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TRAINING IN AGRO-MACHINERY INDUSTRIES

Report of a Survey of Training Needs and Capabilities in Selected Developing Countries*

Prepared by

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0. INTRODUCTION

0.1 Background

The Lima declaration and Plan of Action, adopted by the second General Conference of UNIDO in Lima, Perù, in March 1975, and subsequently endorsed by the UN General Assembly in September of the same year stressed, inter-alia, the development of efficient agricultural-related industries in order to achieve a high degree of integration between the expansion of agriculture and industry in the developing countries. In this context, the creation of integrated production units like agricultural machinery plants, appropriate engineering industries and repair and maintenance services are emphasized.

Accordingly, UNIDO convened the first Consultation Meeting of the Agricultural Machinery Industry in Stresa, Italy, 15-19 October 1979, at which sixty countries were represented. The Consultation recommended a series of action oriented follow-up measures to address specific problems raised at the meeting and to pave the ground for a subsequent Consultation Meeting. As a priority among these measures, the Consultation directed UNIDO to establish a Working Group on Training in the Industry and to initiate appropriate actions to address industry training needs.

A consultant was retained to recommend an initial programme of action for the Working Group. The highlights of his recommendation were two:

- focus attention on a number of developing countries typical of the commonly accepted stages of industry development;
- look towards integrated training programmes.

Therefore UNIDO decided to select a consultant to carry out a training need identification in the field of design, production, use and maintenance of agricultural machinery in 5 countries considered representative of the various stages of industry development.

0.2 Objectives

Objective of the study was to survey and identify the training needs of the agricultural machinery industry in a number of developing countries. The survey had the focus on training needs in three areas:

- product utilization, repair and maintenance management and operation of spare parts and supplies installations;

- manufacturing technology (product engineering, industrial engineering, quality and cost control) and management;

- product development and adaptation as well as prototype fabrication and testing;

and had to include identification and assessment of existing training capabilities.

On the basis of the above, to develop comprehensive project proposal for assistance in meeting the needs identified in each country.

0.3 Countries surveyed

Four criteria were considered in selecting the developing countries to be covered by the study:

1. The agricultural sector should be of major importance in the country and should offer higher than average potential for improvement.
2. An appropriate infrastructure and other conditions should already exist so that results can be achieved in a reasonably short time
3. The countries should be typical of the region and representative of specific levels of agricultural mechanization and industry development
4. The countries should possess some agricultural manufacturing capacity and allied institutional support facility, and Geographical Distribution should be considered to the extent possible.

The five countries selected for study were Sudan, Bangladesh, Tanzania, Syria and Argentina.

The above countries could be considered as a sample representative of 4 groups of developing countries which could be broadly defined as follows:

Category A Countries: may be at the lowest end of engineering industries development (Sudan belongs to this group).

Category B Countries: have just started engineering industry development with basic elements on a modest basis. These may be regarded to be at "Intermediate stage" (Bangladesh and Tanzania belong to this group).

Category C Countries: have developped engineering industries on a sound basis, with appropriate infrastructure.
These may be regarded as "advanced intermediate stage" (Syria belongs to this group).

Category D countries: may be considered as the "most advanced" in the field of engineering industries/infrastructure development (Argentina belongs to this Group).

0.4 The survey and its methodology

Field operations started in July 1982 when two separate teams visited Argentina and Tanzania. Syria was visited in October 1982, Bangladesh in January 1983 and Sudan in May 1983.
Each survey was carried out by a team of specialists in the following areas:

- agricultural machinery utilization, repair and maintenance
- agricultural machinery manufacturing technology
- agricultural machinery design, development and testing.

The team visited, in each country, a representative sample of industries operating in the field of agricultural machinery, agro-mechanization centers, research and testing institutions,

maintenance workshops, training institutions, all governmental and international agencies concerned and collected as many statistics as possible, trying to get a comprehensive picture of the status of the agricultural mechanization in the said countries.

As agricultural mechanization, the following definition offered by FAO (1) has been adopted by the team:

. 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. Agricultural technology can be broadly classified as:

  . handtool technology

  . animal drawn technology

  . motorized technology

FAO's strict definition of agricultural machinery excludes handtools but the consultant has decided to include these implements within the scope of the report, considering that in many developing countries handtools are the only kind of "agricultural machinery" used.

