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A REVIEW OF FAO'S ROLE IN MECHANIZATION
FOR AGRICULTURAL DEVELOPMENT

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



Appendix A

Some Selected FAO Publications and Papers
dealing with Agricultural Engineering

1. Agricultural Engineering Series of
Agricultural Development Papers

All these have been produced in the three working languages of FAO - English, French and Spanish. Some of the earlier ones may be out of print.

- No. 44 (1954) Consideration and Procedures for the Successful Introduction of Farm Mechanization
- 60 (1956) Water Lifting Devices for Irrigation
- 65 (1960) Irrigation by Sprinkling
- 66 (1960) Agricultural Machinery Workshops: Design, Equipment and Management
- 67 (1960) Farm Implements for Arid and Tropical Regions
Revised (1969)
- 71 (1960) Soil Erosion by Wind and Measures for its Control on Agricultural Land
- 73 (1964) Methods and Machines for Tile and other Tube Drainage
- 81 (1965) Soil Erosion by Water - Some Measures for its Control in Agricultural Land
- 84 (1966) Equipment for Rice Production
- 85 (1967) Multifarm Use of Agricultural Machinery
- 90 (1969) Handling and Storage of Foodgrains in Tropical and Subtropical Areas

2. Agricultural Engineering Series of
Informal Working Bulletins

Most of these have been produced in at least two of the three working languages of FAO. Some of the earlier ones may be out of print.

- No. 1 (1957) Factors to be considered when Selecting Tractor and Power Units
- 2 (1958) Equipment for Rice Production under wet Paddy Conditions
- 3 (1958) Engine Fuels and Lubricants
- 7 (1958) Water Control, Tillage and Seeding Practices and Machines for
Revised (1963) Crop Production under Irrigation
- 8 (1959) Tillage and Seeding Practices and Machines for Crop Production in
Revised (1969) Semi-Arid Areas

- No. 9 (1960) **Methods and Machinery for the Establishment and Management of Pastures**
- 10 (1960) **Methods and Machinery for the Harvesting and Handling of Forage Crops**
- 11 (1960) **Methods and Machinery for Harvesting, Threshing, Cleaning and Grading of Forage Seeds**
- 12 (1960) **Planning and Organization of Projects for the Improvement of Hand and Animal Operated Implements**
- 13 (1961) **Methods and Machinery for Cutting and Cleaning Irrigation and Drainage Channels**
- 14 (1961) **Safety Measures for the Use of Agricultural Machinery**
- 15 (1961) **Methods and Equipment for Rice Testing**
- 16 (1961) **Possibilities for the Utilisation of Solar Energy in Under-developed Rural Areas**
- 17 (1961) **Windmills for Water Lifting and the Generation of Electricity on the Farm**
- 18 (1962) **Improved Methods and Equipment for Tillage of Medium and Heavy Soils in Temperate Regions**
- 19 (1962) **Interpretation of Tractor Test Reports by the User**
- 21 (1962) **Portable Equipment for Sampling and Temperature Measurement of Bulk Grain**
- 22 (1962) **The potentialities for Rural Electrification in Asia and the Far East**
- 23 (1963) **Rice Drying Principles and Techniques**
- 24 (1963) **Some Essential Considerations on the Storage of Food Grains (Cereals, Legumes and Oilseeds) in Tropical Africa**
- 25 (1964) **Rearing and Capsizing of Tractors**
- 26 (1965) **The Use of Aircraft in the Mechanization of Agricultural Production**
- 28 (1966) **Equipment and Methods for Tied Ridge Cultivation**

3. **Agricultural Engineering Series of Informal Working Papers**

- (1956) **Mechanization, Project Planning and Management**
- " **The Selection and Operation of Land Development and Agricultural Machinery**

(1956) **Machinery Training and Advisory Services**

" **Machinery Maintenance**

" **Farm Implements**

(1959) **List of Manufacturers of Hand and Animal Operated Farm Implements**

4. Miscellaneous

(1950) **Progress and Economic Problems in Farm Mechanization**

(1951) **Survey on the Farm Machinery Situation in Europe**

(1957) **Illustrated Glossary of Rice Processing Machines**

(1965) **Agricultural Engineering Training and Education in Africa**

(1968) **International Directory of Agricultural Engineering Institutions**

(1956) **Report on the Regional Technical Meeting and Training Centre of Farm Mechanization and Workshop Problems - Ceylon (19 September - 14 October 1955)**

