CHAPTER 2

AGRICULTURAL MECHANIZATION STRATEGY FORMULATION: PROCEDURES AND ISSUES

by

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INTRODUCTION

For over fifteen years, FAO has been working to develop an approach to planning for the rational introduction and use of agricultural mechanization which would be applicable to all developing countries. For over ten years, FAO has provided encouragement and assistance to some sixteen member nations in the formulation of national agricultural mechanization strategies or action plans to help ensure a positive role for mechanization in the rural development process. In spite of these efforts, and the positive developments in some countries in Asia, there are at least one hundred developing countries which do not have a formal plan to guide the introduction and application of mechanization for development. These countries are likely to have a total investment in agricultural hand tools, draught animals and equipment, stationary machines, mechanical power and equipment, and in facilities for mechanization of about US$ 30,000 million by the year 2000. In light of this investment, it is inconceivable that so many governments would neglect or avoid planning for mechanization's efficient and effective use in efforts to achieve food self-sufficiency and a better way of life for rural people.

It is a pleasure to report, however, that the governments of two African nations - Malawi and Zimbabwe - have taken steps in the past six months to redress this situation and by the year 1992 will have national agricultural mechanization strategies to guide the public and private sectors alike in introducing and applying appropriate mechanization inputs in the development process. This paper repeats the message on agricultural mechanization strategy formulation which has been delivered over and over again by various officers of FAO to countless governments, national seminars and workshops, and international conferences during the last decade (Gifford (1981)). It defines and describes what is meant by "agricultural mechanization strategy". The procedures to be followed in formulating a strategy are outlined. And finally, the issues constraining the widespread formulation of strategies and the introduction and use of appropriate mechanization are reviewed.

DESCRIPTION OF MECHANIZATION STRATEGIES

Agricultural mechanization in most of the industrialized countries has developed mainly through the initiative and efforts of the private sector. Private individuals and groups of farmers and manufacturers have formulated

and implemented their own plans. Government have had little need, therefore, to take the lead in developing strategies to ensure an appropriate role and place for agricultural mechanization in the rural development process. Many developing countries have attempted to follow this same pattern and let mechanization find its own course and pace in development. In general, this approach has failed because circumstances are radically different. Developing countries, for a variety of reasons, are under pressure today to develop agriculture in less than 20 years instead of the 200 years taken by the industrialized countries to achieve their advanced level of agricultural production and operational efficiency. The internal capacity of most developing countries to manufacture the inputs required for agricultural development has not evolved at the same pace as the need for the inputs. The chronic shortage of foreign exchange has been a major constraint on importation of the inputs needed for rapid development. And finally, contrary to the historic situation in the industrialized countries, most developing countries do not yet have a dynamic private sector which is capable or interested in assuming the lead in organizing, introducing and supporting mechanization systems for rural development.

Consequently therefore, governments in developing countries must take the initiative to influence, guide and support the introduction and use of mechanization inputs for development. These inputs require a strategy for their identification, mobilization, distribution and support which should be an element in the government's national development plan. Without a strategy, the type and pace of introduction will certainly have unconsidered, and often undesirable effects on overall development objectives, goals and targets. This is not to say that the governments in most developing countries should implement and control mechanization programmes and systems. In FAO's experience, the private sector is more capable and efficient in respect of agricultural mechanization than the public sector. It is generally accepted that the government's role should be restricted to establishing an economic and physical environment in which private individuals or organizations can move ahead with the tasks of introducing and supporting agricultural mechanization systems.

In agricultural development, the inputs critical to development beyond the subsistence farming level are usually improved seed, fertilizers, pesticides, increased farm power, improved credit and marketing systems and improved management capability. These inputs are resources which contribute to development. The plan for their selection, introduction, use and support is, according to internationally accepted definitions, called a strategy. The word strategy has been adopted from the military vocabulary where it means the manner in which a military leader mobilizes and deploys available resources (e.g. troops, artillery, ammunition, support staff, etc.) for fighting a battle or a war. Whether the battle or the war should be fought is a matter of policy; as determined by overall government objectives; and is the prerogative of politicians, not military commanders. This distinction between strategy and

policy is important but has often been lost by people in many countries when they embark on formulating plans for introduction and use of agricultural mechanization technologies. When people say they want to formulate a mechanization policy, there is a great risk that politicians will see the exercise as an infringement on their prerogative and balk at giving their active support. If, on the other hand, people say they want to formulate a mechanization strategy and take time to explain that the strategy will be formulated within the existing national policy framework, politicians are much more likely to accept and support the idea. In the above context, a national agricultural mechanization strategy becomes an integral element in the overall national development plan. It is, therefore, important to have an understanding of the elements and sequence of actions relative to national development planning. This paper does not presume to discourse on development planning in detail; the only intention is to put mechanization strategy in perspective.

NATIONAL DEVELOPMENT PLANNING: THE STRATEGY ELEMENT

There are many ways to approach national development planning. The components of the national plan are reasonably specific but the order in which they are considered during the planning process may vary amongst planners and according to circumstances. Nonetheless, it is useful to look at planning as a rigid sequence of actions in order to clarify what needs to be done and to decide where the action will take place and by whom. The following definitions were developed by FAO and have been in use for some ten years. They are presented below in the order in which action is normally taken:

> *Development Objectives*: Statements of purpose which, in the development plan, define what the government wishes to accomplish.
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> *Development Goals:* Statements in the development plan which quantify expected development achievements.
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> *Development Targets:* Statements in the development plan which establish the time-frame for achieving goals.
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> *Development Policies:* The laws, rules, regulations, etc. which establish the parameters within which actions for development will be carried out.
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> *Development Strategy:* A comprehensive description of how, when and by whom resources will be mobilized, deployed and used, within the framework of policies, to achieve development targets, goals and objectives.
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> *Development Programme:* A detailed design for the implementation of projects and activities to achieve development objectives.

Development Project: A detailed description of actions that are to be taken to carry out a specific portion or element of a programme.

The national development plans in most developing countries usually contain details on development objectives, goals, targets and policies. Strategies, programmes and projects are seldom contained in the national plan document. Some, however, are included in sectoral working documents and annual plans. It is common, for example, for the Ministry of Agriculture to have detailed working plans for the mobilization and distribution of seeds, fertilizers and pesticides. Unfortunately, similar detailed plans for agricultural mechanization inputs are usually missing, though many isolated projects are likely to be described.

The use of agricultural mechanization inputs for development (e.g. hand tools, draught animals and implements, tractors and implements, combines, threshers, sprayers, pumps, etc.) must be planned if technical progress is to be cost effective and compatible with overall development objectives. A strategy needs to be formulated at the national level which ensures that mechanization inputs are selected, introduced, used and supported effectively and efficiently; and which also ensures that agricultural mechanization is in harmony with the national technical, economic, social and political development environment.

PROCEDURES AND RESPONSIBILITIES FOR STRATEGY FORMULATION

Information base

The primary and most often neglected requirement for the formulation of a national strategy for agricultural mechanization is a background of usable information. In most developing countries, this information may exist but it is not generally available in a form suitable for mechanization planning. Much of the required information can be collected from various public or private organizations or individuals, and processed to make it usable - at least as a starting point for mechanization planning. Additional information, however, will need to be obtained from the results of studies, surveys, inventories, etc. This latter action is expensive and time consuming and must, therefore, be well planned and efficiently carried out. Collecting and analyzing the needed information should usually be under the leadership of the planning unit in the Ministry of Agriculture. It will require, however, coordinated cooperation of many ministries, organizations and individuals in both the public and private sectors.

The development of an information base will include but not necessarily be limited to the following actions:

(a) An indepth assessment of national development plans to see how existing plans affect or will be affected by agricultural mechanization.

(b) The identification and categorization of all existing farming systems in the country to provide the basis for identification of appropriate mechanization inputs according to technical, economic, social and political factors.

(c) An inventory of the current national mechanization park which includes a quantitative and qualitative assessment of the composition of the national park (i.e. type, size, age of machinery); of the ownership pattern; and of the main use of each type of machinery or power unit.

(d) A description and assessment of institutional arrangements and infrastructural facilities to support mechanization; with particular attention to credit, research, extension, education and training, input supply and distribution, and machinery operation, maintenance and repair.

Input identification

Using the information generated by the above activities, it will be possible to describe the mechanization systems and specific inputs which are appropriate for each agricultural development and operational situation in the country. Included will be mechanization systems and inputs for land development and soil and water conservation; for crop and animal production enterprises; and for produce processing, handling, storage and transportation. In order to ensure overall appropriateness, the identification of mechanization inputs must be undertaken with the full collaboration of many individuals, organizations and technical disciplines. These include among others the following:

i) Most important, but usually neglected, is the need to have farmers actively involved. After all, they are the end-users of the system and if they are not totally satisfied, the system will not be adopted and the potential impact of mechanization on development will be minimal or completely lost.

ii) Agricultural engineers and other specialists must assess the technical requirements for each development situation and look carefully at the comprehensive list of mechanization inputs which are on the world market and could be selected to meet those requirements.

iii) Farm management specialists and economists must assess all input cost/output value relationships at the farm level, and the economic implications of mechanization alternatives with regard to the national development situation. Any mechanization

system must be financially profitable for the farmer and economically justified for the country in order for its use to be sustained.

iv) Specialists in rural, cultural and social systems must be brought in - to determine the appropriateness of mechanization at an early stage. There are many examples where the introduction of mechanization systems which were technically, financially and economically appropriate but which were not adopted by farmers for social or cultural reasons.

v) National development planners have an important role to play in the selection of mechanization systems. They are well placed to be aware of and to understand the political implications of mechanization system alternatives which might be proposed by technical specialists.

Input acquisition or mobilization

Once the appropriate mechanization system and inputs have been identified, a comprehensive programme to ensure the availability of machinery, parts and supplies in the country must be carefully formulated. Basically, there are two alternatives; importation or local manufacture. Within these broad alternatives, however, there are many choices and combinations and each will need to be considered in the light of all development plans and situations in the country and in light of the critical requirements for technical and managerial capability.

For the importation of machinery, parts and supplies it is usually a government function to make some or all of the following key decisions and establish appropriate laws, policies, regulations or systems whereby these decisions can be implemented:

i) What inputs will be allowed into the country?

ii) Who will be licensed or responsible for importation and under what conditions?

iii) How much foreign exchange will be allocated for importation of machinery and for subsequent importation of parts, etc. to sustain its use?

iv) From which countries will inputs be obtained?

Many developing countries have opted for the local manufacture or assembly of all or part of the required mechanization inputs. When considering this alternative, the following points should be borne in mind:

a) Local manufacturing should be based primarily on real local market demand and not on perceived export market potentials.

b) Technical capability and business management skills are critical prerequisites for successful local manufacturing or assembly.

c) Some protectionist measures may be required during the initial growth of machinery manufacturing, but if applied over the long term, adverse effects are likely to result.

d) Quality control must be rigidly applied if the mechanization product is to be acceptable to the farmer and economically viable for the country.

e) The design of mechanization inputs produced locally must keep pace with design improvements in other parts of the world.

The national agricultural mechanization strategy must describe the measures for implementation of the system chosen for machinery mobilization or acquisition. Many government ministries and agencies will need to cooperate in formulating this section of the strategy and the difficulties are likely to be enormous. The voices of vested interest groups inside and outside the government will be loud and persistent on every issue under consideration. In spite of these expected difficulties, the task must be carried out or the farmer or other end-users of mechanization inputs will not have access to what is needed at the time it is needed.

Input allocation or distribution

The national mechanization strategy must address the issues of who should be encouraged to own and operate mechanization inputs and who should be responsible for their introduction, distribution and promotion. The alternatives for machinery and equipment ownership and operation are so many and so varied that details are beyond the scope of this paper. In general, however, the choice of alternatives should reflect the needs and conditions of the small-farm sector as a priority in most developing countries. Also, the concept of multi-farm use of machinery and power should be encouraged and supported in order to increase economic efficiency of mechanization systems and to bring mechanization services within reach of small- and large-scale farmers alike. Some alternatives for the multi-farm use of machinery and power are:

i) Ownership/operation by individual farmers who use machinery on their own land and use surplus capacity to provide services to others in a relatively small area on a casual or informal hire basis.

ii) Ownership/operation by individuals in rural areas who carry

out a machinery hire service as a business which provides a major source of their income.

iii) Ownership/operation by informal but legally constituted farmer groups.

iv) Ownership/operation by formal rural cooperatives.

The omission of government tractor hire schemes or machinery pools from the above list of alternatives is deliberate. Years of experience of these schemes clearly shows that they have failed to be effective or economically viable over the long term.

The introduction and distribution of appropriate mechanization inputs in most developing countries should be a joint and coordinated effort of government institutions and private machinery manufacturers or distributors. Government institutions, usually the engineering and extension units in the Ministry of Agriculture, should assume the basic responsibility for ensuring that farmers are aware of appropriate mechanization alternatives. These units, however, must work closely with machinery manufacturers and distributors to learn of innovations in the international or national market which would be useful in the farming systems of the country. In the ability to respond to farmer demand, manufacturers or distributors are usually more efficient and effective than government agencies in promoting, demonstrating, selling and delivering mechanization inputs. These actions follow naturally if government engineers and extensionists do an effective job of making farmers aware of mechanization alternatives.

Institutional and infrastructural support arrangements

The quality and comprehensiveness of arrangements to support agricultural mechanization will largely determine its impact and sustainability in the development process. The role of government in providing support is critical but not exclusive. This is equally true for the private sector. In most countries, therefore, the best arrangements will consist of a combination of responsibility between the public and the private sectors which reflects the ability of each to perform under the specific conditions of the country.

Research and development (R & D)

Mechanization is a dynamic input into agriculture and farmers obviously have a vested interest to employ the most appropriate inputs they can afford to improve farm performance. The role of farmers in R & D is, therefore, critical; particularly in light of the fact that historically, more machinery innovations have been developed by farmers than by public sector institutions.

Furthermore, there is little evidence that the agricultural mechanization development carried out in public sector institutions in Africa has been taken up and used by farmers. In most industrialized countries, mechanization is the result of the combined efforts and inputs of farmers and machinery manufacturers. In the developing countries, however, circumstances are different and the role of the public sector will need to be greater. This suggests that public sector R & D will need to be very carefully planned and carried out; and indeed, will need to emulate the historical pattern of successful R & D by farmers and machinery manufacturers in selected industrialized countries. In general, mechanization R & D in most developing countries should have the following features:

a) Applied research should be emphasized; basic research is best left to those countries and organizations with resources to meet the high financial and manpower costs involved.

b) R & D should always be in a problem-solving context and the problems should always be defined in close collaboration with farmers.

c) There should be only one national focal point for mechanization R & D in most developing countries, and the focal point institution should have a sound working mandate to coordinate inputs from all concerned-public and private sector organizations.

d) Mechanization R & D should not be carried out in isolation; it can be successful only when it is an integral part of other agricultural and industrial research activities.

Extension

In general, extension and research in agriculture should be considered as a single action programme; one without the other will have little impact at the farm level. Just as mechanization R & D should be an integral part of other agricultural research activities, it should also be an integral part of the overall agricultural extension programme. Extension agents, who have the first and most direct contact with farmers, should be as well grounded in the basics of mechanization as they are in agronomy or plant protection or animal husbandry. If this principle is followed, major changes in the programme for training extension agents and in the extension programmes themselves will be required in most developing countries. A national mechanization strategy must reflect this situation and ensure that measures are included to establish links from R & D to the farmer. Traditionally, this link has been through established extension agents and has been a function of the Ministry of Agriculture in most developing countries. Many experts are questioning this arrangement, which has been adopted almost in total from the industrialized countries, and there

is considerable agitation for an approach which is more suited to the needs and conditions of developing countries.

Education and training

It is convenient in formulating mechanization strategies to define education as a formal activity to develop a broad base of knowledge. Training can be defined as a formal or informal activity to develop specific skills to meet the requirements of specific jobs or tasks. In this context, some developing countries have education programmes for agricultural engineers which are adequate from the standpoint of developing a broad technical knowledge base. Many of these programmes, however, are not adequately orientated towards farm mechanization and engineering students are too often weak in their basic knowledge of agriculture. A national mechanization strategy should reflect this situation and measures will usually be required to improve or re-orientate the agricultural engineering education programme.

Agricultural mechanization, at the level of animal draught and mechanical power technology, calls for skilled or semi-skilled rural labour. In most developing countries, training programmes to develop the skills required for management, operation and maintenance of mechanization inputs are insufficient or inappropriate. The training of managers for hire-service operations is virtually non-existent in the developing world. Operator training, including animal draught operation, has received too little attention and usually is given in an institutional setting instead of at the on-the-job field level where people can learn the needed skills for machinery operation rather than simply being drivers or animal handlers.

The need for trained mechanics to maintain a tractor fleet is well recognized in some countries and there are usually adequate arrangements for training. However, many countries do not recognize that skills to repair trucks and automobiles are not necessarily appropriate for the repair of agricultural tractors and equipment. Adjustments are needed, therefore, in many country programmes to ensure that mechanics have the skills to meet the specific requirements of agricultural machinery.

The need to have trained blacksmiths/artisans at the village level is only now receiving the needed attention in some developing countries of Africa. With 80-90 per cent of the farmers relying solely on hand tools and draught animal implements, measures to establish a network of facilities at the village level to fabricate and repair these tools and implements should be given priority in most national mechanization strategies.

An often neglected area in developing countries is media education for mechanization. Radio, television and newspapers are all potential education media for such things as animal health, machinery safety, machinery efficiency and energy saving. Strategies should reflect this potential.

Credit

Mechanization strategy measures related to credit for input purchase and operation have many implications outside the agricultural sector. Decisions on whether credit for mechanization should be made available through public institutions or commercial banking channels can be politically sensitive. Often they need only small amounts of credit which is costly to administer; they seldom have collateral required by many institutions; they tend to be isolated with limited access to regular credit facilities and, they are often classified as poor credit risks in the criteria of many credit institutions.

As a mechanization strategy element, credit should be considered in light of the following fundamental principles:

a) Credit for mechanization should facilitate improvement in land or labour productivity - it should not be used solely as a subsidy to promote mechanization as a means to achieve "modernization" of agriculture.

b) Credit should be extended only on a sound business basis - farmers should not be led to expect relief from repayment in full and on time, and the payment should be feasible from increased farm income resulting directly from the use of additional or improved mechanization inputs.

c) Credit should be available to all sizes of farm holdings regardless of the level of mechanization technology being used (i.e. hand tools, animal draught or mechanical power).

d) Credit terms should reflect a time frame which is compatible with the users access to income and, therefore, ability to repay loans on time.

Supply, maintenance and repair services

Countless idle tractors and graveyards of mechanical and animal drawn implements in developing countries attest to the inadequacy of arrangements that will keep mechanization hardware operational. Supply networks to ensure the timely availability of fuel, lubricants and parts do not simply "happen". Blacksmiths to fabricate and repair hand tools and animal implements require training and measures to help establish their businesses on a sustainable basis. Mechanics, replacement parts and repair shops to repair and maintain advanced mechanical-power technology cannot be established to properly serve farmers on a sustained basis in a few short weeks. Draught animals are ineffective as farm power unless measures are taken to ensure a regular supply of feed and health care.

A national mechanization strategy will define what measures are required to ensure the support for mechanization as described above. It will also identify who should provide the support. Experience shows that public sector attempts to organize and operate supply networks or maintenance and repair facilities have not generally been effective or efficient. Government organizations simply have not been able to overcome the constraints on performance caused by unwieldy government financial procedures and inadequately motivated government civil servants.

MAJOR PROBLEMS TO BE SOLVED

Basic to this paper is the strong belief that national agricultural mechanization strategies are essential to the introduction and use of appropriate mechanization in the developing countries. As stated earlier, most developing countries have not yet formulated such a strategy and this maybe the root of the problem. The lack of understanding of what a strategy is and why it is needed; the shortage of trained manpower to formulate and implement strategies; and the shortage of funds to prepare a strategy and supervise its implementation have all contributed to this unfortunate situation.

In addition, the following are specific problems that are major constraints on programmes to introduce and sustain mechanization, which are common to most developing countries:

(a) Neither recipients nor donors have effectively planned and executed international aid programmes in respect of agricultural mechanization. Bulk delivery of inappropriate mechanization inputs is common and often occurs without adequate measures to support and guide input distribution, use and maintenance at the farm level. The results have been disillusioned farmers, graveyards of machinery, discouraged government officials and an unnecessary drain on scarce foreign exchange.

(b) International and bilateral aid agencies have too often made "desk" decisions on the type of mechanization they will support. It is rare for studies to be made of the real farming situation and the realistic requirement for inputs. Such studies would clearly show that combinations of mechanization technology (i.e. hand-tool, animal-draught and mechanical-power technology) are the only way appropriate mechanization can be made available to all sizes and types of farming systems.

(c) Developing countries have often dispersed the authority and responsibility for mechanization so widely amongst ministries, agencies, institutions or organizations that it is impossible to achieve a coordinated effort to provide farmers with the mechanization inputs and systems requirements.

(d) The role of village blacksmiths and repair shops in supporting mechanization for 80 per cent of the world' farmers has been seriously neglected by developing countries and aid agencies alike. Simply training blacksmiths and mechanics is not enough - they must be assisted to establish their businesses at the village level and then supported over time with training opportunities, credit, markets and access to a supply of raw materials.

(e) Some developing countries are still trying to establish and operate government machinery-hire service schemes which, according to 35 years of experience would seem to be, are doomed to financial failure.

(f) Many agricultural machinery manufacturers persist in using the developing countries as a dumping ground for their surplus production. Sales efforts in developing countries usually do not include efforts to develop a sustainable network of distribution and service facilities throughout rural areas.

(g) Bilateral aid agencies in particular have mostly failed to design their loan or grant programmes for mechanization to take advantage of the large store of expertise available from machinery manufacturers in their own countries. This has deprived the recipient countries of valuable and much needed technical assistance which could be made available at a very modest cost.

(h) Training for agricultural mechanization in most developing countries has neither been adequate in scope nor appropriate in form. Often, training needs are ill-defined and training methods are not up-to-date. The result is a labour force which lacks the skills to use mechanization effectively and efficiently. On the education side, it is common knowledge that many programmes to develop agricultural engineers fail to reflect the real needs for skills in the home country.

CONCLUSION

This paper has presented the same message on agricultural mechanization strategy formulation that FAO has been delivering for over ten years. The hope is that if enough different people listen to the message, action will eventually be taken to rationalize the role of mechanization in the development process. This hope is being realized with the progressive attitude of Malawi and Zimbabwe. The experience gained by their action will benefit not only themselves, but all of Africa.

The holding of this workshop represents an important step in the evolution of mechanization strategy formulation. It reflects a recognition that the role of mechanization in the development of African agriculture can be

improved or expanded. Some thirteen nations are represented here by senior decision makers and, if among others the FAO message has been understood and believed, they will go back home and initiate actions that will eliminate the graveyards of equipment, reduce the unjustified drain on foreign exchange, and avoid unpleasant surprises and delays in bringing relief to the millions of farmers in Africa whose physical and financial burdens can be at least partially relieved through the introduction and use of appropriate agricultural mechanization.

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