating and strengthening existing subregional forms of co-operation;
- Assessing the obstacles to such co-operation and identifying measures to overcome them;
- Establishing a subregional information unit on AMI;
- Establishing a subregional network for R&D and specialized training;
- Exchanging information and advice on procurement practices;
- Identifying partners for joint ventures and other co-operative production arrangements.

BOX V

Subregional programmes of action

1. Provide relevant information to member countries.
2. Encourage subregional co-operation in research and development.
3. Implement subregional co-operation by means of regular meetings and communications between the various national bodies which co-ordinate policies to aid the development of AMI.
4. Assess obstacles to co-operation and identify measures to overcome them.
5. Establish a subregional information unit on AMI.
6. Establish a subregional network for R and D and specialized training.
7. Exchange information and advice on procurement practices.
8. Identify partners for joint ventures and other co-operative production arrangements such as Multinational Production Enterprises and other innovative forms of ECDC/TCDC.

5.3 Regional programmes of action

As with subregional bodies, regional bodies should try to identify existing bottlenecks facing intra-regional producing units and develop measures to help remove these obstacles. Any or all of the following policies may be useful in overcoming existing obstacles to production - establish and/or strengthen existing:

- Regional research and development centres, such as the successful Los Baños centre in the Philippines, to help national centres make research economical and commercially viable, and to provide prototypes;
- Regional agricultural machinery information centres to disseminate information on AMI;
- Regional networks to provide training opportunities for R and D workers with emphasis on practical application;
- Travelling rural exhibitions of appropriate AMI that are manufactured locally, and by neighbouring countries; these exhibitions should be organized in co-operation with UN bodies such as UNIDO and other relevant regional bodies;

- Regional centres and/or agreements to help standardize AMI products;
- Agreements for regional specialization in the manufacture of products;
- Regional centres to provide appropriate product designs for Latin American conditions;
- Agreements to remove trade barriers within the region.

Co-operation at the regional level already exists in Latin America. The Latin American Free Trade Association (LAFTA) has held meetings relating to the production of AMI in Latin America. These meetings have provided useful information about the AMI industries in the LAFTA area. As a result of these meetings, within the new Latin American Integration Association (ALADI), two agreements on economic co-operation between Argentina and Uruguay were approved. As part of the agreement each country provides a list of products including AMI which if imported from the partner country will be exempt of taxes and restrictions. The agreement also calls for the development of binational enterprises.

Regional bodies should try to establish or strengthen existing co-operative arrangements among member states such as that established between Argentina and Uruguay as an outcome of the ALADI meetings. Possible areas for close co-operation amongst Latin American countries include the following:

- Transference of designs from one country to another with similar environmental and working conditions and equipment which is appropriate to local farming conditions;
- Development of joint manufacturing programmes;
- Licensing and financial participation in joint ventures;
- Import and export of ancillary parts.

Implementation of regional programmes of action and co-operative ventures

Regional programmes of action and co-operative ventures could be implemented by a regional AMI committee similar to the previously mentioned subregional committees. The committee would meet regularly and comprise representatives of the various national, subregional and international bodies which promote the development of AMI. The committee would design regional programmes of action, give support to and monitor existing co-operative arrangements, initiate new co-operative ventures, and finally plan long-term strategies to foster the growth of the AMI industry. The specific functions of the regional committee are those discussed earlier in connection with regional programmes of action; for convenience, these functions are listed in box VI.

BOX VI

Regional programmes of action

1. Establish regional R and D centres to help make research economical and commercially viable, and to provide prototypes.
2. Establish regional AMI information centres.
3. Establish regional networks to provide training facilities for R and D.
4. Provide travelling rural exhibitions of appropriate AMI.
5. Establish regional centres and/or agreements to standardize AMI products.
6. Encourage agreements for regional specialization in the manufacture of products.
7. Establish regional centres to provide appropriate product designs for local conditions.
8. Facilitate agreements to remove trade barriers within the region.
9. Strengthen or establish co-operative ventures between member states.
10. In general, identify existing obstacles facing interregional production units and develop measures to remove these obstacles.
11. Implement regional programmes of action by means of regular meetings and communications between member states.

5.4 Programmes of action for the international agencies

International agencies like UNIDO, FAO, EEC, and the various other international food agencies have an important role to play in the development of AMI in Latin America. International action falls into the following areas;

- New methods of financing and material support for AMI;
- Pilot studies of strategies;
- pilot rural workshop schemes;
- Information and studies;
- Technical assistance;
- International co-operation.