(1957) **Report on the Near East Regional Training Centre on Farm Mechanization Land Development Workshop Problems - Egypt (17 September - 13 October 1956)**

(1959) **Report on the South American Regional Training Centre on Problems Relating to the Use and Maintenance of Agricultural Machinery and for Land Development - Chile (24 February - 22 March 1958)**

(1963) **Report on the Farm Machinery Training Centre at Fahs - Tunisia (5 June - 26 September 1963)**



A Review of FAO's Role in Mechanization for Agricultural Development

1. Background

The Food and Agriculture Organization of the United Nations was conceived at Hot Springs, Virginia, U.S.A. in 1943; 42 governments signed the Constitution in 1945 in Quebec, Canada, when the Food and Agriculture Organization of the United Nations was formally created. Temporary headquarters were established in Washington, D.C. In 1951 the Organization moved into its present permanent headquarters in Rome which had been put at its disposal by the Italian Government. Today FAO has 117 Member Nations and 2 Associate Members.

2. Early sessions of the FAO Conference and Advisory Groups took special note of the need for adequate supplies of tools and implements and machines, initially to re-equip farms ravaged by war during 1939-45. It also took note of the need to provide nations everywhere with machinery to increase food production. These sessions made a number of recommendations, the implementation of which started the work on farm machinery in FAO.

3. The first Agricultural Engineering Expert was appointed to FAO headquarters in 1946, followed by further experts in 1947 and 1949. Right from the end of world war II, the United Nations Relief and Rehabilitation Administration (UNRRA) had started to provide farm equipment for countries ravaged by war. In February 1947 FAO entered into an agreement with UNRRA by which residual funds were transferred to FAO. It was under this UNRRA-Transfer Fund that the first field assignments were conducted, six specialists being sent to Austria, China, Czechoslovakia, Hungary and Poland.

4. In this initial period a number of farm equipment surveys were undertaken by FAO. One of these embraced the whole of South and Central America and the Caribbean area and resulted in an FAO/SOLA Report devoting a section to machinery. Similar FAO surveys were made in a number of Far East countries. In Pakistan an FAO study was used as a basis for a loan from the International Bank for Reconstruction and Development (IBRD) to finance the establishment of machinery centres in the country. A survey in the Philippines was accepted as a basis for the machinery to be used for a land clearing and settlement programme. In Thailand studies were made of the possibilities of mechanization of rice production which resulted in the establishment of the Agricultural Engineering Section in the rice department of the Ministry of Agriculture. A detailed study was made of the Japanese farm machinery industry and lists of manufacturers and the machines they built were prepared to determine how such production could be used in the Far East region.

5. FAO convened a meeting in 1947 with farm machinery experts from five countries in Europe to examine the farm machinery situation in that area following the war, and to define the manner in which FAO could best assist in its improvement. Recommendations of this group dealt mainly with the mechanization of small farms and with improving service facilities, including supplies of spare parts. In 1949, at the request of some member countries, FAO made a survey of the farm machinery situation in 23 European countries, including Turkey. This study more clearly defined the specific problems in individual countries and the common ones affecting groups of countries in the areas as a whole. The results of the survey were subsequently published at the request of the member countries.

6. From the early days FAO has been active in operational projects in which farm mechanization has played an important role. As world pressure mounted for agricultural development in the developing countries, FAO's work began to expand into more operational areas. FAO's field programme really got under way in 1951 when the United Nations Expanded Programme of Technical Assistance (EPTA) was inaugurated. This development role was extended further when the United Nations Development Programme (Special Fund) was initiated in 1959 to help finance resource surveys, pre-investment research, training and demonstration projects requested by member governments.

7. The most active part of FAO's work on farm power and machinery was under the Expanded Technical Assistance and UNDP(SF) Programmes. Work included the provision to governments of farm mechanization experts, awarding of fellowships for training abroad, and the organization of regional development and training centres. The main spheres for which Technical Assistance was requested were in the selection of, operation, maintenance and servicing of agricultural and earth-moving machinery. A number of assignments also concerned the planning of overall country mechanization programmes, including the introduction of improved small tools and the establishment of training programmes for machinery operators and workshop personnel.

8. The first Regional Development Centre on Farm Mechanization and Land Development Machinery Problems was held in Ceylon in 1955. It was attended by 34 participants from 11 countries in Asia and the Far East. The value of this centre was so evident that the programmes were continued and a second centre was held in 1956 in the United Arab Republic and provided training for 30 senior men from 10 countries in the Near East Region. In 1958 a similar centre in Chile was attended by 38 participants from 8 countries in South America. A further training centre was held in Tunisia in 1963 with 56 participants from the three Maghreb countries. FAO reports cover the organization, programme of work and participation of these centres.