(1) FAO Agricultural Bulletin, 45, Rome, 1981.

1. Major findings and conclusions

The survey has allowed the identification of a number of training needs in:

. design, development and engineering of agricultural machinery

. manufacturing

. use and maintenance

The identified needs vary considerably according to the peculiar production/utilization each country has. TABLE I (see next page) shows the production of agricultural machinery by type of manufacturer in the five countries.

1.1 Training needs

The areas in which training needs have been identified are:

. design and engineering

. machinery testing

. production equipment maintenance

. quality control

. production personnel

. use and maintenance

1.1.1 Design and engineering

Design and engineering in the field of agricultural machinery in most of the developing countries remains quite limited with the following main consequences:

TABLE I: PRODUCTION OF AGRICULTURAL MACHINERY BY TYPE OF MANUFACTURER

	Category A			Category B			Category B			Category C			Category D		
MAIN AGRICUL. MACHINERY	SUDAN			BANGLADESH			TANZANIA			SYRIA			ARGENTINA		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Handtools	X	X		X	X	X	X	X	X	X	X			X	X
Animal drawn plough	X	X		X	X	X	X	X	X	X	X			X	X
Other animal drawn implements	X	X		X	X	X	X	X	X		X			X	X
Irrigation equipment					X	X									X
Power tillers						X***									X
Tractors						X **						X			X
Tractors drawn implements						X			X *						X
Self propelled agric. machines															X
Post harvesting equipment		X		X	X	X	X	X	X		X				X

* Plant under construction
** Assembly only
*** On prototype development stage

1: Blacksmiths
2: Small workshops
3: Industry

. need to import most of machinery

. the use of machinery that very often is not suitable for local conditions

. high costs of production because of poor engineered products/ parts

The high production cost means, in turn, higher selling prices with the consequence of reduced input to the agricultural (considering the low purchasing power of farmers in most developing countries) and low utilization of producing plants. A few specific examples in the five countries are:

. In Sudan the lack of design and engineering capabilities (limited to the construction of few prototypes at the Faculty of Agriculture) is one factor that has prevented, so far, the establishment of any industrial production of agricultural machinery and/or of spare parts (the only ones locally manufactured originating from the artisanal sector).

. In Tanzania there are institutions active in R + D in the agricultural machinery field both at factory level (MMMT, UFI etc) and public level (CAMARTEC) and some interesting results have been obtained (recently, for instance, a solar dryer, locally designed, has been successfully tested). But problems arise at the engineering level expecially, because there is lack of specific experience.

Consequently defects in the conceptual design of certain pieces resulted (for instance the clevis of the drawbar of a locally produced trailer is rigid and not rotating, with consequent

frequent breaking), as well as difficulties in the choice of most appropriate raw materials, in the identification of the best manufacturing cycle for a spare parts, etc.

In Bangladesh the research and development of agricultural machinery and implements is carried out by a number of public (i.e. the Rice Research Institute) and private agencies and companies. There is no central coordinating and/or standardizing unit. Lack of engineering capabilites reduces the possibility of fast and low cost industrialization of the prototypes designed and tested by local agencies there is, as well, a costly duplication of efforts (e.g. several companies active in the design and construction of prototype of power tiller but without specific technical knowledge and with consequent poor results and high development and production costs). Furthermore locally designed products have often lower technical characteristics than the imported ones (for instance the efficiency of the irrigation pumps).

In Syria there is presently a limited activity in this field and most of the equipment is imported. However a tractor factory has recently started-up and this plant could become an active center for the development of other equipment and implements as well as carrying out, provided that specific training is assured, the design and the relevant testing activity needed to modify imported equipment to make them more suitable to Syrian conditions.

In Argentina the R + D activity is carried out with good results at both factory level and public institutions. In particular two of them, INTI and DAT are very well equipped and the staff is particularly well trained and play a very important role in information dissemination and technolog, development in agricultural machinery industry. Perhaps more emphasis could be given in future to the components standardization and specific seminars on this topic could be organized.

For all countries surveyed with the exception of Argentina, there is therefore the need to create, or strengthen when existing, a center at national level that can carry out the following main tasks:

- cooperate with the government (Ministry of Planning or other body) in the development of national policy on the total spectrum of agricultural tools, implements and machinery;
- design, construct and test prototypes of machines/implements tools and qualify local engineering companies for their production;
- provide the national engineering industry with qualified expertise and consulting services in the design and development of agricultural machinery.