5.4.1 New methods of financing and material support

International agencies can provide useful assistance to the Latin American AMI industries by developing and/or giving advice on novel methods of financial aid that are directed specifically towards the low income small rural farmers and the small-to-medium sized firms producing AMI. This financial aid should clearly recognize the near insolvency of a large number of rural farmers; and in conjunction with national governments formulate methods to enable small farmers to purchase appropriate equipment for more productive agriculture. A number of methods to do this have already been mentioned in this study.

Small to medium firms should also be encouraged by financial inducements, help on the selection of appropriate technology, advice on appropriate product designs, general economic advice, assistance on marketing and sales techniques, the procurement of an adequate supply of raw materials and spare parts, and training to repair and maintain machinery.

5.4.2 Pilot studies of strategies for fostering the development of AMI

Many countries do not have specific and clearly defined strategies for developing local production of AMI and the mechanization of agriculture. The common reason given for this is that agricultural mechanization conflicts with the goal of increasing employment in rural areas. The argument here is that increased mechanization of agriculture generally leads to a reduced demand for labour in agriculture; this increases the migration of labour into the cities, widens urban/rural wage differentials and increases social dislocation in urban areas. This line of reasoning, if it has any force at all, really only suggests that the wrong type of mechanization of agriculture has been used in the past in Latin America - for example, the use of heavy, sophisticated tractors where local conditions did not warrant it. It need not be the case that agricultural mechanization implies large reductions in the demand for labour if technology appropriate to local conditions is chosen. For instance, in production, cutting and welding techniques could be used instead of casting and forging; production processes could be de-automated and simpler designs could be employed; the production of smaller firms could be expanded by greater use of subcontracts for less sophisticated components from larger firms with subsequent increases in the demand for labour. On farms, mechanization approaches could be adopted which increase the demand for labour by using animal drawn AMI and not sophisticated power machinery.

It must be emphasized that labour replacement or displacement by mechanization in a particular operation or for a particular crop is not necessarily the same as displacement of labour from agriculture in general. It is conceivable that labour displaced by mechanization in one operation can be used for other operations such as tending and harvesting the larger crops made possible by the increased cultivated area due to mechanization, or by multiple cropping and more careful irrigation, weeding and pest control. The labour released from working on one crop can be used on others, or for the production of livestock. Thus mechanization may even sometimes lead to an increase in the demand for labour. This has not generally been the experience in Latin America, however, where many of the larger, more mechanized farms are notorious for their under-utilization of land and their owners having little or no interest in intensifying production. Data analyzed by Abercrombie shows that, at least before the mid-1970s, the size of farm increases in Latin

America, less advantage was taken of the intensification of production made possible by mechanization and of the resulting possibility of providing alternative employment for the labour that is replaced.^{32/}

To add some perspective to the above discussion, it is clearly true that mechanization has displaced significant amounts of labour in Latin America. In Brazil, if one compares looks at the production of sugar cane in the different states, comparing the states where this crop is most (Sao Paulo) and least mechanized (Pernambuco), the demand for labour per hectare in 1963 in Sao Paulo was only 42 per cent of that in Pernambuco.^{33/}

In addition, there is a greater incentive to adopt mechanization to save labour because labour costs have been increased by minimum wage legislation and social security systems. Though in general these factors are less effective in rural areas (because a large proportion of the wage is paid in kind, such as housing, rather than cash) they are gradually becoming more effective in the larger, more modern farms who are large employers of labour. It is estimated that in the 1970s social security payments have added about 40 per cent to the wage bill in Chile, 20 per cent in Peru, and almost 50 per cent in Argentina.^{35/}

Although minimum wage legislation and social security can be justified on many grounds, it is important to be aware of the relative distortion they create in the demand for labour. Some way has to be found to make social security payments less of a tax on labour. One method used by Uruguay is to assess the tax on a per hectare instead of a per worker basis.

Minimum wage legislation, increasing trade union activity and social unrest also decreases the likelihood that large estates will hire more workers.