9. Throughout these years, farm machinery specialists were making an important contribution to the work of FAO. At the same time, agricultural products processing specialists were making their contribution. Finally, in 1959 a separate Agricultural Engineering Branch was formed as part of the Land and Water Development Division. It consisted of a number of professional officers with special responsibilities for:

Farm Mechanization

Hand Tools and Animal Draft Equipment

Products Handling, Drying and Storage

Agricultural Products Processing

These last two activities are closely inter-related and require, wherever possible, integrated action.

10. Since June 1968, the Agricultural Engineering Service, as it is now known, has been part of the Agricultural Services Division and is responsible for all aspects of mechanization for agricultural development and production, products handling, drying, storage and farm structures, and the application of rural electrification. The present Agricultural Engineering Service has 75 professional posts including 67 professional officers in field posts in some 40 different developing countries. Regional Farm Mechanization Officers have been stationed in the South American, African and the Far East Regions, while the Near East Region has been covered from Rome. Agricultural Products Processing has become the responsibility of a renamed "Food and Agricultural Industries Service" within the same Division. Over the last 23 years, in all several hundred technical and professional experts have undertaken assignments concerned with all aspects of mechanization, crop drying and storage in over 60 developing countries.

11. From its inception FAO has served as an organizing and co-ordinating agency bringing together representatives of national governments and scientific bodies to review and exchange information and to study problems of common interest. At the request of its member nations, FAO plans action programmes within the whole range of food and agriculture including agricultural engineering and processing.

12. Through its professional staff the agricultural engineering service acts as a clearing house for information on agricultural engineering development. It keeps abreast of developments in the agricultural engineering industry, agricultural engineering institutions, research stations and at agricultural engineering faculties in universities all over the world. It is also concerned with the technical aspects of the formulation of field projects involving mechanization and providing training, technical advice and giving technical assistance.

13. FAO over the last 23 years has issued well over 60 development papers, bulletins and special studies dealing with agricultural mechanization, storage and processing of agricultural products. A selected list of these publications will be found in Appendix A.

The role of Agricultural Machinery and its Usage in
Increasing the Productivity of Land and Labour

14. Amongst the functions defined in FAO's Constitution are the following:

"The Organization shall promote and, where appropriate, shall recommend national and international action with respect to:

The conservation of Natural Resources and the adoption
of improved methods of agricultural production. The
improvement of the processing, marketing and distribution
of food and agricultural products."

Mechanization undoubtedly is one of the most important factors for improving methods of agricultural production. Mechanization also has an important role to play in the conservation of natural resources and in the improvement of the processing of food and agricultural products.

15. (i) Hand Tools and Animal Draft Equipment

It is well known that the production of at least 80 percent of agricultural crops in the world today is dependent on human and animal power. Undoubtedly for the next 20 years they will remain the main source of power, particularly in the developing countries of Africa and Asia. This is partly due to the predominance of small farms with fragmented fields, lack of roads and access, lack of the necessary infrastructure, such as the availability of service, spare parts, fuel and oil, technical know-how and lack of purchasing power and of credit facilities. In such areas the main benefits of mechanization will come principally from improved hand tools and animal draft equipment.

16. Thus, improved ox yokes could increase the power output of draft animals. Improved, light-weight steel ploughs could in many cases reduce the number of ploughings required, while improved seeding and tillage techniques could substantially increase yields. It will be necessary, however, for such improved equipment to be produced in quantity and at prices that the small farmer can afford, and that credit facilities are readily available for their purchase. At present their relatively high cost puts them well beyond the reach of most of the small subsistence farmers in the developing countries.

17. The introduction of animal draft equipment into areas where most of the work has previously been done with hand tools requires the training of draft animals and the training of operators and extension workers. The promotion of animal draft equipment and training is an activity with which FAO has long been intimately concerned. Many successful projects have been and are being run in areas such as the Andean regions of South America, the land-locked territories of Africa, the Indian subcontinent, and in Madagascar. In 1953 a Development Paper (No. 32) was published, intended mainly for the guidance of agricultural leaders and teachers. It described and recommended designs of small tools and also included information on their proper use and maintenance. A revised and expanded Development Paper entitled "Farm Implements for Arid and Tropical Regions" was published in 1960. This was twice reprinted and has since been revised again and is currently being processed in FAO's Agricultural Development Paper series. Wherever possible local artisans at the village level have been encouraged to take up new and improved designs of hand tools and animal draft equipment.