At the same time, at factory level, training has to be provided to strengthen expertise in product engineering, production technology etc.

1.1.2 Machinery testing

Agricultural machinery is usually tested and certified by local authorities before its use in a given country. This procedure is particularly important for the developing countries, where the majority of the agricultural machinery, especially the self-powered ones, are imported. Careful analyses of the characteristics of the equipment must be carried out in order to ascertain its suitability to operate under the prevaiiing local conditions (climate, soil, level of existing service for maintenance, infrastructures etc).

A testing agency is present in the majority of developing countries but in many cases its efficiency is not adequate, due to lack of modern and accurate testing procedures, lack of equipment and lack of trained personnel. As result of this situtation many of these agencies are limiting their work to preliminary and physical inspection of the equipment.

The importance of strengthening the testing activity cannot be overstated, particularly with respect to the suitability of the machines for the local use, in order to avoid the risk of spending large amount of foreign currency for low efficiency machinery (or, often, machinery that is actually harmfull for local agriculture).

In all countries visited there is the need to strengthen the operation of these centers by providing adequate training to the personnel to equip them not only to test the equipment but also to suggest modifications, development possibilites and to contribute to the standardization of the tools/implements and machinery used in the country.

1.1.3 Production Equipment Maintenance

Industries located in developing countries are often operating at a low level of productivity because of poor maintenance of the production equipment. Maintenance is often provided only when machinery break down. Preventive maintenance is seldom planned and carried out resulting in more frequent break-down and consequently larger consumption of spare parts.

The majority of the spare parts have to be imported and, in absence of well planned maintenance procedures, the parts are ordered only when actually needed. In addition most of the developing countries suffer a shortage of foreign exchange. As a consequence import licences are issued with great delay and this contributes to reduce considerably the already low level of productivity (some equipment is simply not in operation for a relevant percentage of the year).

There is a serious lack of maintenance schedules, inspection programmes, preventive maintenance systems, machine repairing workshops (and capability).

Training of the personnel is in many cases inadequate and there is the need of increasing both the quality and the quantity of maintenance engineers.

The present situation in the surveyed countries varies considerably; the lack of maintenance personnel is, for instance, acute in Tanzania, less in Bangladesh, while in Syria it is important only for some kinds of production machinery (for instance sophisticated machine tools) and it is negligible in Argentina. In plant training can be the short term solution but it is advisable to

create and/or strengthen institutions specially devoted to improving/expanding training in the field of industrial maintenance to equip a sufficient number of engineers. In this field the contribution of the suppliers of production machinery could be significant in conducting training courses and organizing ad hoc seminars.

1.1.4 Quality control

The need of quality control on both raw material/parts and finished products is obvious.

In most of the plants visited, particularly in Tanzania and Bangladesh, quality control is seldom carried out on regular basis or its procedures can be considerably improved.

In fact the quality control laboratory, when existing, is activated only when problems arise and this delay is of course the origin of loss of output, quality and Company reputation.

Training and seminars on national scale followed by in-plant training for the major factories could be conducted in Tanzania and Bangladesh, as far as the countries that have been surveyed, but the need is present in most of other countries belonging to the same category.

1.1.5 Production personnel

The need for training of production personnel cannot be generalized, in the sense that each producing unit has peculiar training needs due to the type of production equipment installed, the type of labour available, the availability of local training institution, the size of the facility etc.

First of all a distinction can be made between industrial scale enterprise and blacksmiths/rural workshops.

With respect to industrial scale enterprises, differences exist according to the level of production technolcgy used and the level of development of the engineering industries in the country:

In Tanzania where the production technology generally used is simple (foundry, forging, welding, etc) there is the need (1) for production engineers to industrialize prototypes, to manufacture spare parts locally adapting the production methods to the locally available equipment, and (2) for qualified workers for some specific operations (welding, heat treatment etc).

In Bangladesh where more sophisticated machinery/components are produced (i.e. diesel engines etc) there is also the need for operators of modern machine tools, foundry specialists who can improve existing operations (e.g. for the casting of irrigation pump parts), etc.