Finally, it should be noted that labour requirements differ greatly from crop to crop even without mechanization. Data shows that mechanization has reduced the labour requirement for barley and wheat but potatoes and sugar beet are least affected by mechanization. In Colombia in the early 1970s, potato production actually required more labour with mechanization than in traditional agriculture.^{35/}

The arguments above suggest that there is a role for international organizations such as UNIDO to offer assistance on the formulation of appropriate strategies to develop AMI industries for interested nation states and even subregional and regional bodies. This technical assistance by UNIDO could take the form of assistance to develop systematic programmes of action for aiding the growth of AMI industries. This assistance would take explicit

32/ Abercrombie, 1972, op. cit., p.27.

33/ Ibid., p.28.

34/ Ibid., pp.33-34.

35/ Ibid., p.24.

consideration of the diverse characteristics of Latin American countries. Provided it is agreeable, five countries, comprising a representative sample of Latin American countries, could be selected for a pilot programme.

Missions from UNIDO and other relevant international organizations would survey these countries, modify the methodology as necessary, then use the results to prepare integrated strategies geared towards the specific characteristics of individual nation states. After approval by the relevant countries, it would be up to individual governments to implement these strategies.

After a period of time, say, two to five years, depending on the circumstances, UNIDO, other international organizations and individual countries would analyse the results of the pilot strategy programme, make final methodological adjustments and prepare final documents as aids in decision-making. The aim would be to prepare documents which would be a series of practical guides to the formulation of appropriate national strategies to foster the development of AMI industries. These guides could be distributed throughout Latin America, supplemented in each case by social and technical-economic studies of the relevant agricultural mechanization systems used, methods of manufacturing AMI, and AMI production units in particular countries. Expert groups consisting of representatives from all the relevant national and international agencies could meet and make a final assessment of the proposed strategies. The guides and supplementary studies would then be extremely useful tools to decision makers: They would have been developed with specific consideration of the unique characteristics and economic and technical conditions of individual countries. They would have had the constant input of appropriate national experts, and more importantly, they would have been conceived in the spirit of the integrated development of industry and agriculture.

The guides and supplementary studies could also be used by the international agencies to train technicians and senior personnel in the application of the methodology in other Latin American countries.

5.4.3 Pilot rural workshop schemes

Decentralized rural production units have great potential in many countries in the production of AMI specifically geared towards the diverse requirements of local farmers. Unfortunately, it is far from easy to establish these units without a strong commitment by national governments in areas such as:

- Financial and technical assistance;
- Banking services;
- Training programmes;
- Extension services;
- Supply of raw materials;
- Short-term protection;
- Availability of suitable designs, technology and production equipment.

International agencies, such as UNIDO, can assist countries to establish rural workshops by focusing their efforts on three areas:

- Operational study of rural workshops;
- Setting-up of pilot rural workshops;
- Creation of a data base of manufacturing plans or drawings.

5.4.4 Operational study of rural workshops

An operational study of rural workshops should include three important aspects. First, it should investigate the basic characteristics of rural workshops to prepare operational data for pre-feasibility studies and to attract the interest of Latin American decision makers. Second, it should evaluate the experience of existing rural workshops in terms of general engineering and agricultural machinery production. Third, it should identify the basic types of rural workshops, ranging from self-contained units to groups of units working together. This identification should include details of the technical specifications of products manufactured, productive capacity, major activities undertaken (repairs, stores for spare parts, and so on), manufacturing processes, production equipment; details of prototypes, lay-out of production machinery, the specifications and quantities of raw materials and components required for particular types of workshops together with possible suppliers; and, the qualifications of required manpower and the characteristics of suitable training programmes.

5.4.5 Setting-up pilot workshops

The effectiveness of rural workshops should be field tested by establishing a small number of pilot workshops in selected Latin American countries. The experience gained in running these workshops should be made available to any country that desires it.

5.4.6 Creation of a data base of manufacturing plans or drawings

One problem common to most rural workshops is to make the linkage between the perceived demands of local customers and the design and equipment required to manufacture the products to meet these demands. This problem could be overcome by giving workshops access to files of typical manufacturing drawings of equipment appropriate for local conditions. A data bank of such drawings, along with an inventory of suitable production equipment and operational instructions on how to manufacture appropriate products, would go a long way in overcoming the linkage problem.

5.4.7 Information and studies

International organizations, particularly UNIDO, can provide substantial assistance to help develop AMI industries by providing relevant statistics, sectoral studies, and technological information.

(a) Statistics

It would be beneficial to improve statistics on production and trading in AMI in Latin America; usually, the only reliable information relates to tractors and powered machinery. It is necessary to develop a data base which also includes reliable information on:

- Stationary equipment;
- Hand tools and animal-drawn machines.