18. (ii) Power Mechanization

Power mechanization has an important contribution to make in increasing the productivity of land and labour in the developing areas in conjunction with other inputs. Its main role is in the intensification and increased efficiency of agriculture, including the reduction of fallows and the introduction of multicropping, particularly under irrigation. All these functions presuppose an adequate supply of power during peak periods.

19. One of the main necessities of farming is timeliness of operations. In many areas, particularly in sub-tropical areas, ploughing can commence before the first rains only if mechanical power is available. Timeliness of planting is all-important because it can have a big influence on yields, particularly where it allows crops to take full advantage of any early rain. Where multicropping can be practised there is usually too little time to get one crop off and prepare the ground for the next. At peak periods there is always demand for more power whether it be provided by animals or by tractors. Power mechanization enables the farmer to get on with his work quickly when the weather and climatic conditions are right and, furthermore, it is often his salvation when conditions are not right.

20. Power mechanization can also help to increase yields by doing the job more effectively than can be done by hand or with animal power. Tractor power enables a better job to be done of land levelling, terracing, bunding and the application of effective soil and water conservation methods. In medium and heavy soils it allows a better tillage job to be done in deep ploughing, chisel ploughing, sub-soiling, discing and in mulching operations to maintain productivity and in many other operations. The accurate placing of seeds at regular spacing and at regular depth also has an important influence on yields. This is particularly true for the new high-yielding varieties.

21. Other important functions are pumping water for irrigation, and crop protection, including aerial spraying. Weed control also is mostly done by mechanical means. Alternatively, sprayers are required for the application of chemicals for weed control. Diseases, moulds and insect pests normally have to be controlled by chemical means and this also requires the use of mechanical sprayers or dusters.

22. A bottleneck in farming operations very often is the harvest. If crops are not harvested at the right time there can be considerable losses from shattering, from birds and rodents and from weather hazards. Not only will the combine harvester ensure the safe collection of the harvest from the field, but furthermore, it has been estimated that a combine will reduce harvest losses by at least 10 per cent over conventional methods, where the crop is cut by hand or by other mechanical means, then has to be stoked, carted and subsequently threshed.

23. Transport forms an important link in farm mechanization. Tractors and trailers or animal-drawn carts are essential for getting crops off the field. Equally important is the availability of transport for getting produce from the farm to market. This may best be served by rail or by trucks rather than by tractors, although tractors are widely used for this purpose.
24. It is clear that power mechanization has an important role to play as part of a package of inputs for increasing the productivity of land and labour. It is one of the main responsibilities of FAO to assist in introducing and promoting mechanization but only in the right and appropriate conditions. Furthermore FAO can assist in creating the right conditions.
25. Power in agriculture may be provided by 2-wheel, 4-wheel and crawler tractors. It may also be provided by engines mounted on self-propelled implements, particularly self-propelled combine harvesters. Power for pumping for irrigation may be provided by tractors, internal combustion engines (mainly diesel) or by electric motors. Tractors, petrol, diesel and electric motors are also used for providing power for grinding, mixing, lifting, conveying and similar farmstead operations, and last, but not least, tractors may also provide the motive power required for farm transport. The many FAO publications listed in the Appendix are ample evidence of FAO's involvement over the years with all sources of power.
26. At one time crawler tractors were extensively used for ploughing and other tillage operations requiring plenty of power. They are, however, relatively expensive to purchase, complicated and expensive to maintain and lack flexibility. Today they are used mainly for land clearance and reclamation and for very heavy work under certain soil conditions but they are not to be recommended for general agricultural use.
27. The 2-wheel single axle tractor or motor cultivator is best suited for market garden and vineyard work and for paddy cultivation. It may be fitted with a petrol or with a diesel engine. Because of its lower capital cost and ease of maintenance it gained some acceptance in the developed countries in the early days of mechanization. However, it normally has a shorter working life than the 4-wheel tractor and the working costs per hectare, including depreciation, are somewhat higher. In most countries it has been very largely superseded by the 4-wheel tractor. The widespread acceptance and use of 2-wheel tractors in Japan is largely due to socio-economic reasons which are not paralleled elsewhere. The 2-wheel tractor could play a more important role in some of the paddy areas of Asia where the farms are predominantly small and access is difficult. Moreover it lends itself more easily to local manufacture as in Taiwan, India and Iran.
28. The most popular and commonly used tractors for agricultural purposes today are the 4-wheel models, usually fitted with diesel engines. They have the most versatile application in that they can be used for a wide range of activities, including land preparation, primary and secondary tillage, seeding, inter-row cultivating, spraying, harvesting and transport and can also provide power for pumping and other operations. Furthermore, the operating costs of a medium to large diesel engine 4-wheel tractor, including depreciation and maintenance, is lower than for any other type of tractor.
29. Historically, most countries have started power mechanization with the smaller types of 4-wheel tractor. The long term trend, however, is towards the medium and large sizes. Some people have suggested the need for small, simple unsophisticated 4-wheel tractors. So far no such tractor has been successfully commercialized, although there is something to be said for them in areas with small farms and with lack of service facilities. Unfortunately, the cost of production of a 20 h.p. tractor usually works out at about 60-75 per cent that of 40 h.p. tractor. For the time being at least the developing countries may be best advised to stay with the medium to medium-large 4-wheel diesel tractors.