In Syria the single large industrial plant is producing tractors and tractor drawn implements and the need for training is more oriented toward accurate production planning, the use of numerically controlled machine tools and, in general for more sophisticated operations.

The second kind of production personnel is found in the artisanal sector that, especially in category A and B countries (in this case Sudan, Tanzania and Bangladesh) but also in some countries belonging to C category (in this case Syria), provides a large share of the inputs to agriculture by producing hand tools and simple implements and by repairing and servicing agricultural machinery. This sector is facing a number of problems when dealing with agriculture, namely:

- lack of raw material and parts (the materials used derive primarily from scrap)
- lack of financing to improve production equipment and to expand activity
- lack of specific training and knowledge in the field of agricultural machinery. Therefore the trend is to copy the imported implements/equipment without any consideration of their suitability to actual requirements.

In Sudan most of the inputs in terms of tools and implements is coming from workshops and blacksmiths (no industrial production existing) and they could be notably improved both as regards performance and construction (with resulting longer life and lower cost).

In Tanzania, even if a number of industrial plants are in operation, the artisan sector is still very active. According to figures elaborated by the Ministry of Industries there are 14,000 blacksmiths and some organized artisan groups and it is known that a part of them are involved in production and repairing activities in the agro-mechanization field

In Bangladesh the importance of small workshops has been recognized by the Government and there is a plan to build 400 small workshops, scattered in the country and having as main goal the production and maintenance of agricultural tools/implements/ machinery. Several classes of training can therefore be proposed, according to the peculiarities of the needs. Some examples could be:

. in plant training for operators of special machines, production equipment etc, with the help of the manufacturers.
. training and seminars at national scale in such areas as product engineering, production planning etc., followed by expert technical assistance directly in the factories in order to apply the theory/techniques learned to the actual solution of production problems.
. to develop a form of extension service for the blacksmiths and the operators of small workshops.

A further development of this idea is to have a central agency for agro-mechanization which would design, construct and test prototypes of simple tools/implements, standardize the production technology, and then pass on this information to the artisanal sector for production.

1.1.6. Use and maintenance

Use and maintenance of an agricultural machinery are closely inter-related for obvious reasons. This is particularly true in the case of tractors and other self propelled machine, irrigation equipment etc.

Most of the mechanical break-downs which contribute to bring the average life of tractors down to very low levels (1,000 hours in Tanzania) and to reduce its productivity (number of working hours per year) are the results of the low skill and technical knowledge of the operators as well as of the lack of skilled repair personnel. Compounding this situation the local engineering industry is generally not equipped to produce the spare parts required which consequently have to be imported and paid for with scarce foreing exchange.

In Tanzania in 1981, according to statistics of the Ministry of Agriculture, there were 8,952 tractors, of which 4,396 were out of use because of thelack of skilled operators and maintenance personnel.

In Sudan the number of tractors imported between 1970 and 1980 was 11,152 units of which only 50 - 60% are assumed to be still in operation. Again due to lack of skilled operators and maintenance personnel.

In Bangladesh the focus is on irrigation equipment and thousands of technicians are presently involved in their maintenance. Large number of new pumping sets are foreseen, dramatically increasing the need of skilled maintenance personnel. In this case too the majority of break-downs are caused by incorrect use, and better extension service to farmers would reduce the burden of repair work.
The implementation of the network of small rural workshops now under consideration would greatly improve the situation.

In Syria particular emphasis is now given to the problem of maintenance of agricultural machinery and results are quite fine. Maintenance is primarly provided by large maintenance workshops owned by the General Organization for Agricultural Mechanization (GOAM) and also by a considerable number of private small workshops. The GOAM is also using mobile vans for field service.

1.1.7 Generalization of training needs

As result of the survey a number of suggestions can be made, ranging from specific in-plant training (machine tools operators for instance) to courses addressed to engineers on nation wide basis (quality control, maintenance etc.), to courses abroad for trainers of trainers, design and development engineers etc.

PROJECT IDEAS/SUGGESTIONS	SUDAN	TANZANIA	BANGLADESH	SYRIA	ARGENTINA
Training in plant for production personnel		X		X	
Seminars/workshops/training in plant for factory maintenance personnel		X	X		
Seminars/workshops/training in plant for quality control personnel		X	X		
Training or regional basis for design and engineering personnel	X	X	X	X	
Seminars on specific technical topics on national basis			X		X
Training on national/regional basis for trainers for tractor operators	X	X		X	
Training on national/regional basis for trainers for tractor maintenance	X	X		X	
Extension service for blacksmith and small workshops	X	X	X		

The above table can be considered as a quite representative picture of the training needs in most of the developing countries by level of development of their agricultural machinery industry (note that Bangladesh does not require training of tractor operators and maintenance because the peculiar characteristic of its geography and agriculture has limited its tractorization).
On the basis of our findings considering the peculiarities of each country (agriculture traditions, level of development etc), we can identify the major training needs typical of each category of countries:

A. Category A Countries are characterized by no or limited industrial production of "hand tools and implements", the majority being manufactured by the artisanal sector. The majority of "intermediate" implements and equipment (e.q. basic tractor drawn implemens etc) and all powered machinery are imported as well as the necessary spare parts.
Main training needs can be identified as:

. Equip a core of engineers and agro-mechanization experts with the necessary expertise to design, construct, test and industrialize tools/implements and simple machines suitable to meet local requirements as well as to test and modify imported equipment.

. Develop the local engineering industry to start production of tools/implements/machines and spare parts for imported machinery, using as much as possible the existing production equipment.

. Organize an exstension service for the artisanal sector (blacksmiths and small workshops) to disseminate information, know-how, standard design for tools/implements etc.

B. Category B Countries have already started the industrial production of "intermediate" implements and equipment and, in many cases manufacture (with different levels of industrial integration) small motorized equipment.
Main needs for training can be identified as follows:

. Improve the skill of industry personnel, with particular emphasis on such areas as: production planning, product engineering, quality control, production equipment maintenance; heat treatment, foundry operations etc.
. Improve the design, testing and engineering of agricultural machinery
. Organize seminars and provide technical assistance for specific topics (for instance courses on design and engineering of irrigation pump and power tillers in Bangladesh)
. Provide technical assistance and know-how to the small workshops and blacksmiths

C. Category C Countries have a quite developed engineering industry and in general produce motorized mechanization systems.
The needs are therefore for more qualified training in more specialized areas such as:

. improvement of training for operators of sophisticated numerical control machine tool

. production planning and management in large factories

. improvement of design and engineering capabilities in order to increase the number of tools/implements/machines already in production

. organization of seminars/workshops in specific topics followed up by technical assistance at plant level.

D. Category D Countries require very little assistance in training and that only to improve already quite satisfactory situations (standardization of components, better design of certain parts, improvement of testing procedures etc).

Category D Countries can greatly contribute to satisfy the needs of countries belonging to other categories by providing specialized training, know-how, technical assistance etc.

In the foregoing we have purposely omitted the training needs of tractor operators and maintenance personnel. Nearly all countries belonging to A, B and C categories need assistance in these areas. On the assumption that the population of tractors will increase from the present 22,000 to 40-45,000 units by 1990 it seems mandatory that the output of existing training institutions for training of operators and maintenance personnel must increase substantially and this means, inter alia, that the number of trained and qualified trainers must be increased accordingly. Too, the number of such institutions must be increased - which means assistance in:

. establishing the institutions

. organizing the operations

. training of staff in training methodology and technique

. properly equipping

In Argentina maintenance is adequate to needs.

1.2 Training Capabilities in the Five Countries

Training institutions in the five countries surveyed are, with few exceptions like Argentina and some institutes in some other countries, not enough to prepare the number of personnel that would be needed by the agricultural machinery field. Not only the quantity is a problem, but the quality too: courses are usually too theoretical and there is a lack of experienced trainers.
The situation in the various countries is described in the following paragraphs.

1.2.1 Argentina

The school system is well developed and there are several schools specialized in agricultural mechanization, and vocational schools for industry workers. Training programmes are equivalent to the European/American standards but, as common to several other countries, the industry is not satisfied with the level of practical training of the hired personnel and therefore internal ad hoc training is usually provided.

Furthermore, in the specific field of agricultural machinery there is an official institution, INTA, Instituto Nacional de Tecnologia Agropecuaria, that deals with the research and development in the agricultural and cattle breeding sectors and is also providing well organized courses for tractors and other agricultural machinery operators.

One of the best institutions visited by our consultants is the Direccion General de Asesoramento Tecnico, (D.A.T.), incidentally our host is this meeting. DAT is active in the research, development and technical consultancy services for industry in general and in the field of agricultural machinery as well and could be a source of excellent specialized training for the whole Country.

The DAT has efficient laboratories and personnel and could expand its activities to other up-grading courses, seminars, workshops etc., on various aspects of the design and construction of agricultural machinery on a national/regional basis.

1.2.2 Bangladesh

Beside the normal technical education system, inadequate so far but with development plans under i ntation, there is a number of institutions providing techn training which could be used for the basic training or up-grading of personnel in the agricultural machinery field. The main ones are:

- The five technical training centers under the Bureau of Manpower (a number of new TTC; are now under construction). Beside the two year programmes in 16 different trades (agro-mechanization is not included, so far) the centres are providing short terms courses for skill up-grading.
  The centres are well provided with laboratories and could be also the basis for the training for the large numbers of technicians that will be needed by the 400 rural workshops now in program.

- The Power Development Board has three training institutes and offers training and up-grading courses for various levels officials.

- The Bangladesh Industrial Development Corporation operates, with the support of I.L.O., 4 training centres and 35 regional workshops.
  The centres provide training for personnel engaged in the maintenance of irrigation equipment (diesel and electric-motor pumps mainly).
  Two new centres are planned, located in the Northern part of the country.
  The consultant was impressed by the operation of these centres and by the quality of the existing facilities, and feels that they could be strengthened also to offer training to other classes of agromechanics (power tillers, post-harvesting equipment, tractors, etc.)

- Bangladesh Industrial Technical Assistance Center.

The BITAC is one of the most advanced technical centres presently operating in Bangladesh and can provide training services as well as consulting services in several industrial fields.

The centre has not been involved in agricultural machinery so far, but the BITAC management expressed their willingness to use their facilities (very modern laboratories and classrooms) for specific training in this field.

Furthermore potential training opportunities exist within two large factories: the Machine Tools Factory (for mechanics and machine tools operators) and the General Electric Manufacturing Co. (for electricians).

These factories are well equipped but underused and the existing infrastructures could be used to qualify personnel also for the new rural workshops.

1.2.3 Syria

There is presently only one school specialized in farm machinery (2 year program) and there is no agriculture engineering specialization at university level.

The first secondary school with farm mechanization specialization started operation few years ago and five additional units are scheduled for the near future.

There is therefore a lack of specialized schools and training courses for the personnel that should operate in the agro-mechanization field.

1.2.4 Sudan

Four training centres are presently existing offering courses in agromechanization, mainly for machinery operators and for service engineers.

The fact that in Sudan there is no industrial production of agricultural machinery (only at artisanal level) has of course limited the opportunities of training for such personnel.

The only university level courses are provided by the Faculty of Agriculture of the University of Khartoum with 55 students (15 only are going to specialize in agricultural engineering) in 1983.

The consultant's team was favourably impressed by the Madani Training Centre, belonging to the Ministry of Interior. It is supported by ILO and offers courses for agriculture mechanics, blacksmiths, electricians etc. It could serve, in future, as one of the bases for the "extension service" in agricultural machinery production to the artisanal sector that has been mentioned previously.

1.2.5 Tanzania

The number of degrees, diploma and certificates issued every year in areas relevant to the agricultural machinery field is considered lower than the actual needs of the Country by the concerned Authorities and a number of plans are going to be implemented, including the establishment of special training centers to equip village craftmen. It is definitely suggested that training on agricultural machinery production/maintenance be provided during these courses.

The following institutions are presently preparing personnel for the industry as well as operators of the equipment:

- 3 vocational training centres (one of which will start regular courses on agricultural engineering soon);
- 7 MATI, Ministry of Agriculture Training Institutes.
  Two centres (out of seven) are specialized in agricultural engineering.
  Some special seminars on tractors have been occasionally carried out with the help of the major dealers in one of the MATI.
- 4 technical colleges
- Dar Es Salaam University (engineering and agriculture).

Beside the centres there is an institution, the CAMARTEC, the new research and testing organization for agricultural engineering that has been formed by merging two institutions operating in this field, the TATMU and the AATP, both located at Arusha. The new centre, adequately staffed could be an important institution for further training to both the industrial and artisanal sectors.

Other two institutions that could provide training are:

- TEMDO, Dar Es Salaam, the Tanzanian Engineering and Manufacturing Design Organization has been established in 1982 and will operate with the assistance of SIDA (Swedish International Development Agency).

It has been created to support the development of the Tanzanian Industry particularly as far as the products engineering, design etc. It could play a role similar to the one of DAT in Argentina and of BITAC in Bangladesh. It is assumed that it will organize training courses and seminars too.

- SIDO, Small Industry Development Organization, provides financing and technical assistance in various fields. It also organizes training courses and seminars, meetings on specific topics and finance training abroad.

2. Recommendations

The first and obvious approach to meeting the above mentioned needs is, of course, to conduct training programmes, to solve the problems case by case and Country by Country by identifying, for each case, the most appropriate form of training:

. training in plant

. specific courses at national/regional basis

. study tours

. fellowships etc.

On the other hand these training programmes would have a much better impact if the assisted countries could have an agro-mechanization framework that would include the following functions:

a) Strategy policy and planning: The Ministry/Department which has the mandate to elaborate national policies on the total spectrum of agricultural tools, implements and machinery sector (agricultural mechanization, the product requirements, import vs. local production, import policies, local manufacturing promotion, R and D, utilization, extension, rural finance etc). The national counterpart identified in that way may be the Ministry of Planning.

b) Immediate manufacturing promotion: Public and private sector manufacturing firms/enterprises which may become the focal point for national activities must be identified and encouraged.

c) Mechanical engineering/design services: A national organization which has the capacity to be the focal point and develop/render technical services in the areas of engineering product design, production technology, tool engineering material engineering and consultancy services to industry in the field of agricultural tools, implements and machinery.
Such an institution, at a national level, may be a suitable existing technician institution under the Ministry of Industry or the Mechanical Engineering Department of the University, etc.

d) Agricultural machinery testing and development: A national agricultural machinery institution/centre/station/unit either under the Ministry of Industry or the Ministry of Agriculture with facilities and capabilities to undertake field testing, modifications, development and standardization work in the field of agricultural tools, implements and machinery.

e) Documentation and information dissemination: A national institution/unit which has the capability to become the focal point for the collection of information, classification, publication, information dissemination and to render industrial enquiry services on all aspects of agricultural tools, implements and machinery both from agricultural mechanization and agricultural machinery production aspects.

This institutional framework (in part or in whole) is present in many countries but, even where it exists, is in need of substantial improvement/expansion.
The institutions could then form the basis of regional networks which could then offer regional/interegional training programmes.

A. National level programmes

. organize seminars courses, study tours to sensityze national authorities on the importance of agro-mechanization (not considered only as tractorization as unfortunately done too frequently but also the total spectrum of tools/implements/machines) versus agriculture needs/infrastructures/traditions/etc.

. provide technical assistance and experts to elaborate/improve national policies.

. provide technical assistance to identify local/existing engineering industries that could be used to produce agricultural tools/implements/machines or contribute to the creation of new factories.

. contribute to the establishment/improvement of a national organization that could provide technical services/consultancy services in design and production of agricultural tools, implements and machinery.

. provide the necessary training services to improve the existing agricultural machinery testing and development centers so that they can become the source of countinuous development in this field and perhaps also provide the documentation and information dissemination services required.

B. Regional level programmes

The importance and benefits of a Regional network is well demonstrated by the RNAM, Regional Network Agricultural Machinery in Asia which includes institutions from India, Pakistan, Sri-Lanka, Korea, Thailand, Indonesia, Philippines and Iran. Such networks should be established in the other regions as well and each country should be integrated in such an organization.

Such regional network could offer services in the following areas:

- study on the application of tools/implements/equipment to local agriculture;
- creation of a regicnal task force of agronomists/engineers to design and test prototypes that then could be produced on national/regional basis;
- training courses and up-dating seminars on regional basis on topics like:
  - . production technology (foundry, forging, heat treatment, machining, etc.)
  - . quality control
  - . products engineering
  - . maintenance of production equipment
  - . agro-machinery maintenance and repair
  - . equipment design etc.
- information dissemination

and thus supplement/complement activity at national level and also provide training services which individual countries may not be able to provide by themselves.