UNIDO should maintain a permanent data base on the production of the various types of agricultural machines. In order to do this it is necessary that the data are updated by periodic surveys, organized in collaboration with other relevant UN agencies and manufacturers of AMI.

(b) Studies

It would be valuable for sectoral studies to be undertaken or continued in the following areas:

- Detailed analysis of trends in the demand for AMI in Latin American countries;
- Analysis, in collaboration with the FAO, IDB, the World Bank, and various regional agencies, of ways to increase the solvent demand for AMI;
- A survey of the increasing role of non-traditional manufacturers of AMI, and an analysis of their role in the development of the AMI industry;
- Concrete applications of an appropriate method of estimating the demand and supply of AMI;
- Programmes of action to standardize AMI products, components and materials in order to simplify the manufacture of AMI and maintain quality standards;
- An in-depth analysis of policies applied to the AMI industry and their effects;
- An analysis with UNCTAD of obstacles hindering the development of commercial trading and technology transfers in the AMI sector between Latin American countries;
- An analysis with UNCTAD of the effects of import controls and other trade barriers to the development of the AMI industry in Latin America;
- An analysis of the role of small and medium sized firms in the development of the AMI industry;
- An analysis of the impact of new technological advances in the capital goods industry on the development of AMI production;
- An analysis of the role of women in the production of AMI in Latin America.

5.4.8 Technological information

The UNIDO Technological Data Bank which contains, among other things, information on AMI, could be a useful source of data for Latin American countries. However, to be really valuable it is necessary that the following information be gathered and/or updated:

- Statistics relating to AMI;
- Alternative technologies for the manufacture of AMI and appropriate methods to transfer this technology to developing countries;;
- Technical, economic and commercial data concerning owners of manufacturing processes and how access to these processes may be obtained;
- Data on investment projects in the AMI industry in various countries;
- Offers of exports of AMI and technologies to produce AMI from more advanced Latin American countries and other developing countries in order to increase South-South trading and co-operation;
- Offers of co-operation from small and medium-sized enterprises.

5.4.9 Technical assistance

The international agencies should reinforce existing assistance programmes and consider new actions which include the following areas:

- Within their current assistance programmes, the development of new types of simplified AMI for use and also for manufacture; the promotion of small and medium-sized enterprises and technical assistance for the establishment of basic facilities;
- In terms of new programmes of action, to assist in the organization of national surveys of industrial production capacities for AMI; joint ventures with FAO, IBD to train individuals to plan and co-ordinate policies towards AMI; assistance to make R and D economically viable.

In addition, regional bodies, UNIDO and other international agencies should especially provide appropriate technical assistance to:

- Explore, and where warranted, facilitate debt-equity swaps as a means of alleviating foreign exchange constraints and encouraging foreign capital, especially private capital, into the country.
- Restructure system of tariffs, taxes, subsidies and other protective measures.
- Assess the costs and benefits of counter-trade to the AMI industry - especially with African countries.
- Explore the possibilities of more extensive and innovative South-South co-operation in AMI such as Multinational Production Enterprises and other innovative forms of ECDC/TCDC in a more routinized institutional framework.
- Strengthen and/or set-up national systems of metrology, standardization and industrial quality to improve the productivity of the AMI industry and the quality of its products; and, help to plan, design and implement pilot/demonstration programmes in this area.
- Encourage the growth of regionally dispersed small-to-medium scale production of AMI in Latin America.

- Strengthen the capabilities of national institutes to test, evaluate, design, develop and fabricate prototypes of equipment to suit local manufacturing conditions and to establish appropriate methods for testing and evaluation;
- Strengthen the R&D capabilities of national institutes by providing consultancy services, training facilities and making available designs and prototypes of appropriate AMI;
- Establish pilot and demonstration units for the small- and medium-scale production of AMI and ultimately in the establishment of commercial production units;
- Explore the possibilities of providing more technical and financial assistance that is in keeping with the social and cultural values of Latin American countries;
- Develop expert systems, when appropriate, for the repair and maintenance of AMI for possible export to other developing countries;
- Pair sister AMI producing enterprises in Latin America with those in other developing countries to act as a catalyst for the further development of the AMI industry in Latin America.