Developing the Mechanization of Agriculture

30. One of the most important functions of the Agricultural Engineering Service has been to advise on the correct selection and application of equipment. Too often failures or partial failures of agricultural development projects have been experienced due to the use of totally unsuitable equipment. Research and field testing are essential to ensure the correct choice and application of equipment suited for the working environment of tropical and sub-tropical areas.
31. The technical advice and assistance provided by FAO covers the whole field of farm mechanization from hand tools to animal draft equipment to tractors, combines and equipment for land clearance and preparation. It also covers the application of mechanization to a wide range of climatic and soil conditions and a variety of crops, including cereals, pulses, oil seeds, sugar cane, fibres, horticultural and tree crops.
32. By far the most important crop in the developing countries is rice, the mechanization of which has been given special attention by FAO. The International Rice Commission at the Sixth Session held at Tokyo during 1953 requested the Director-General of FAO to invite members to form a permanent working Party on the Engineering aspects of Rice Production, Storage and Processing. This working Party came into effect on 1 January 1959, and now meets regularly every two years. The professional staff of FAO now includes a rice mechanization specialist and a rice drying and processing specialist. An Informal Working Bulletin "Equipment for Rice Production under Wet Paddy Conditions" was first issued in 1958. An up-dated special Development Paper, No. 84 "Equipment for Rice Production" was produced in 1966.
33. The Agricultural Engineering Service of FAO is also very much concerned with soil and water conservation methods and with the economic viability of mechanization under varying conditions. This is particularly relevant to areas of "Dryland Farming" with 250-500 mm of annual rainfall. Such areas often can be made economically viable only through the application of the latest techniques of fully mechanized dryland farming practices. This subject was covered in Informal working Bulletin No. 8 first issued in 1959 and now being revised and up-dated for a third edition to be published at the end of 1969. In 1967 FAO sponsored a seminar on Land and Water Use for the Near East in which mechanized farming practices featured prominently.
34. Many field projects require tractors and farm machinery, including equipment for land clearance and land preparation and for transport. A professional equipment officer is available for field visits to assess local conditions and to prepare equipment specifications, ensuring too that the necessary supporting spare parts and service facilities are available.
35. Farm sizes should be large enough to justify the capital investment in mechanization; but the range may vary greatly according to the working conditions and type of equipment - say 2-4 hectares for a 6 h.p. 2-wheel tractor or 15-25 hectares for a 40 h.p. 4-wheel tractor under intensive irrigated conditions to 40-100 hectares exclusive of fallow for the larger wheel type tractors in rainfed areas and 100-150 hectares in the low rainfall (dryland) areas.
36. Clearly power mechanization is best adapted for large farms and large fields. Where such conditions do not exist, FAO gives advice on the setting up and administration of machinery contract hire services. Many field experts have been and are currently working in developing countries for this purpose. In addition, in 1967 FAO issued a Development Paper No. 85, "Multifarm Use of Agricultural Machinery". This reviews in detail the various forms of multifarm use including:

Contract work, i.e. the carrying out of machinery services for farmers by individual contractors or group of companies providing contract services.

Government hire and contract services.

Neighbourly help.

Partnership or association such as co-operatives.

Registered farm machinery services.

This publication also deals in detail with government promotion of multifarm use, the establishment, organization and management of hire services, the cost of operating farm machinery and the need for planning, training and extension.