BOX VII

Programmes of action for the international agencies

1. Provide new methods of financing and material support.
2. Undertake pilot studies of strategies for fostering the development of AMI.
3. Undertake pilot rural workshop schemes; create a data base of appropriate manufacturing plans or drawings.
4. Provide relevant statistics, sectoral studies and technological information.
5. Assistance to strengthen the capabilities of local institutes to test, evaluate, design, develop and fabricate prototypes of equipment suitable for local conditions; assistance to establish appropriate methods for testing and evaluation of AMI.
6. Assistance to establish centralized repair and maintenance facilities, with appropriate training facilities and extension services.
7. Assistance to strengthen the R&D capabilities of national institutes by providing consultancy services, training facilities and making available designs and prototypes of appropriate AMI.
8. Assistance to establish pilot and demonstration units for the small- and medium-scale production of AMI and ultimately in the establishment of commercial production units.
9. Assistance to explore the possibilities of providing more technical and financial assistance that is in keeping with the social and cultural values of Latin American countries.
10. Assistance to explore, and where warranted, facilitate debt-equity swaps.
11. Assistance to restructure existing systems of tariffs, taxes, subsidies and other protective measures.
12. Assistance to assess the costs and benefits of counter-trades to the AMI industry.
13. Assistance to explore the possibilities of more extensive and innovative forms of South-South co-operation such as Multinational Production Enterprises and other forms of ECDC/TCDC.
14. Assistance to strengthen and/or set-up national systems of metrology, standardization and industrial quality; and, help to plan, design and implement pilot/demonstration programmes in this area.
15. Assistance to encourage the growth of regionally dispersed small-to-medium scale production of AMI in Latin America.
16. Assistance to develop expert systems, where appropriate, for the repair and maintenance of AMI.
17. Assistance to pair sister AMI producing enterprises in Latin America with those in other countries.
18. Assistance to develop new types of simplified AMI for use and also for manufacture.

5.4.10 International co-operation

International co-operation between UNIDO, FAO, and IDB and Latin American countries is required to strengthen the capabilities of national institutes to test, evaluate, design, develop and fabricate prototypes of equipment to suit local manufacturing conditions and to establish appropriate methods for testing and evaluation. Such co-operation would also help build up a domestic capability to select and evaluate suitable designs and to analyse the performance of prototype equipment.

In addition, international agencies could strengthen the R and D capabilities of the national institutes by providing consultancy services, training facilities, and making available designs and prototypes of appropriate AMI. They could also assist in the establishment of pilot and demonstration units for the small and medium-scale production of AMI and ultimately in the establishment of commercial production units.

Assistance would also be of value in the establishment of decentralized repair and maintenance service facilities, with appropriate training facilities and extension services. The international agencies could assist by providing technical and financial assistance that is in keeping with the social and cultural values of Latin American countries.

Finally, the auspices of the various international agencies, UNIDO in particular, could be used to organize or maintain a working group composed of representatives of:

- A working group composed of representatives of the major Latin American AMI companies and individual countries;
- The small and medium-sized enterprises in the industrialized countries with those of Latin America;
- Other developing countries to examine how South-South trade and co-operation could be increased.

APPENDIX

DEFINITIONS OF MECHANIZATION

To assist understanding among the many actors involved in agricultural, mechanization and rural development, the FAO offers the following definitions:^{a/}

Agricultural mechanization embraces the manufacture, distribution and operation of all types of tools, implements, machines and equipment for agricultural land development, farm production, and crop harvesting and primary processing.^{b/} It includes three main power sources: human, animal and mechanical. Based on these three power sources, the technological levels of mechanization have been broadly classified as handtool technology, animal-draught technology and mechanical power technology:

- Handtool technology is the simplest and most basic level of agricultural mechanization. The term refers to tools and implements which use human muscle as the power source;
- Animal-draught technology refers to a wide range of implements, machines and equipment used in agriculture which are powered by animals—generally buffalo, oxen, horses, mules, donkeys or camels;
- Mechanical-power technology is the highest level of mechanization commonly used in agriculture today. It takes many forms: a wide range of tractor sizes which are used as mobile power for field operations and transport, and as stationary power for many different machines, engines or motors using petrol, diesel fuel or electricity to power threshers, mills, irrigation pumps, grinders and other stationary machines, aircraft for distributing crop protection materials and fertilizers, and self-propelled machines for production, harvesting and handling a wide variety of crops.

Farm mechanization is technically equivalent to agricultural mechanization but refers to only those activities normally occurring inside the boundaries of the farm unit or at the farm unit level (e.g. village, commune, co-operative etc.).