37. Providing farm equipment can also be a problem. New developing countries have unlimited sources of foreign exchange for importing what they require. Very few have the necessary experience and industrial background to enable them to manufacture tractors and the more complicated types of farm machinery. Many of them, however, are already manufacturing the simpler types of hand tools and animal draft equipment, even if only at artisan level. There is certainly plenty of scope for building up the smaller workshops and also for expanding the infant implement industries in several countries. This clearly is the responsibility of FAO. It is a field where FAO and ILO must work closely together. FAO, through the practical experience gained over the last twenty-three years, is in a position to advise on the type of equipment to suit local soil, climatic and economic requirements and also advise on equipment to match the size and strength of local draft animals. Where necessary, FAO can assist in further research and field testing to establish the most appropriate equipment to suit local conditions. For this purpose FAO works closely with research and experimental stations, with the Ministries of Agriculture of the developing countries and with the leading manufacturers of farm tractors and machinery.

38. At the suggestion of the International Commission of Agricultural Engineering (CIGR) and of the European National Committees of FAO, a list was compiled in 1949 of "Agricultural Engineering Institute in Europe". This greatly facilitated the exchange of knowledge between agricultural engineering experts in specific fields in the region. Later, this work was expanded and in 1957 an International Directory of Agricultural Engineering Institutions throughout the entire world was published. Since then this has been revised and up-dated and re-issued again in 1963. The material for this latest issue was collated from 108 countries and gives full details of government services and institutions, development, research and testing centres, universities, technical colleges, industry centres, agricultural shows, periodicals, reference books, films and a list of agricultural engineers attached to the various institutions and organizations.

Training Service and Spare Parts

39. In many developing countries there is a tremendous need for trained personnel, the lack of which in the past has led to a number of costly failures of mechanized production projects. The greatest need and greatest number of trained personnel are required at the intermediate level. Over the past twenty years, FAO has assisted its member governments in organizing suitable training programmes for all classes of personnel connected with mechanization. This includes tractor and machine operators, maintenance personnel, field servicemen and supervisors, and extension workers to demonstrate and make known the correct application of mechanization on the farmer's own land. Regional seminars and training centres have been prominent features of this training activity. FAO has also assisted in providing scholarships for further training.

40. In addition, FAO is assisting member governments in a number of countries in the execution of projects for education at University level of agricultural engineers. Furthermore, through its fellowship programmes FAO has enabled large numbers of men to receive university training at both graduate and post-graduate levels in the more advanced developed countries. A proportion of these graduates are absorbed or enter employment in the agricultural engineering industry and in agricultural machinery research and development institutions.

41. The following are notable examples of this continuing educational and training activity. Finance for these is being, or has been provided by the UNDP Special Fund and Technical Assistance Sector, philanthropic bodies under the Freedom from Hunger Campaign and the machinery industry itself.

The Strengthening of the Faculty of Agricultural Engineering at the Agricultural University of La Molina, Lima, Peru.

The agricultural engineering courses at the University of Monrovia, Liberia.

The Farm Mechanization Centre at Riyadh, Saudi Arabia.

The North Africa College of Agricultural Engineering in Tunisia.

The Farm Mechanization Centre in the Congo (Kinshasa).

The Banda Agricultural College in Malawi.

Mention should be made of the "Report on Agricultural Engineering and Training in Africa" (1965). The findings of this report are relevant to many of the developing areas throughout the world.

42. Another important requirement is the availability of spare parts and field service to ensure the economic and efficient operation of mechanized equipment over a long working life under mostly arduous conditions. Such services cannot be normally provided by large industrialized central workshops except for specialized services such as crankshaft regrinding and engine and fuel injection pump reconditioning. What the farmer needs essentially is prompt field service spread over wide and remote areas. Here again FAO works closely with machinery manufacturers to ensure that spare parts and field service facilities can be provided where required. In the case of field projects, FAO provides technically trained staff for supervising equipment and for training local staff in its maintenance and use.

Crop Handling, Drying and Storage

43. As long ago as 1946 an FAO expert committee estimated that world storage losses for cereals, pulses and oilseeds were in the region of 10 per cent*. There is no reason to think that these losses have been reduced in any way over the last 23 years. On the contrary, in many of the developing countries these losses may amount to 20 per cent and in some cases can reach very much higher figures.

*FAO - Destruction of Food in Storage by Insects, Mites, Rodents and Mould Fungi. Report of an Expert Committee, Washington, D.C., May 1946.

44. Losses during storage and transport may be due to exposure to weather, to lack of, or inefficient, drying and to destruction or spoilage by birds, rodents, micro-organisms, mites and other pests. Losses occur at all levels from the field to storage on the farm, storage at co-operatives or dealers and at the main storage structures of large centres of population.
45. Contamination or inefficient drying or sun drying under unfavourable conditions can lead to excessive cracking during milling and processing and thus to further losses and deterioration in quality. The remedy lies in the provision of improved drying equipment and storage containers and structures. These latter should preferably be of a design which can be made up out of locally available materials.
46. FAO's main responsibility in this field has been, first of all, to create an awareness of the problems which may be so easily overlooked in many developing countries. This has to be supported by technical assistance for carrying out surveys and then by pilot projects for setting up drying facilities and storage structures at various levels. Drying and storage is intimately tied in with what happens before, namely, during crop production, harvesting and crop handling. Especially important, efficient drying and storage can have a considerable effect on the reduction of losses during processing and on ensuring the required quality of the end product.
47. FAO is operating a number of field projects dealing with drying and crop storage and preservation. In some cases it may be part of crop production projects as with a rice production project in Fiji. Or it may be a project for carrying out research into the most suitable types of dryers and storage structures and containers, which would ultimately be manufactured in the country concerned out of locally available materials, as in India. Or again, it could be part of an integrated pilot project taking in crop handling, drying, storage, preservation and processing of rice. This is currently being proposed in Pakistan with a view to ultimately obtaining the support of the World Bank or of regional banks for setting up a large number of similar integrated production plants throughout the country.
48. A new agricultural development paper is now going into print in English, French and Spanish, entitled "Handling and Storage of Food Grains in Tropical and Sub-Tropical Areas". This is one of the most comprehensive publications of its type ever produced and brings up to date information collected and research work carried out over a period of years, some of which has been previously published in FAO bulletins. A fuller list of publications will be found in Appendix A.

Processing, Marketing and Distribution

49. Farmers the world over need incentives to produce food, fibres and agricultural products over and above the requirements necessary to fulfil the needs of the family. These incentives can only be offered through an assured market for their products. To assure market acceptability, the quality of the product becomes all-important. To arrive at the final product, a long integrated process has to be gone through, starting with land preparation, the choice of suitable varieties of seed and breeds of livestock, and protection against disease and insects throughout all stages of growth through to harvest. Disease and insect pests can seriously affect the quality of food crops and of meat products and hides and skins. After harvest, crops have to be transported, possibly dried and safely stored. Varieties of crops grown, the efficiency, or otherwise, of drying and of preservation and protection against moulds, insects and rodent pests all have an important effect on the percentage of recovery during subsequent processing. Processing also normally throws up a number of by-products which may be fed back into agriculture in the form of animal feed or fertilizers.

50. Crop protection and preservation through improved drying and storage is, however, not, in itself, enough for a number of perishable products. Consideration also has to be given to the introduction of special processing techniques suitable to the local environment. Processing may start right on the farm itself or at local village or co-operative level. The establishment of food and agricultural products processing facilities from the farm and village level onwards is thus an important step in the overall planning of the agricultural development of a country. Such rural industries may, in time, become the forerunners to a wider development of industries, to the diversification of national economies and to the ultimate expansion of foreign exchange earnings leading to greater prosperity.

51. Rural development must always be one of the main objectives of FAO. Throughout its twenty-three years of existence, FAO has always been interested in the development of simple techniques and equipment for processing, starting from the farmer level. From there the next step may be the setting up of multi-purpose farmers' co-operatives covering the collective purchasing of seeds, fertilizers, insecticides, pesticides and production tools and farm machinery. It may well include also the establishment and operation of processing plants for dairy products, for the canning of fruits and vegetables, the drying, storage, dehusking and polishing of rice and the production and utilization of by-products as animal feed or as fertilizers.

52. The modernization of agriculture along this or similar patterns ensures the required integration linking, on the one hand, the primary producer with the processing plant, and, from there on, into marketing and distribution systems, thus creating further incentives for the primary producers. The very large number of projects that FAO has been operating for the last twenty years or more and the large number of publications that it has produced on the subject are ample evidence of its deep involvement in all aspects of agriculture from crop and livestock production through storage, preservation, processing, marketing and distribution.

The Contribution of the Agricultural Engineering Service to the Indicative World Plan for Agricultural Development (IWP)

53. The rate of growth of the population of the developing countries is around 2½ per cent per annum. From 1958 to 1965 the average rate of growth of food production was 2 per cent. An average rate of growth of 3 per cent per annum in food production is going to be needed to be reasonably sure of keeping just slightly ahead of population increases. Industrialization will not provide new employment for more than a small fraction of the 20 million who will be added each year to the potential labour force of the developing countries. Only by accelerating the rate of agricultural growth would it be possible to solve the problem of massive unemployment which most developing countries will have to face over the next two decades. After more than a decade of planning, many governments realize that the lack of satisfactory agricultural progress can be the stumbling block to the "take-off" of the entire economy. It was in an endeavour to remove this stumbling block that FAO embarked in 1965 on the preparation of the Indicative World Plan for Agricultural Development. FAO's objective was to analyse the problem as a whole in an integrated way and in sufficient detail to serve as a basis for policy guidance to the developing countries as well as for developed countries. It is being prepared with two time horizons - a ten-year perspective to 1975 and a twenty-year perspective to 1985.

54. Four regional studies have been completed to date covering South America, the Near East, South and South East Asia, and Africa, South of the Sahara. A consolidated World Study is now in its final stages of preparation for presentation to the FAO Conference in November 1969. A framework is being set up which will help to identify the main requirements for future planning, not only for the developing countries but also for the developed world and for FAO and the other United Nations agencies.

55. The four regional studies include chapters on:

The Role of Agricultural and Economic Development

Development and Utilization of Land and Water Resources

Material Inputs Required to Support Crop Production Objectives
(including Seeds, Fertilizers, Pesticides and Mechanization).

These studies are supported by detailed statistics* giving, on a country by country basis, crop areas for a wide range of crops, yields and total production, together with their values. This is shown for the base period (average 1961/63) 1975 and 1985.

56. The Agricultural Engineering Service has prepared studies for each of the four regions and one for the World Report. These studies indicate the main role of mechanization in the agricultural development of the developing countries. They are supported by statistics, giving the estimated tractor and combine harvester parks of the individual countries for 1965. Also shown are the IWI proposals for 1975 and 1985 for the expansion of the tractor and combine parks required to meet the agricultural production targets for these years. There are also tables giving the cost of the capital investment envisaged and of the current inputs covering the cost of service, spare parts and fuel. Included in these tables is the cost of hand tools and animal draft equipment as well as of power equipment. These studies can be of great assistance to UNIDO in considering future requirements for tractor and farm implement manufacturing plants in the developing areas as well as to ILO in considering labour requirements.

FAO/Industry Co-operative Programme

57. For some years now a number of multi-national companies have been working with FAO interchanging technical information and in some cases providing financial and technical assistance, mostly under the auspices of the Freedom from Hunger Campaign. The association of Industry with FAO was formalized when the FAO Conference of 1965 approved the setting up of the FAO/Industry Co-operative Programme.

58. Some of the leading farm machinery manufacturers have been particularly prominent in the assistance they have been providing in furthering the general aims of FAO. In 1964 a tractor and farm machinery manufacturer held an international conference on the Mechanization of Sugar Cane, followed in 1966 by an international conference on "Mechanization and the World's Rice". Several of the world's leading experts were brought together from all five continents to participate in this conference which was held in the United Kingdom and Italy. The same manufacturer, in association with FAO, under the Freedom from Hunger Campaign, has set up a South American Regional Training Centre in Colombia for the formation of tractor and machinery instructors. Another leading manufacturer is holding, in association with FAO, an international conference in the U.S.A. on Dryland Farming in August 1969. Yet another manufacturer, in association with FAO, is at present preparing a manual on Land Clearing Methods and Techniques.

* Most of the statistics are based on the FAO Production Yearbook which has been published annually for the last 22 years and which, in addition to crop, livestock number and livestock products, also covers tractors, combined harvester-threshers and milking machines. FAO is at present promoting the participation of member countries in the 1970 World Census of Agriculture, including a census of tractors and a wide range of farm machinery.

59. There has also been close co-operation with Industry in the field of agricultural products processing. In Turkey, a leading multi-national company has set up a fruit and vegetable processing industry working very closely with a UNDP/FAO Centre for the Production, Processing and Marketing of Fruits and Vegetables. Industry are also working closely with FAO in developing the utilization of by-products from food and agricultural products processing plants for animal feed, e.g. molasses in the Sudan.





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