Tractorization refers to the application of any size tractor (e.g. single-axle, double-axle or track-type of any horse power rating) to activities associated with agriculture.

Motorization refers to the application of all types of mechanical motors or engines, regardless of energy source, to activities associated with agriculture.

Intermediate technology, in reference to agricultural mechanization, describes a level of mechanization somewhere between handtools and a high-horsepower tractor, often without specifying a particular type of mechanization input.

(Note: The term is sometimes used to mean animal-draught technology, since it is intermediate in relation to handtool and mechanical power technology. Still others use the term to mean a tractor of 20-30 hp, or to mean a single-axle tractor as opposed to a double-axle tractor).

Appropriate technology, in the context of agricultural mechanization, refers to the level of mechanization which is best suited for introduction and use in a specific development situation. Appropriateness of a mechanization input is determined by the technical, economic, social and political characteristics of each development situation.

Agricultural implements are devices attached to, pulled behind, pushed, or otherwise used with a human, animal or mechanical power source to carry out an agricultural operation. A tractor-mounted plough and a hand jabber for planting maize are both considered as implements. An agricultural machine is normally a mechanical device which has a number of moving parts such as a combination seed drill powered by a tractor. Agricultural machinery is a general term used to describe tractors, combines, implements, machines, and any other device more sophisticated than a handtool,^{c/} which are animal or mechanically powered. Agricultural equipment generally refers to stationary mechanical devices such as an irrigation pump-set. It may, however, also be used in place of the word "machine" to describe a stationary thresher or grinder, for example.

^{a/} FAO Agricultural Services Bulletin, 45, Rome, 1981

^{b/} In this book, land development includes irrigation and other water control operations. Other uses not specifically mentioned are storage and transport of farm inputs, people and products.

^{c/} In this study, handtools are included in agricultural machinery.

MAIN TYPES OF IMPLEMENTS, MACHINERY AND EQUIPMENT USED IN AGRICULTURE

Agricultural operation	Implements, machinery and equipment for increasing degrees of mechanization			
	-----Increasing mechanization----->			
Land development				
Clearing and cultivation	Simple implements	Brush-clearing and forestry implements and equipment	Scrapers, graders, levellers, compactors Forestry tractors	Bulldozers, hydraulic shovels
	Multipurpose handtools		Heavy tractors and ground-breaking equipment	Subsoil machinery, drainclearers, draincutters, drainpipelayers
Ground and soil improvement	Multipurpose handtools		Rotary breakers, rippers, chisels, heavy 4-wheel-drive tractors	
	Irrigation equipment (valves, mains)		Pumps and water-distribution equipment	
			Mobile irrigation equipment	Self-propelled equipment
Land development (chiefly irrigation)	Simple irrigation machinery and processes: bucket chains, augers, hand-pumps etc.		Motor pumps	Permanently installed irrigation equipment
	Handtools and supplies for fences		Electric fencing	
Farming				
Crop farming:				
Soil cultivation	Multipurpose or specialized handtools	Hand sprayers, sulphur sprayers, animal-drawn ridgers	Self-propelled cultivators	
Sowing, fertilization, vegetable conditioning		Seeders, fertilizer distributors, trailed sprayers	Tractors and specialized machines	
Harvesting (horticulture)	Horticultural tools and equipment	Specialized buildings	Mechanized pickers	Self-propelled reaper-threshers, vineyard machinery
Stock farming:				
As above	Cultivation and moving implements	As above	Movers and fodder-handling equipment	
Foddering operations	Simple multi-purpose buildings	Specialized buildings and equipment	Specialized non-industrial stock-farming equipment	Industrial stock-farming (automatic feeders and feed conditioners equipment)
Transport and handling	Load-carrying equipment (baskets, vats, wheelbarrows)	Wagons, carts and other equipment drawn by men or animals	Low- and medium-power multipurpose tractors	Lorries
		Manual discontinuous handling equipment	Motorized discontinuous handling	Specialized transport equipment (for milk, meat, grains)
			Motorized discontinuous handling	Motorized continuous handling

(contd)

Agricultural operation	Implements, machinery and equipment for increasing degrees of mechanization -----Increasing mechanization----->			
<u>Product conditioning, preservation and other operations</u>				
Storage	Storehouses, shelters, sheds	Buildings with specialized equipment in traditional farming (silos, barns, cribs)	Industrialized modern buildings	Buildings with highly specialized equipment: grain compartments, forage silos, grain augers, silage unloaders, pumps etc.
Sorting and packing	Tools	Manual discontinuous sorters and packers	Specialized batch sorters and packers	Continuous sorting packing equipment (washers, weighers, baggers)
Conditioning and preparation for consumption	Specialized implements (e.g. milk-beaters) for food production	Crop-conditioning equipment (screeners, winnowing-machines, shredders, stripers)	Apparatus and equipment for particular techniques (sun-drying, dehy-dration)	Preserving appliances (refrigeration, boiling, vacuum)
Handling and transport	As for farming	As for farming	As for farming	Specialized transport equipment for liquid (vats) or solid (crates) food products
Energy production and utilization of waste	Man- and animal power (roundabouts) Water bucket-chain and windmill power	Windmills, water-mills hydraulic rams simple digesters Simple sunlight-catchers	Small multi-purpose motors: petrol, diesel, electrical Power take-off of tractor to operate machines	Electricity generators and large specialized motors Continuous digesters solar panels, etc.

REFERENCES

- UNIDO/IS.377 Agricultural machinery and rural equipment in Africa. A new approach to a growing crisis. Sectoral studies series No. 1 (1983)
- UNIDO/IS.377 Machines agricoles et équipements ruraux en Afrique: une approche nouvelle pour résoudre une crise croissante. Série des études sectorielles No. 1 (1983)
- UNIDO/IS.379 The development of African capacities for the design and manufacture of basic agricultural equipment. Sectoral working paper series No. 2 (1983)
- UNIDO/IS.407 A survey of the Latin American agricultural machinery industry. Sectoral studies series No. 6 (1983)
- UNIDO/IS.407 Estudio sobre la industria de la maquinaria agrícola en América Latina. Serie de estudios sectoriales Núm. 6 (1983)
- UNIDO/IS.408
Vol.I The agricultural machinery industry. An appraisal of the current global situation, production and market outlook. Sectoral studies series No. 5 (1983)
- UNIDO/IS.408/
Add.1 - Vol.II The agricultural machinery industry. An appraisal of the current global situation, production and market outlook. Statistical compendium. Sectoral studies series No. 5 (1983)
- UNIDO/IS.503 The present situation of the agricultural machinery industry in North America and Western Europe. Sectoral working paper series No. 24 (1984)
- UNIDO/IS.581 The present situation of the agricultural machinery industry in Latin America. Sectoral working paper series No. 42 (1985)
- UNIDO/IS.607 The multipurpose approach to agricultural machinery manufacturing in Latin America. Sectoral working paper series No. 46 (1986)
- UNIDO/IS.607 El empleo de plantas polivalentes para la fabricación de maquinaria agrícola en América Latina. Serie de documentos de trabajo sectoriales Núm. 46 (1986)

For the guidance of our publications programme in order to assist in our publication activities, we would appreciate your completing the questionnaire below and returning it to UNIDO, Studies and Research Division, Sectoral Studies Branch, D-2073, P.O. Box 300, A-1400 Vienna, Austria

Q U E S T I O N N A I R E

Guidelines for the development of the agricultural machinery and implements industry in Latin America - Volume I

(please check appropriate box)

- | | yes | no |
|--|--------------------------|--------------------------|
| (1) Were the data contained in the study useful? | <input type="checkbox"/> | <input type="checkbox"/> |
| (2) Was the analysis sound? | <input type="checkbox"/> | <input type="checkbox"/> |
| (3) Was the information provided new? | <input type="checkbox"/> | <input type="checkbox"/> |
| (4) Did you agree with the conclusion? | <input type="checkbox"/> | <input type="checkbox"/> |
| (5) Did you find the recommendations sound? | <input type="checkbox"/> | <input type="checkbox"/> |
| (6) Were the format and style easy to read? | <input type="checkbox"/> | <input type="checkbox"/> |
| (7) Do you wish to be put on our documents mailing list? | <input type="checkbox"/> | <input type="checkbox"/> |

If yes, please specify subjects of interest

- | | | |
|--|--------------------------|--------------------------|
| (8) Do you wish to receive the latest list of documents prepared by the Sectoral Studies Branch? | <input type="checkbox"/> | <input type="checkbox"/> |
| (9) Any other comments? | | |

Name:
(in capitals)

Institution:
(please give full address)

Date: