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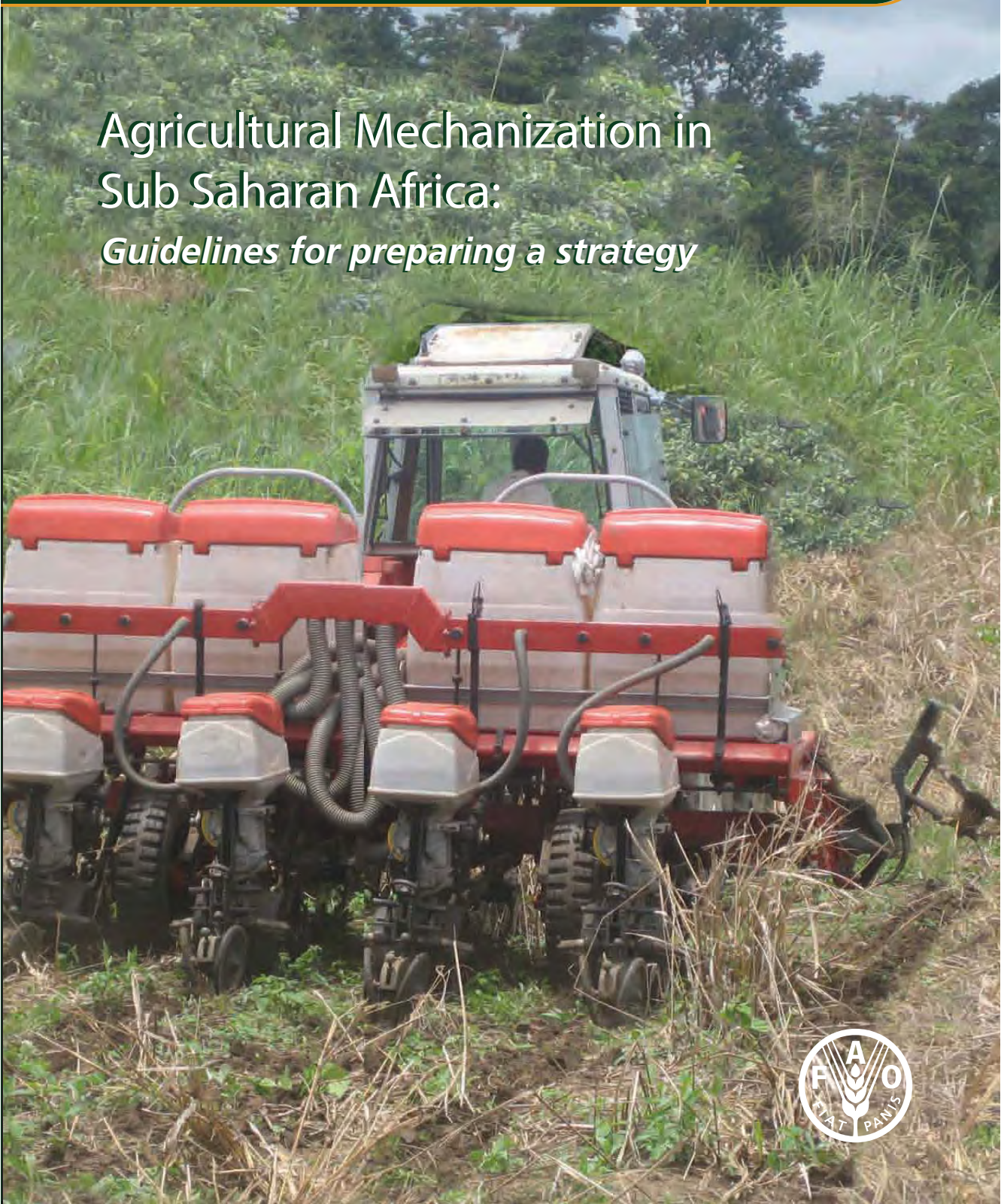
Guidelines for preparing a strategy



Integrated Crop Management Vol. 22-2013

Agricultural Mechanization in Sub-Saharan Africa
Guidelines for preparing a strategy

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FOREWORD

The production of food in developing countries is generally very labour intensive particularly in smallholder agriculture. The manual work carried out by farmers and their families is very arduous and time consuming and in many countries this is a major constraint to increasing agricultural production. Also, the day to day drudgery of farming is a major contributory factor in the migration of people, particularly young people, from the rural countryside to the prospect of a better life in towns and cities.

Farm production can be substantially increased through the use of mechanical technologies which are both labour saving and directly increase yields and production. Inputs of hard labour by farmers and their families can be substantially reduced if they have access to a carefully selected use of tools, machines, and equipment. The labour released can be used for other productive activities. The use of improved mechanical technologies can also have a direct impact on yields and area under production. Such technological interventions are commonly referred to as agricultural mechanization. In a rural context the term also extends to cover other closely related small scale activities such as the primary processing of agricultural products, on-farm storage, and the delivery of irrigation water.

Within the term ***"mechanization"*** there is a large number of possibilities and technologies for farmers to choose from. These range from choosing between the different sources of additional farm power to selecting from the various other production enhancing mechanical technologies available. A judicious choice from amongst these is crucial for farmers to achieve optimum profitability from their businesses and to attain an acceptable quality of life for themselves and their families. There is now also the realization and acceptance that the choice of mechanical technologies to be used can also have a major impact on the environment; only the use of technologies which have a positive effect can be sustainable over the long term. This sets a major challenge for all those involved in mechanization; planners, advisors, manufacturers, service providers, practitioners and farmers. It is therefore important that governments should identify the correct strategies for increasing mechanization in their countries with particular emphasis on increased production, farmers' livelihoods, and environmentally sustainable options.

One of the major mandates of FAO is to assist member states to make their input supply and food production chains more effective and efficient and at the same time provide farmers with improved livelihoods. The goal is

clear: to increase sustainable food production. The effective and sustainable use of increased levels of mechanization is one of the most important means of achieving this.

But what is required to best achieve this? This document outlines why and how a strategy on mechanization can make a major contribution to the achievement of the goal of increasing levels of agricultural production and improving the livelihoods of farmers. These guidelines on the development and formulation of a *sustainable* agricultural mechanisation strategy form part of FAO's approach on sustainable production intensification.

Clayton Campanhola
Director
Agricultural Production and Protection Division (AGP)

ACKNOWLEDGEMENTS

The development of these Guidelines originates from the early 1990's when interest was expressed by several countries in Asia, Eastern Europe and Africa for assistance from FAO for the development of plans for the expansion of mechanization. In the case of Eastern European countries advice was requested on how to privatize the public sector mechanization services. In response to these requests the Agricultural Engineering Service (AGSE) of FAO developed some guiding principles for the assistance to be provided. Subsequently, field work was conducted in several countries from which a mechanization strategy was formulated for each. From this experience, in 1997 AGSE produced more detailed guidelines on strategy formulation. The author of these was Clare Bishop, a consultant who had been involved in the formulation of several of the country studies. Overall guidance and supervision during this period was provided by Lawrence Clarke, Chief of the Agricultural Engineering Service.

Since then, based on this first version of the Guide, a number of AMS formulation exercises were carried out mainly with FAO TCP funds. The main focus for these studies was on countries in sub-Saharan Africa (Benin, Burkina Faso, Cameroon, Democratic Republic of the Congo, Guinea, Malawi, Mali, Niger, Sudan, Tanzania). In these countries, teams of local experts under the supervision and guidance of a senior consultant, collected data and prepared detailed reports on strategies to be followed for the adoption and wider expansion of mechanization. Acknowledgements must be given to these national experts who contributed to the great overall wealth of knowledge on how mechanization is to be expanded and sustainably adopted.

In 2008, a second version of the AMS Guide was prepared based on experiences of the Mali Formulation Exercise and this French version has been further refined and produced in English leading to this finalized document. So many experts have contributed both directly and indirectly to bring these guidelines to this present state that it would be impossible to name each individual. Never-the-less our thanks go to all of these anonymous contributors. The overall supervision for this document has been the responsibility of Josef Kienzle, Agricultural Engineer, Plant Production and Protection Division. Brian Jackson, FAO Consultant, joined the authors for the proof reading tasks and Magda Morales formatted the document for printing. Thanks also go out to the contributors and reviewers from many different countries.

CONTENTS

LIST OF FIGURES AND TABLES

INTRODUCTION

This guide is published during a crucial period when most African countries are taking steps to modernize their agriculture. Improving the performance of the agriculture sector has become one of the important challenges to be faced in the context of fighting malnutrition, illness, poverty, and unemployment. Furthermore, in recent years, the situation has been aggravated by very high food commodity prices on the world market. This has significantly increased the number of people in poverty in many countries. As a result, progress in human development has been slowed down, and the danger of failing to deliver the Millennium Development Goals (MDG), especially MDG1[1], is all too evident.

In Africa, particularly in those countries south of the Sahara (SSA), there is a great potential to increase agricultural production, however, the realization of this potential will require high levels of commitment and resources. At the same time, due consideration will have to be given to ecological and climatic considerations. This requires a rational and responsible approach to the choice of cropping systems and crop production inputs. One of the most important of these inputs is the development and use of increased levels of farm power and appropriate mechanization techniques.

In the developed world, maintaining existing levels of agricultural production would be impossible without mechanization. In many parts of the developing world, the use of increased levels of mechanization is already making a significant contribution to agricultural and rural development. In recent years, by means of development programmes and other incentives, governments of many African countries have been encouraging farmers to make increasing use of agricultural machinery. Unfortunately, these efforts have mostly failed to have much impact on overall production, and there is now a realization that the acceptance and greater utilization of agricultural machinery is still below what had been projected.

Several reasons are behind this but in particular it is now realized that the manner in which structural adjustment programmes were undertaken throughout the 1980s had a major impact on the expansion and use of farm mechanization. The underlying reason for this was a failure to understand the effect of structural adjustment on the agricultural tools and machinery markets particularly for those items that were imported. Furthermore, the respective roles of the government and private sectors were not clearly defined: Governments withdrew from activities in farm mechanization with the expectation that the private sector would step in and take over. But in most

[1] MDG1 – The Eradication of Extreme Poverty and Hunger

cases this did not happen and the expansion in the use of mechanization in agriculture in many countries entered a period of decline. This has been largely due to a failure to put in place an effective political and economic environment as well as implementing effective programmes to support the emergence and development of the private sector. This decline has had an adverse effect on the development of agricultural mechanization in general and the emergence of the private sector in particular. It has certainly had an adverse effect on the overall development of agriculture.

Unfortunately, a dominant factor in this has been the fragmented, sometimes contradictory, and uncoordinated approach adopted by governments and donors when measures were taken to encourage mechanization. Instead of taking a holistic approach, isolated and stand alone measures have often been taken, when in reality, every stakeholder – institutional as well as the private sector - has a role to play.

Increased agricultural production and improved rural livelihoods cannot be achieved without the adoption and use of increased levels of farm power and mechanization. However, agricultural mechanization is not quite as straightforward an input as fertilizer or seed; in order for farmers to have access to farm tools, machinery and equipment, there needs to be in place a whole complex system of manufacture, importation, retail outlets, support, provision of spare parts - the so-called supply chain - as well as the availability of advice and guidance for farmers. Therefore the development and use of mechanization as an input to agriculture is a complex and long term process and calls for a correspondingly long term, consistent effort.

As a first step, one of the most important tools and an essential part of the process is the formulation of a strategy as to how increased, sustainable levels of mechanization can be brought about without subsidies and without distortions. The strategy should provide a framework of how to make decisions on the allocation of resources, address challenges, and take advantage of opportunities that arise. It should be a structured, but flexible, participatory process which leads to the definition of a coherent plan of achievable actions and programmes.

For over twenty years, FAO has assisted many countries in Africa and Asia to elaborate their own agricultural mechanization strategies (AMS). The approach evolved under the influence of changes occurring in the development philosophies of individual countries, FAO members, and financial institutions. Niger, Democratic Republic of the Congo, Cameroun, Morocco and Sudan, are some examples in Africa where strategies have recently been formulated. These projects have created opportunities for in-depth analyses and discussions, and have resulted in clear objectives being set and action plans formulated. A sound platform has emerged on which the respective countries can now take action.

This present guide is prepared from a compilation of many documents published by FAO in this domain and is a guide to the process of formulating an agricultural mechanization strategy. The aims are:

- To raise awareness of the main constraints which hinder the development of agricultural mechanization and especially those hindering the development of the private sector;
- To provide approaches and methodology for a comprehensive and inclusive agricultural mechanization strategic planning process;
- To raise the awareness of politicians and decision makers of the need to develop a strategic plan for the development of agricultural mechanization.

The guide is divided into six chapters:

Chapter One defines and clarifies concepts. It presents definitions and principles and demystifies terminologies related to agricultural mechanization. It clarifies what is meant by the term "strategy" and demonstrates that agricultural mechanization is not a narrow engineering discipline but is an important sector to be viewed in a much broader context. Any analysis of agricultural mechanization has to take into account not just the technical and engineering aspects but also the connections and inter-dependencies with other sectors and their place in the farm tools and machinery supply chain as a whole.

Chapter Two presents an overview of the current situation of agricultural mechanization in SSA. In this chapter the main issues and constraints found in the agricultural mechanization sector are emphasized. The issues are many and varied and range from technological problems to economic and commercial issues and to the demand and supply aspects of agricultural mechanization. They are all inter-related and have, in the past, led to the development of inter-related negative factors which can explain the stagnation in adoption and growth of agricultural mechanization. On the demand side of agricultural mechanization; it is clear that the output from many farming systems remains very low. This is due to many negative factors which result in low farm incomes and therefore leads to a low capacity by farmers to invest. On the supply side too, it can also be observed that the farm machinery commercial sector has been unwilling to invest and become involved as suppliers. This has been due to several negative factors but particularly the unfavourable business environment, unfair competition, lack of an enabling policy environment and issues of governance. This chapter identifies and describes these negative factors and describes how these may be overcome so that agricultural mechanization can fulfil its potential as a vital input into agricultural production.

Chapter Three covers elements of the fundamental requirements for the development of agricultural mechanization. The chapter provides recommendations on issues of demand for mechanization. It is aimed at farmers, suppliers of mechanization inputs and supporting institutions. Evidence is provided that demonstrates why a strategic approach is vital for the development of agricultural mechanization. The chapter demonstrates that the development of agricultural mechanization is a complex task that involves many different components and that the development and adoption

of mechanization as an effective input to enhance agricultural production and human development is therefore a long term process.

Chapter Four sets out the methods and tools that can be used once the idea to conduct an AMS formulation project has been accepted. It outlines organizational tools and describes the main stages in strategy preparation. The formulation of a strategy requires the use of effective methods, procedures, and rules. This chapter provides ideas on how a project should be prepared and what are the main steps. The role of the project team during the collection and analysis of data stages is clarified and the role of the stakeholders at participatory workshops is defined. The use of tools such as SWOT analysis and Log-Frame matrix analysis is outlined.

Chapter Five presents the first of two critical parts of formulating a mechanization strategy; to identify and describe the existing situation of mechanization in a country. Guidance is provided on how the current situation of agricultural mechanisation can be defined and how it is achieved by focussing on the identification of the relevant information to be collected and the kind of analysis to be carried out. Emphasis is placed on the importance of maintaining a holistic approach taking into account not only the engineering sector but also other aspects related to farming systems such as the economy, the institutional framework and the environment. Finally it explains the importance of participatory workshops where a SWOT analysis might be utilized.

Chapter Six This final chapter focuses on the final steps in the formulation of a strategy for mechanization; a strategy that will lead to the creation of an enabling environment in which agricultural mechanization can freely develop. The first step in the formulation process is a definition and analysis of the existing situation (covered in chapter five). The second part of the strategy process is to define an ideal future situation; a situation in which the mechanization sector contributes to the overall development of agriculture in the country but which will also contribute to improving farm incomes and living standards. This chapter deals with how this future situation can be identified and defined. Emphasis is given to the individual roles of the public and the private sectors and how they interact with each other. It describes how the preparation of the strategy should be completed by reviewing strategy documentation, the procedure for presenting the findings, and implementation. The outcome is a framework of policy and institutional recommendations, supported by programmes and projects where appropriate. An example of a strategy framework is given.

This guide aims to be a valuable reference and is intended for use by politicians, decision makers, officials and experts involved in the agricultural sector in general and in agricultural mechanization in particular. However, it must be pointed out that it can never be a complete substitute for sound common sense; each country has its own individual characteristics and each study will need to be customized to fit these characteristics.

CHAPTER 1

Agricultural mechanization strategy formulation: Definitions and principles

1.1 INTRODUCTION

Agricultural mechanization is a very broad field in which numerous factors have to be considered. It is a cross-cutting term that includes several disciplines. In addition to agriculture, it includes many economic aspects. It involves many different stakeholders coming from a whole range of sections of society; the smallest farmer can have an interest and be involved but so can very large private and public sector companies and organizations. Across this wide spectrum of interests, there is a necessity for a common understanding of the terminologies and concepts used. It is also desirable for the layperson to understand these terms and concepts.

This first chapter serves as an introduction to this guide and sets out the general context of agricultural mechanization by defining principles and clarifying definitions. It also explains patterns of agricultural mechanization, its evolution, and the notion of sustainable development of mechanization. Finally, it clarifies the concepts of strategic planning and the way it should be approached.

1.2 SOME TERMINOLOGY USED IN AGRICULTURAL MECHANIZATION

1.2.1 Agricultural mechanization

According to FAO (Clarke, 1997), the term *"Agricultural mechanization"* generally refers to the application of tools, implements, and powered machinery as inputs to achieve agricultural production. In general three sources of power are used in agriculture; manual, animal and motorized (fossil fuel and electric).

The term covers the manufacture, distribution, maintenance, repair, management, and utilization of agricultural tools, implements, and machines. It applies to agricultural land development, crop production, harvesting, and preparation for storage, on-farm processing and rural transport.

Agricultural mechanization is often associated solely with tractors and sophisticated agricultural machinery – so called "tractorization". ***In reality, particularly in developing countries, the term covers all levels of technology from the simplest and most basic (hand tools) to the most sophisticated and powerful.*** What is very important is that the technology involved meets

the real needs of farmers and can be used efficiently and effectively and is financially viable. In other words, increasing levels of mechanization doesn't necessarily mean big investments in tractors and machinery, but involves shifting to an alternative combination of the use of land, capital and labour, which results in improved farm incomes either through increased output or through reduced costs, or through a combination of both. Additional other, non-monetary benefits such as a reduction in the drudgery of farm work must also be considered.

Although agricultural mechanization is an essential input for agricultural production, it is difficult to place it alongside other inputs. It is not a single input like seed and fertilizer, but rather a series of production tools which are used in almost all phases of production. In almost any agricultural production system, the annual expenditure on mechanized inputs (tools, implements and machines), greatly exceeds the individual costs of other single inputs such as agrochemicals and seeds. Cost components of mechanization include labour, animal costs, and running costs of tools and machines (fuel, repairs, depreciation, and interest). Farm machine and tool use, in contrast with other inputs such as seed, fertilizer, and chemicals, requires an initial capital investment. Engine driven machines such as tractors and stationary machinery require fuel, servicing, and maintenance. Animals used for draught (pulling) purposes require fodder and veterinary services. Therefore the use of mechanization can involve many different stakeholders and include technical, economic, and social aspects. Environmental issues also have to be considered.

1.2.2 The different levels of agricultural mechanization

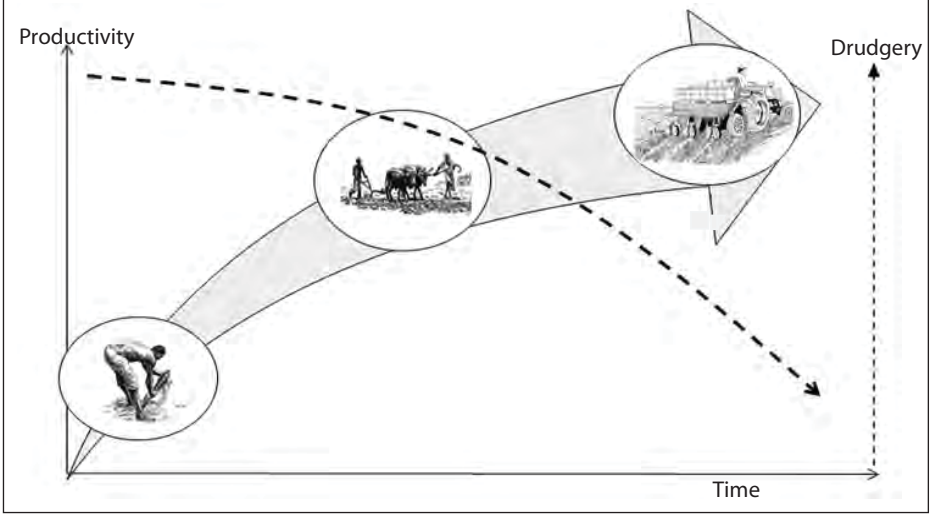
Mechanization based on human power sources

Manual technology (the use of hand tools and manually powered machines) relies upon human beings as the source of power ("muscle power"). There is a very wide array of tools and hand machines used in agriculture. This includes hand tools such as machetes, hoes, spades, forks, axes, knives, but also machines such as manually powered winnowers and seed drills. These are technologically simple and can be designed and made locally in small quantities by artisans (blacksmiths) and small workshops. They may also be mass produced and sold through shops. Hand tools are generally multi-purpose tools and may be used for several operations related to crop production and agro processing.

Hand tools are relatively easy to manufacture and use, as well as easy to maintain and to repair. They also offer the advantage that they are inexpensive and accepted socially. However, their use demands very high levels of human effort which limits what can be achieved in production terms. In terms of area to be cultivated, the use of hand tools puts a limitation on the area that can be cultivated by one person (Figure 1.1). Within this overall limitation, the amount of time it takes to accomplish various farming operations will nevertheless vary widely according to considerations such as the crop, soil

type, soil moisture, optimum seeding dates and desired quality of work. The amount of work a human can deliver is influenced by nutrition and health. Climatic conditions also play a significant role; in particular high ambient temperatures and humidity drastically reduce human work capacity.

FIGURE 1.1
Sources of farm power and their effect on productivity



Currently, hand tool technology constitutes the most widespread mechanization level within small-scale farmers in sub-Saharan Africa and some estimates even show that the use of manual tools is increasing in Africa whereas their use is decreasing in Asia.

Animal power based mechanization

Animals are used extensively as a source of power in agriculture. The potential draught power of animals varies greatly according to the type of animal. The main animals used for work purposes are horses, oxen, mules, donkeys and camels. Their size, nutrition, state of health and general condition at the time of use are key factors determining the amount of work they are capable of carrying out. For equines (horses, donkeys, and mules) and camels the optimum pulling force is about 12 percent to 15 percent of body weight. The working speed for most draught animals when working at optimum pull is about 3½ km/hr (Ashburner *et al.*, 2009).

It is strongly recommended that animals which are adapted to the local conditions be used as they generally exhibit a greater resistance to local diseases. High temperature and humidity greatly reduce the work output of animals. Animals need to be trained for work purposes and it takes about a year for them to attain maximum performance.

There is considerable evidence to show that by replacing and augmenting human power with animal traction, the total cultivated area can be expanded and labour productivity increased (Figure 1.1). The rate of work achieved by work animals varies considerably but can be from 5 to 20 times greater than manual labour. Land preparation is particularly power intensive and huge increases in production can be achieved by replacing hand hoes with animal drawn ploughs. For crop production, the main implements used with animals are the plough and trailer. More recently, technological advances have led to the development and manufacture of other types of animal draught equipment such as seeders and mowers; however, primary tillage and transport still remain by far the main operations carried out by work animals. Animal power can also be used for other operations such as pumping, milling, and road construction.

The use of animals as a source of power provides economic gains not only for farmers but also for the local economy. Local businesses benefit from the use of draught animals both on the support side (retailing, manufacturing, and servicing of implements) as well as the processing, marketing and sale of surplus agricultural products. For the national economy, the requirement for foreign currency is generally small or non-existent. Animals and trailers also provide local transport facilities in rural areas. Another major economic benefit for farmers who switch to using animal draught is that it releases them and their family to carry out additional, income generating activities.

One of the main problems in using draught animals in many developing countries is the often poor condition of the animals at the end of the dry season. Yet this is the time when, in conventional farming systems, the first ploughing is undertaken, and which is the most arduous of all the tasks for the animals. Most farmers rely solely on grazing for animal feed during the off-season. This is the time when grasses and other fodder plants have dried out and are least nutritious and least plentiful. As a consequence the animals lose condition and weight and are more susceptible to diseases which seriously reduce their work capacity. If farmers are to keep their animals in peak condition then supplementary fodder must be given before and during the work season. However, if productive land needs to be specifically set aside for this, then the food producing capacity of the farm will be reduced.

Another problem with using animals for work purposes is the common perception that their use is archaic and backward. This is in contrast to tractors and other large machinery which are viewed as progressive and modern. These are generally opinions and perceptions held by ill-informed commentators which are formed without knowing or taking into consideration all prevailing factors and conditions. Unfortunately, and to the detriment of increasing the use of animal power, tractors and other advanced machinery have been used as political tools both by donors from industrialized countries as well as politicians from recipient nations who argue that continuing to promote the use of work animals indicates a lack of development.

Mechanical power based mechanization

Engine powered machines represent the highest level of mechanical technology in agricultural mechanization. The sources of energy are usually fossil fuels but may also involve direct or indirect use of wind or solar resources for generating electricity for electric motors. Generally the use of advanced mechanical technology calls for higher levels of management and support services in order to optimize returns on the investment.

The introduction of mechanical power into agriculture has normally brought about increases in both labour and land productivity. Not to be underestimated is the reduction in drudgery (Figure 1.1) that generally results from mechanizing operations. For example it has been estimated that a mechanized farmer can provide enough food to feed up to fifty people whereas by using draught animal power alone a farmer can only feed about six others. (Clarke, 2008).

Almost all of these mechanical technologies were initially developed in Europe and North America and were used for the wider industrialization of industry. At the same time the industrial revolution needed large numbers of people to work in factories. This "pulled" labour from rural areas (although there were "push" factors as well). This in turn spurred the development of agricultural machinery that was needed to replace this labour. It is a moot point as to whether industrialization "pulled" labour from rural areas or whether the introduction of farm mechanization "pushed" labour off the farms. In reality it was probably a combination of both. More recently in the 1960's, 70's and 80's, the "labour displacing effect of mechanization" in developing countries became a contentious issue and a major point of debate.

Where the conditions for the use of tractors and large machinery are suitable, investment in agricultural mechanization has proven to be profitable. The main conditions being that the returns gained from using machinery are sufficient to cover investment and running costs as well as to generate profit. Farmers also need to be sufficiently skilled, both technically and managerially in order to make best use of the technology. This is often not the case in many developing countries, particularly in sub-Saharan Africa, where the introduction and adoption of advanced technologies has been found to be problematic.

Over the last two decades there have been further rapid advances in industrialized countries in the development of agricultural machinery. This has largely been due to the use of electronic and information technologies. The use of these technologies in tractors and combines has become commonplace and has led to the development of precision farming techniques as well as the automation of a large range of other farming operations. It is not uncommon to find systems of automatic feeding of dairy cows with levels of feed based on an individual cow's milk production. Another example is the use of sprinkler irrigation systems which automatically apply water according to levels of soil moisture but also apply controlled amounts of fertilizer and pesticides.

These new developments have widened the agricultural technology gap between industrialized and developing countries. This gap is being filled by an increase in the manufacture of less sophisticated farm tractors and machinery in many other emerging economies especially in Latin America and South and East Asia. This machinery in the main still reflects the technology of the 1970's and 80's and is generally well suited to the budgets of farmers. It is also well suited to the levels of knowledge and skills of operators and service providers in developing countries.

Patterns of agricultural mechanization

To understand patterns of agricultural mechanization and to understand how they have evolved, it is important to look at the historical perspective. This shows that agricultural mechanization cannot be isolated from other aspects of land and labour. Nor can it be separated from developments in the technical and biological sciences. The pattern and pace of mechanization in any economy are strongly influenced by land and labour resources as well as the development of demand for agricultural products and demand in other sectors.

Generally speaking, expansion in the use of mechanization in agriculture has played an important role in improving labour productivity. Similarly, progress in biological and chemical sciences has played a key role in improving land productivity. However the distinctions between mechanical and biological technologies are not always clear cut. The use of mechanical technologies is not solely designed to improve labour productivity. Similarly, the use of biological technologies is not intended to improve only land productivity.

With the development of the industrial sectors in the USA and the UK, the supply of labour in the agriculture sector shrank drastically. The further development of agricultural mechanization then played a key role in replacing this labour. In the USA between 1870 and 1920 mechanization contributed to a more than doubling of the area under cultivation. This demand for mechanization was also a major factor in the types and variety of machinery that were developed. In Japan, however, which experienced similar increases in production as the USA, the development of the agricultural sector was based more on biological and chemical technologies improving the productivity of a limited area of agricultural land. One of the main reasons for this was the increase in the price of land compared to labour, particularly between 1880 and 1900.

The various types of agricultural mechanization may also be grouped according to whether they are power intensive or control intensive. At one end of this spectrum is, for example, primary tillage which is extremely power-intensive, i.e. it requires a great deal of power to pull a plough but requires relatively little control. At the other end of the spectrum is mechanical rice transplanting which requires a great deal of control but relatively little power.

Generally when increasing the level of power inputs and changing from one source of power to another (human labour to draught animal power to tractors), emphasis is first placed on utilizing the extra power available for power intensive operations. Operations which directly increase production by being able to cultivate greater areas and which reduce human power inputs are the first to be mechanized. As the cost of labour rises and labour becomes scarce, the higher capital costs of more sophisticated machines which are control intensive become justifiable.

The evolution of power intensive operations differs depending on whether the source of the energy is stationary or mobile. For example, pumping and threshing operations were often mechanized first because the first motorized sources of power that became available were stationary. When tractors were developed then soil tillage became the first operation to be mechanized. It is very interesting to note that even after the introduction of tractors for tillage, other operations such as seeding often continued to be performed by draught animals or even still by hand. This is still the case in many countries in transition.

This historical background shows that in developed countries agricultural mechanization has evolved according to the specific requirements of the farming system. Several factors such as labour availability and cost, as well as the productivity of land, determined how mechanization developed. However, in developing countries, particularly in the majority of sub-Saharan African countries, agricultural mechanization has not made much progress at all and in some instances even the achievements obtained in earlier years are being lost. The transition to sustainable development and increased production has not yet begun and many sub-Saharan African countries are still looking for mechanized methods of farming that can be adapted to their conditions. For countries to keep pace with the growth in the demand for food, substantial increases in the application of scientific and technical methods of farming will be required. Having said that, it can also be observed that a large potential for improvement in productivity exists.

1.3 SCOPE OF AGRICULTURAL MECHANIZATION

Mechanization of agriculture has to be viewed in a very broad context. The overall scope of the term "agricultural mechanization" encompasses several components: manufacturing and/or importation, distribution, supply of spare parts and service as well as institutional support. Due attention must be paid to ensure that this system functions in an integrated manner. For the mechanization sector to function well all of the individual components must be in place and all must be working efficiently. A graphical representation of this can be seen in Figure 1.2 where the linkages between the key components are presented. This analysis gives an overview of agricultural mechanization and shows clearly the interdependent relationships of the various components as well as the linkages between them.

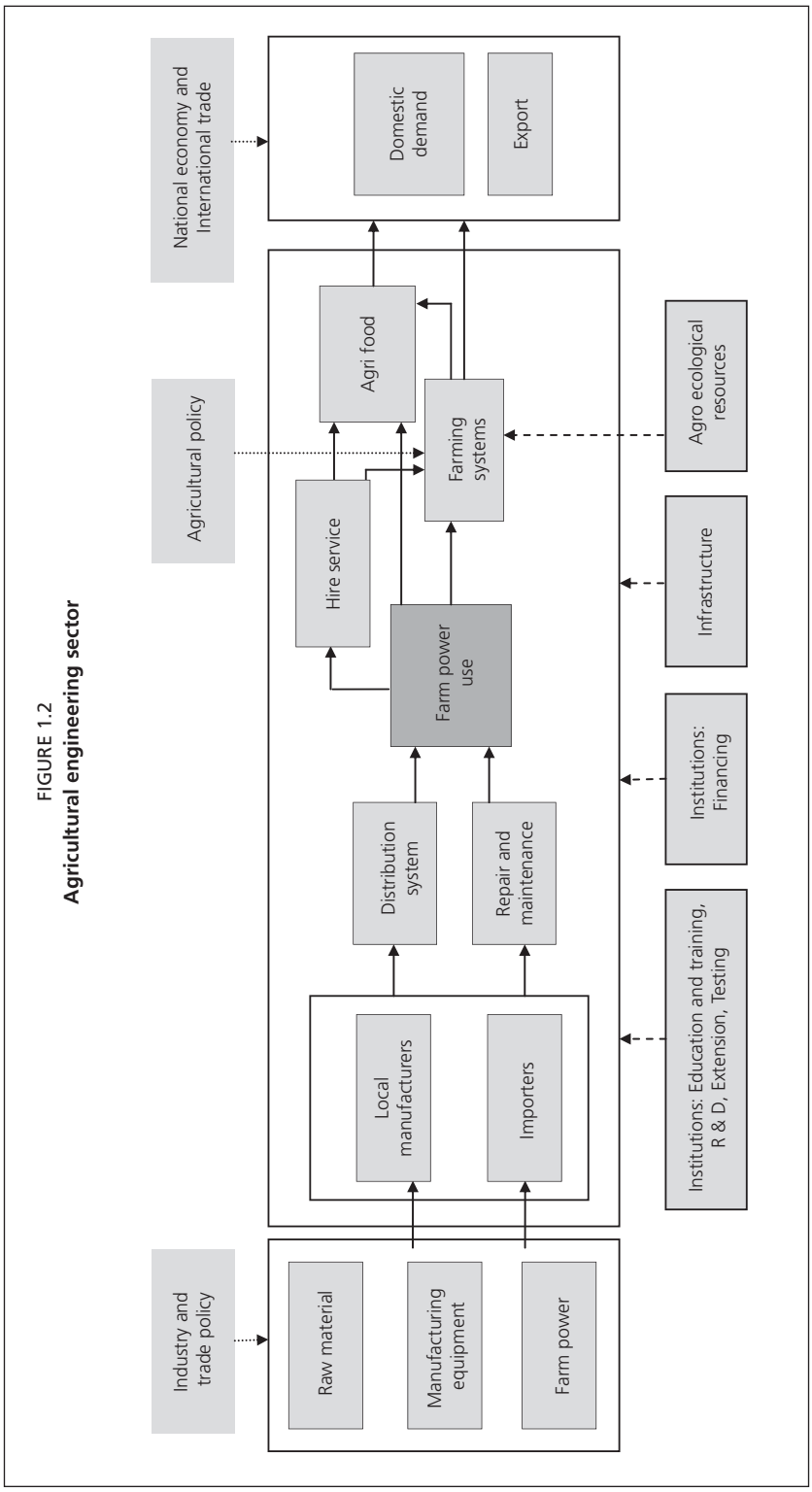


FIGURE 1.2
Agricultural engineering sector

The level of agricultural mechanization is determined to a large extent by the profitability of the farming system which, in turn, is influenced by the domestic and international markets for farm products. Farmers respond to market demand by changing cropping patterns which may need different tools and machinery. Also, at some point, all tools, machines, and implements need to be replaced. Therefore demand for new machines and equipment is composed of two parts: replacements for existing machines and, availability of new machines and equipment for the expansion and diversification of the farming sector. Parallel to this will be an ongoing demand for spare parts and repair services. This will require a functioning input supply chain.

Due attention must therefore be paid to the influence of the prevailing policy environment on the sector as well as the role of supporting institutions. Whereas agricultural policies may have specific reference to agricultural mechanization, other policies such as fiscal, trade and industry, may have an indirect influence. For example, trade policy may be to place greater reliance on increasing foreign exchange earnings, and thereby placing an emphasis on the production of export crops. Industrial policy may be to promote local manufacture which may include the production of agricultural tools and equipment. Influences of other existing policies outside of the agricultural sector should therefore also be identified and taken into account. It is unlikely that any effective changes to the mechanization sector can be effected if other, non-agricultural, policies are in place that may distort or influence the mechanization market place.

Similarly, many NGOs and institutions in the public sector are associated with the agricultural engineering sub-sector. Many important services such as training, extension, research, and credit are provided, and the extent and effectiveness with which these function should be taken into account.

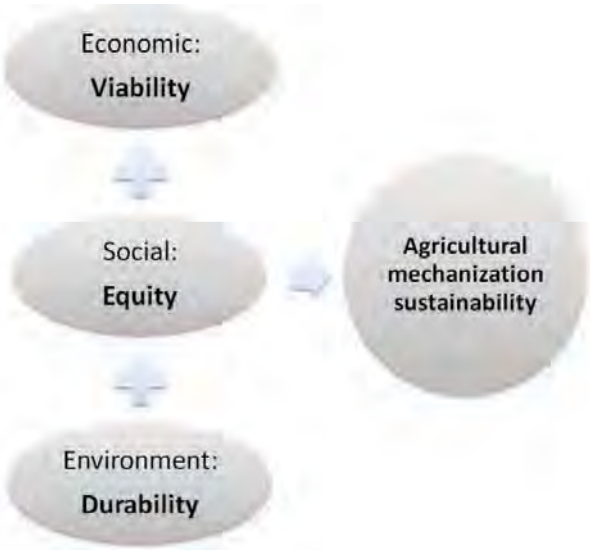
1.4 AGRICULTURAL MECHANIZATION AND SUSTAINABLE DEVELOPMENT

Within an overall sustainable development framework, agricultural mechanization has to be looked at from three aspects: economic, social, and environmental (Figure 1.3).

As regards economic aspects, mechanization is an investment for farmers and they have to generate income and profit from their investment by means of greater production or increased value. The economic aspect has also to take into account the commercial and financial links between farmers and other stakeholders. These are the retailers, distributors, manufacturers, importers and service providers. The fundamental requirement for a sustainable sub-sector is a strong linkage between these different parties and that all of them must be able to make a livelihood from their businesses.

Sustainable agricultural mechanization must also be seen in a social context because it has other, non-economic, benefits for the user. These are very varied

FIGURE 1.3
Agricultural mechanization - the principles of sustainability



and may include for example, a reduction in the drudgery of farm work and more leisure time. The status of a farmer in his local community is also an important factor. However, these benefits are very subjective and cannot be easily translated into cash equivalents.

The impact of agricultural mechanization on rural employment may also be a very controversial issue. As has been mentioned previously, many analysts consider mechanization to be a major factor in reducing employment opportunities and reducing the skill levels of ordinary labouring jobs. Other analysts however, consider mechanization to be a means of reducing rural unemployment through the development of new employment opportunities such as manufacturing, repair, and provision of mechanization services. This is certain to be an ongoing debate.

Finally, for a sustainable development of agricultural production, issues and concerns about the environment must be considered. Mechanization has been criticized for the negative impact that some operations have on the environment. In particular, the degradation of natural resources through intensive tillage has come in for criticism. It should however, also be pointed out that mechanization opens up new possibilities for the conservation of natural resources and the environment. Conservation agriculture, for example, is one of those very important concepts that have been developed during recent years. FAO describes it as *"a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment"* (FAO, 2007). The key parts of the concept are (1) reduced and

no-tillage practices (including direct seeding technologies); (2) permanent soil cover and the use of leguminous cover crops plus (3) crop rotation and crop associations in order to avoid plant disease and pest outbreaks and to allow the soil to re-balance its nutrient availability and to sustain fertility. Without mechanization, such a comprehensive move away from destructive intensive tillage would have been barely possible.

1.5 FORMULATING A STRATEGY FOR AGRICULTURAL MECHANIZATION

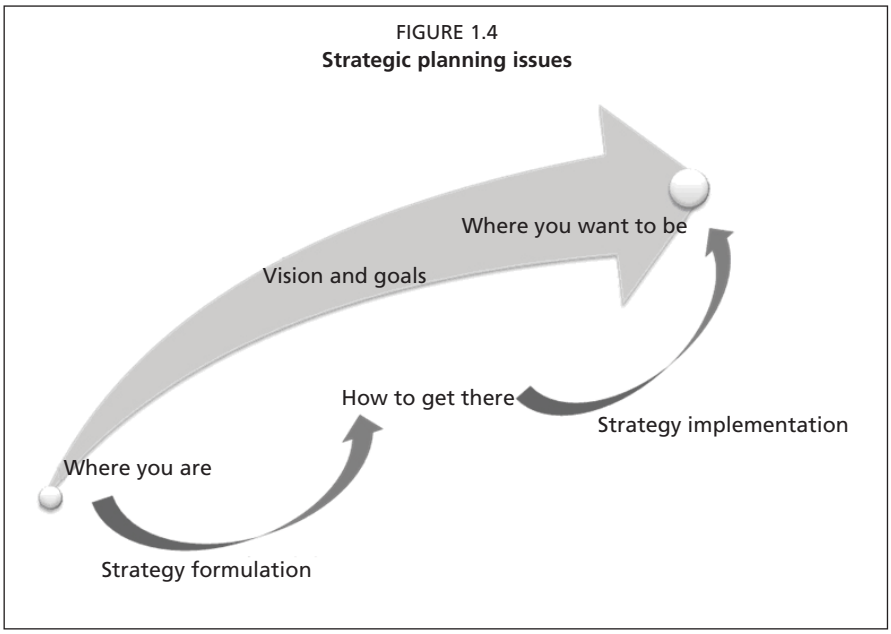
The formulation of a strategy as part of an overall plan for the development of the agricultural sector is an essential step in the implementation of government policy. Several years ago the Agricultural Engineering Service in FAO initiated work in this field by publishing the first guidelines on strategy formulation for agricultural mechanization. This was followed up by assistance to a number of governments of member countries in Latin America, Africa, Asia, and Eastern Europe to formulate strategies for their agricultural mechanization sectors. During more recent years but particularly with changes occurring due to the implementation of structural adjustment programmes, the concept of formulating a strategy for agricultural mechanization has been further developed and refined.

1.5.1 Formulation of a strategy: A general definition

There is often confusion about the meaning of "policy" and "strategy". **Policy** is a general statement setting out what is to be achieved. Policy also states the general overall principles governing how the policy objectives will be achieved. **Strategy** is the next step down and is an overall plan stating how the policy goals will be achieved. Plans, programmes, and projects are the individual components of the strategy. Agriculture can be used to illustrate this; the overall agricultural policy goal of a government might be to increase production and achieve self-sufficiency. In order to achieve this policy objective, a strategy needs to be formulated so that the various players involved (plant breeding, crop husbandry, farm management, fertilizer, crop protection, marketing etc.) can all work in an integrated and coordinated manner. Strategy is a statement as to how the policy objective will be achieved. For example, through the use of more fertilizer, better crop varieties or more mechanization. It means making decisions and managing work in order to guide the sector towards its desired objectives.

Generally, as is shown in Figure 1.4, it is necessary to first define accurately and in detail the present situation. The second important step is to define a vision of how the future should look. The strategy formulation process is to define what changes must be made and to determine those steps that must be taken to get from the present situation to the situation you have defined for the future.

FIGURE 1.4
Strategic planning issues



The first step in the strategy process is to develop a thorough understanding of the current situation. The second step is to create a scenario for the future; one which can be realistically achieved i.e. what will the mechanization sector look like in the future. The third step is to elaborate a strategic plan of how to get from the present situation to the future one. This will be comprised of several components and involve many sectors, for example manufacturing, importation, retailing, finance, training, and private and government sectors. The final step is the drawing up of individual plans for the various sectors and implementation of the plan. This will need to be accompanied by a monitoring system to assess whether the objectives are being achieved.

1.5.2 The purpose of formulating a strategy for agricultural mechanization

The philosophy behind a decision to formulate an Agricultural Mechanization Strategy (AMS) relies upon the conviction by the national government concerned that it should put in place an appropriate policy framework and create appropriate conditions for such an exercise. Normally this would involve the largely self-sustaining development of the agricultural mechanization sub-sector within a policy of minimum direct intervention. If it is overall government policy to intervene in the agricultural or industrial sectors, then the reasons and purpose of any intervention should be clearly stated within the objectives of the strategy.

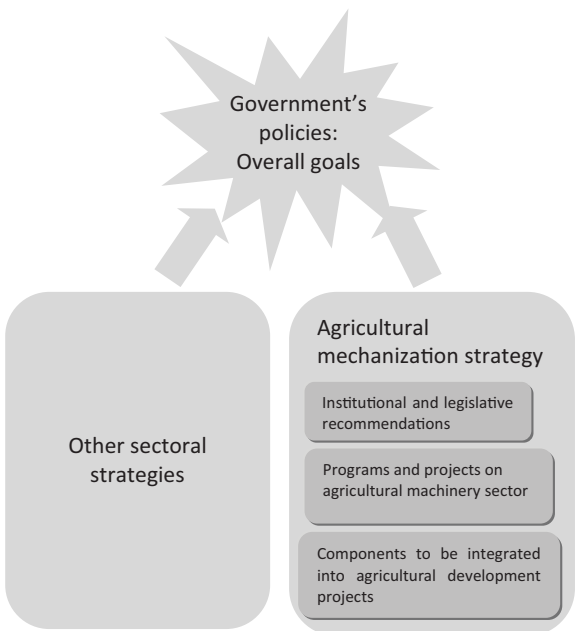
The purpose of an AMS is to create an enabling policy framework, as well as an institutional and market environment in which farmers and other end-users have as wide a choice as possible of farm power and equipment suited to

their needs within a sustainable delivery and support system (Bishop, 1996). The overall group of farmers and other end users includes those from small family operated farms, commercial farm or agricultural businesses, farmers' organizations, irrigation groups, contractors, government departments, rural transport operators and primary food processors.

Generally, a strategy on mechanization should not stand alone; it should be just one of a number of strategies leading to the achievement of overall government policy (Figure 1.5). This will, in turn, contribute to the wider policy goal of increasing agricultural production by farming existing areas more productively as well as bringing increased land under cultivation where it is environmentally sound to do so. It will also contribute to the reduction of drudgery associated with farm operations, releasing family labour for other income generating activities, as well as facilitating the adoption of sustainable farming practices. It will contribute to overall economic development.

The outputs of a strategy formulation will include a range of policy and institutional recommendations supported, when necessary, by outline programmes and projects designed to implement the strategy. These outputs will not generally remain static; during the on-going process of implementation, progress will be monitored and, where necessary, revised in the light of changing experience and circumstances.

FIGURE 1.5
Purpose and framework of a strategy for agricultural mechanization



1.5.3 Approaches to formulating an agricultural mechanization strategy

With the rapid political and economic changes of the late 1980s and early 1990s, particularly with the implementation of structural adjustment programmes in many countries, it was recognized that a more flexible, free market approach to the mechanization of agriculture was required. Instead of a rigid planning process for mechanization, the strategy which is being formulated has to be flexible, both in terms of resources and time. Also, because mechanization strategy implementation will involve many different players, it is strongly recommended that emphasis be placed on using a participatory formulation approach. All stakeholders should be involved at all stages of the process. This will include creating opportunities for them to participate in, and to profit from, the outcome of the strategy. Other reasons for using a participatory approach are:

- To be able to reach a national consensus on the outputs resulting from the implementation of a mechanization strategy;
- To strengthen the national debate on mechanization, thus giving stakeholders, including civil society and private sector, the means to take a more active role in addressing issues;
- To develop more comprehensive objectives through the participation of all stakeholders;
- To enhance the sense of ownership, responsibility and transparency of the strategy process.

Three main groups of stakeholders will be involved:

- Farmers who use the technology (the DEMAND side);
- Private sector equipment and service providers to the farmers (the SUPPLY side); and
- The public sector (the INSTITUTIONAL SUPPORT).

The process of strategy formulation should also include the adoption of a systems approach whereby agricultural mechanization is viewed in the broader context of the agricultural engineering sector and where the linkages between the key components are emphasized. As shown in Figure 1.2, to analyze issues of agricultural mechanization, several sectors will need to be analyzed, including the institutional framework. Therefore it is vital that the strategy formulation is carried out by a multidisciplinary team. This team will include agricultural engineers, economists, sociologists, agronomists, policy experts, planners, and developers.

CHAPTER 2

Overview of agricultural mechanization in Sub-Saharan African countries

2.1 INTRODUCTION

In the past many Sub-Saharan African (SSA) governments have at various times introduced schemes, development projects and incentives, designed to encourage farmers to make more use of agricultural machinery, in particular tractors. It is generally recognised though that most of these efforts did not meet expectations (Ashburner *et al.*, 2009). In fact many of them were financial and operational disasters that had little or no effect on the adoption rate of mechanization. Today, the rate of use of agricultural machinery is still below that which is considered necessary to meet the rising demand for food (Mrema, 2011).

This chapter makes proposals for a different way to analyze the current situation by highlighting the importance of strategic planning. It focuses on the role and development of the private sector and the involvement of all parties that have an interest in mechanization. These are on the one side farmers, and on the other the machine importers, manufacturers, retailers, and service providers (repair shops). In other words it is an analysis of the whole agricultural mechanization supply chain.

After a short review of the historical background, an analysis of the main determinants of agricultural mechanization demand is provided. This includes an identification of the bottlenecks which are hindering the development of the supply side of agricultural mechanization. Finally, it concludes by presenting opportunities for agricultural mechanization development in the new context of countries in SSA.

2.2 THE HISTORICAL BACKGROUND OF AGRICULTURAL MECHANIZATION IN SUB-SAHARAN AFRICAN COUNTRIES

The history of agricultural mechanization in Africa can be divided into three distinct periods; before, during and after colonization.

The first period was marked by the use of rudimentary tools and the main sources of power were manual and in some cases, animal.

The colonization of many countries led to the introduction of more sophisticated mechanization and the use of the internal combustion engine as a source of power. Engine powered tractors and their associated equipment were brought in mainly for use on the farms and estates owned and operated by the colonialists. For indigenous smallholder farmers, better hand tools and animal draught equipment (manufactured in the country of the colonizing power) were made available so that cash crops such as cotton and groundnut could be more widely grown (for export). During this period a fully functional dealer network was developed in many countries, but designed primarily to serve the settler farmers and large estates.

On gaining independence, the situation in most countries remained relatively unchanged for a decade or so. This was largely due to the fact that many settler farmers and the dealer networks remained. The importation of agricultural machinery continued and support services remained available.

The situation then changed and many governments began to "control" their economies. One of the measures taken was to peg their currencies against a major international currency, particularly to the CFA Franc in West and parts of Central Africa. This had several effects; (a) it kept imports cheap, (b) it made exports expensive (c) it caused demand for foreign exchange (FX) to rise, and (d) it discouraged local manufacturing. The demand for FX could not be satisfied by FX currency earnings and so governments started to place strict controls on FX sales, in effect rationing it for those people who wished to import goods or who wished to travel. Exporters who were paid in FX were compelled to surrender it to the government or the national bank. In some instances, governments had different "tiers" of exchange rates where government purchases had a preferential rate to purchases made by the private sector or where the price paid for the FX generated by exporters was lower than the price of purchasing FX.

In the late 1960s and 1970s, many SSA countries adopted policies of direct public sector involvement in development; policies in which the government played a central role not only as facilitators and regulators, but also took over the roles of producers, manufacturers, traders, and bankers. Governments started to become involved in the direct importation of tractors and machinery, activities against which private sector importers could not compete. In many countries during this period, the private sector was effectively pushed out of the business of farm machinery importation and retailing, in many cases destroying companies that had had a long history of providing service to farmers.

Initially, in response to these government interventions, the growth rate of gross domestic product (GDP) and employment increased. But in the mid-1970's, these strategies led to increasingly higher budget and trade deficits. Inflation accelerated and levels of internal and external debt became unsustainable leading to instability at the macroeconomic level. These structural

imbalances were the primary reason that led to many African countries having to agree to externally imposed fundamental structural adjustment programs (SAPs) which focused on macroeconomic stabilization, based on trade liberalization, floating exchange rates and economic deregulation.

In many countries by the time of structural reform in the 1980's, the distortions present in the market had reached extreme levels. One of the pillars of structural reform programmes was the "freeing" of exchange rates where FX was sold to the highest bidder. This had the immediate effect of drastically increasing the local prices of imported goods, including farm inputs, and lowering the purchase prices of exported goods. Unfortunately, the expectation by economists that the private sector would re-emerge and take up its previous position mostly did not happen. The private sector had been so destroyed by the distortions of the fixed exchange rates that it simply did not have the resources to recover to their previous position. Also much of the commercial and entrepreneurial expertise had been lost and that which had survived was only interested in enterprises that made quick returns and high profits. Farming did not belong to that category of enterprise. Unfortunately, in many countries the market for farm tools and machinery has still not recovered and as a result, the agricultural mechanization sector has not expanded or developed significantly.

In fact, in many instances agricultural mechanization still continues to receive "special" treatment. Governments are still intervening not only as facilitators and managers of regulation but also being directly involvement in manufacturing, importing and distribution and sales of farm machinery. Despite past mistakes, we are still seeing many of the same old scenarios being played out again. On the institutional side it is argued that intervention is justified because the private sector is "not yet ready" to operate effectively and efficiently. Never-the-less, interventions by the public sector in the agricultural machinery sector still creates a distorted and unfavourable environment which prevents the emergence of a free market and a dynamic and effective private sector.

2.3 THE CURRENT STATUS OF AGRICULTURAL MECHANIZATION IN SUB-SAHARAN AFRICAN COUNTRIES

In SSA the total cultivated land area is about 2 455 million ha of which 173 million ha are under annual cultivation. The principle farming systems, in terms of areas cultivated are: cereal-root crop mixed; maize mixed; and agro-pastoral millet/sorghum (Sims *et al.*, 2006). Farming systems in SSA are dominated by small-holder peasant farmers which in most cases are based on subsistence farming. The average landholding of farmers is less than 2 hectares. The average number of persons in the family varies greatly but with an average of about five members. These family members constitute the main source of labour, however, it is often the case that not all members are available for farm

work all of the time. In particular the younger generation, in order to earn off-farm income and to seek a better life, are increasingly migrating from rural areas to urban centres and elsewhere.

Fertilizer use is far less in SSA than it is in the rest of the world. For example, in 2007 average fertilizer use was only 13 kg per hectare, compared with 208 kg in Asia and Latin America (Table 2.1). The area under irrigation in SSA accounts for only five percent of cultivated area, compared to more than 38 percent in a selection of other countries in Asia and Latin America (Table 2.1).

Generally, crop yields in SSA are very low when compared with other regions in the world. For example, average cereals yields of about 1000 kg/ha in SSA are only about one third of average cereal yields in other countries in Asia and Latin America (Table 2.1). Another problem is the losses that occur during harvest, transport, and storage. Losses in both quantity and quality are common. Several factors contribute to these low levels of production. Some of the reasons are technical (low fertilizer use, poor seed, poor crop husbandry, low levels of irrigation, poor storage etc.); others reasons relate to the prevailing physical and socio-economic environment.

TABLE 2.1
How Africa compares with other developing regions

Region	Cereal yield Kg/ha	Fertilizer use Kg/ha	Irrigation percentage of arable land	Tractors per 1 000 ha
Africa[1]	1 040	13	5	28
Average of 9 selected countries[2]	3 348	208	38	241

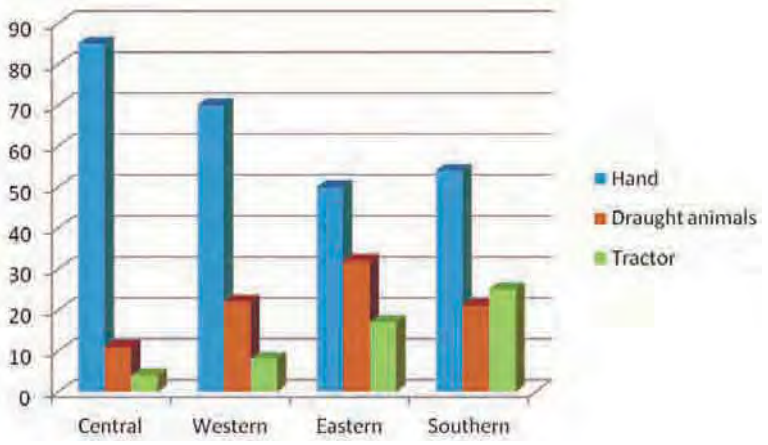
Source: The World Bank (2007) as cited by FAO and UNIDO (2008).

Studies show that Sub-Saharan Africa remains the region in the world with the lowest power usage (manual, animal and mechanical) and the lowest level of farm mechanization. In SSA the general average number of tractors is about 28 tractors per 1 000 ha whereas it is about 241 tractors in other regions (Table 2.1).

In SSA the principal power source is humans who dig, by hand, between 50 percent and 80 percent of the area under cultivation (Clarke, 1998). The use of manual power dominates in Central Africa whereas in Western and Eastern Africa more use is made of draught animals. In SSA, tractor usage is highest in Southern Africa (Figure 2.1).

[1] Africa less Egypt and Mauritania
[2] Bangladesh, Brazil, China, India, Korean Rep., Pakistan, Philippines, Thailand, Viet Nam

FIGURE 2.1
Percentage use of different sources of power in agriculture in four regions in Africa



Source: Clarke, FAO (1998).

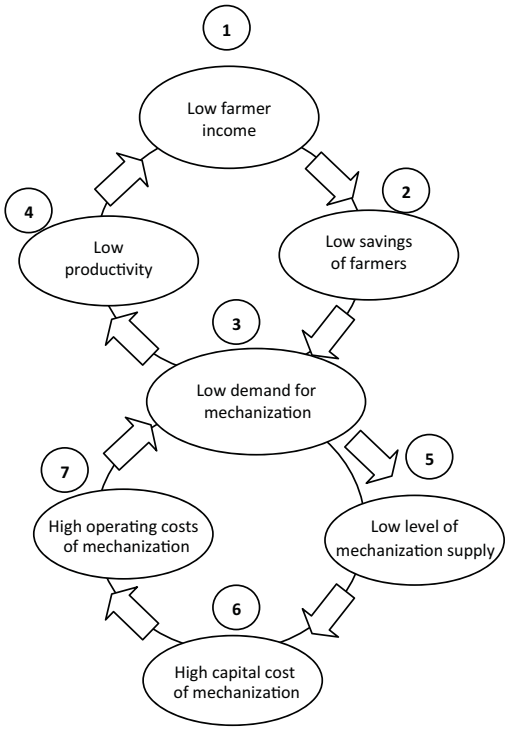
2.4 FACTORS LEADING TO LOW LEVELS OF AGRICULTURAL MECHANIZATION

In order to explain the low levels and lack of growth in the use of mechanization, an analysis of the relationships between the different determinates was carried out. This analysis clearly indicates that conditions exist in SSA which has led to the creation of a restrictive environment, which has held back the development of mechanization (Figure 2.2).

The first element represents demand for Agricultural Mechanization. Most agricultural systems in African countries, especially in SSA, are based on subsistence farming. The cash incomes of farmers remain relatively low (1). This is not only due to low production and productivity but also to other factors such as the lack of any added value to crops that are sold. Therefore there is very little surplus cash generation in these subsistence farming situations (2). One of the consequences of this is that there is a very low potential to invest in inputs. This also includes agricultural machinery and therefore demand for tools and machinery remains low. This also applies to other inputs such as improved seed and fertilizer. This lack of investment in production enhancing technologies has resulted in a very low increase in productivity (4) which again leads to a continuing situation of low farm incomes (1).

The lack of demand for mechanization drives another debilitating element: the supply side. This is represented by the bottom half of Figure 2.2. The low supply (limited choice and low sales volumes) tends to lead to higher costs of Agricultural Mechanization (6). This in turn leads to higher ownership and running costs (7). Finally, this high cost of Agricultural Mechanization use leads back to the low demand.

FIGURE 2.2
Factors weakening the demand and supply of agricultural mechanization



These inter-related factors illustrate the structural constraints to the increased use of mechanized methods of farming faced by African countries. They also demonstrate the inter-dependent relationship between the demand and supply sides of Agricultural Mechanization. However, they also give some indication as to how debilitating factors might be converted to enabling ones (see Chapter 3).

Never-the-less, these weakening factors provide only a partial explanation of the problems surrounding the development of agricultural mechanization. Other factors are present and these also have to be considered. This can be achieved by further analysis of both the determinants and the main constraints in the farm machinery sub sector.

2.5 DETERMINANTS OF AGRICULTURAL MECHANIZATION: LOW DEMAND

Farmers at, or close to, subsistence levels face several major problems which prevent them generating sufficient income for investment in mechanization. Even though each country has its own unique constraints, some general common problem areas can be identified.

2.5.1 Unfavourable physical environment

The different agro-ecological zones across the region determine the local farming systems. For example, the Niger rain-fed zone, which lies between the 200 to 300 isohyets, covers more than two thirds of all the cultivated land and is the most important agricultural production area. The rainy season determines that all operations must be carried out within a period of three to four months. Crop yields, dominated by millet, remain very low (FAO, 2011a). Also in the humid zone of Cameroon, despite a high crop production potential, yields remain low and the possibilities to use tractors are restricted due to the lack of areas suitable for mechanization (FAO, 2011b).

Soil degradation in tropical climates is also another major concern and is increasingly affecting crop production in many regions. Nutrient depletion, soil erosion, soil salinity, overgrazing, and deforestation are major issues in African agriculture and are leading to declining soil fertility and constraining crop yields. This is becoming a critical issue in Africa, particularly in the arid and semi-arid regions.

2.5.2 Unfavourable business environment

Unfortunately the business environment in which farmers are operating deprives farmers of economic incentives to invest in inputs, including farm machinery. Social, political, economic, regulatory, tax, cultural, legal, and technological factors are contributing to this poor business environment. Some of these are discussed in more detail below.

Farm gate price issues

Private sector-led input and output markets have not developed as quickly as expected and farmers are constrained by a lack of free competition in these markets, including high prices for agricultural inputs as well as lower farm gate prices than in other regions of the World. The consequent reduction in farm incomes has led to an overall decline in the level of investment in agriculture. At the same time farmer organizations have not generally been effective in assisting smallholders to improve their access to markets and public services.

Land tenure regulation discouraging investment

Land tenure is one of the most important issues in agriculture and in many countries is the one which most hinders investment in the agricultural sector. For a successful transition from semi-subsistence farming to profitable, productive agriculture land tenure must be secure and guaranteed by the state as well as by local laws and traditions. This will give farmers the security and confidence to invest in mechanization and other production enhancing inputs.

Several countries have attempted to organize land tenure by the establishment of regulations and laws but these have often not met with much success. For example, customary common land ownership by clans and extended families

makes it difficult to commercialize farming. It is also very difficult to change these traditional patterns of land ownership.

In many countries despite the introduction of national legislation, no "secure" land transaction can take place without the participation of the traditional chiefs. Any investor always has to provide "gifts" at the beginning of the change of title procedure as well as later when farming commences.

2.5.3 Inadequate and insufficient infrastructure

The existence of adequate infrastructure is also a very important determinant of agricultural mechanization development. For example, in the Democratic Republic of the Congo (DRC), one of the reasons for the high cost of tractor use is the lack of roads to access rural areas and farms. Another constraint is the scarcity of fuel stations (FAO, 2011c).

This lack of access to rural areas also has a negative effect on transport costs of commodities out of the areas. In some cases, the transport costs in SSA have been found to be as high as 77 percent of the value of exports (Economic Commission for Africa, 2004). In Latin America, rural roads amount to 0.017 km per hectare compared to 0.007 km per hectare in sub-Saharan Africa. In addition to a lack of transport another serious problem in Africa is reported to be bribes demanded by police and others officials at border posts and road blocks.

All of these factors demonstrate how crucial it is to develop a strategic plan and how essential it is to take these broader issues into account when planning and programming agricultural mechanization developments.

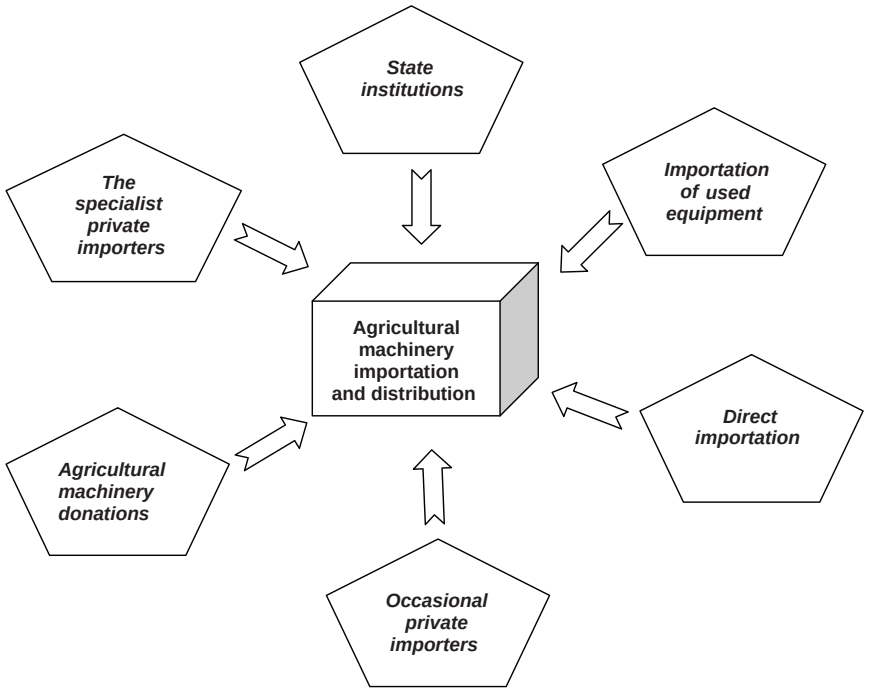
2.5.4 Lack of farmer skills

Although African farmers have a great deal of traditional knowledge and experience accumulated over generations, access to new knowledge remains largely limited. Mostly the level of training for farmers is relatively low and the opportunities for further training are limited. Another problem is that a large proportion of rural farming populations are illiterate. This situation stands in the way of improving agricultural production and productivity as well as general levels of farm management. For example, in some cases in Niger, only land preparation and transportation are carried out by tractors. Other operations such as seeding and harvesting are still mostly carried out manually. This is due to a lack of knowledge by farmers about suitable equipment and a lack of skills in operating such equipment (FAO, 2010). Where machines are used, the lack of both farmer knowledge and skills leads to misuse and mismanagement of machinery; especially more sophisticated machines.

2.6 CONSTRAINTS ON THE PRIVATE SECTOR

The whole of the farm machinery sub sector, which encompasses manufacturers, importers, distributors, and retailers, faces several constraints which hinder its

FIGURE 2.3
Agricultural machinery importation and distribution



development. Although low demand is mostly caused by lack of development, these other constraints should never-the-less be taken into account.

2.6.1 Agricultural machinery importation and distribution

There are several ways in which farm machinery is imported and distributed (see Figure 2.3). Some of these ways are more successful and sustainable than others. This is discussed in the following paragraphs.

The specialist private importers of agricultural machinery

These are usually companies which have a franchise to sell and import a selected and mostly limited number of brands. The franchise is given to them by the company manufacturing the machines. These companies are usually located in the capital city and sometimes have branches in other major cities and towns. Traditionally they have represented one of the major western agricultural machinery manufacturers but more recently, Asian and Latin American manufacturers have moved into these markets. Unfortunately in almost all markets in SSA, sales of major items of equipment (tractors and combine harvesters) are still very low. This has led these franchise companies to diversify their activities into other types and makes of equipment. Because

of the low volumes of machinery sold, the demand for spare parts is also limited. The holding of large stocks of spare parts is very expensive and so most companies only hold the barest minimum inventory. If the availability of spare parts is limited, or the part needs to be ordered from overseas, the long time delay can lead to large financial losses by the machine owner whether he is a farmer or contractor. Air freighting a part usually takes 4-6 weeks and sea freight normally takes up to 6 to 10 months or more; long enough for a season to be missed.

Occasional private importers

These tend to be general traders with no specialist knowledge or experience of farm machinery. It is usual for these companies to import a batch of machines and once they are sold there is no further obligation to provide either spare parts or service for the machines. The next batch of machines to be sold might well come from a different manufacturer. The farmers who purchase from these companies are mostly inexperienced and do not realize that there may be later problems with spare parts and repair services.

State institutions

In some countries state institutions as well as aid agencies become involved in the importation of farm machinery. For example, in Niger, the importation and distribution of agricultural equipment is carried out by the state institution the "Centrale d'approvisionnement" (FAO, 2011a). Also several African countries have created local tractor assembly plants in a mistaken effort to promote agricultural mechanization or with the objective of providing lower cost machinery. The batch importation of farm machinery (in a similar manner to the occasional importation by private traders) also occurs when governments and aid agencies issue tenders for purchasing large quantities of farm machinery (See Box 2.1). In such a situation the imported machinery generally bypasses the local distributor who subsequently has no obligation to provide spare parts or service for the machines. These tenders are almost always evaluated on the basis of price and the winning bidder may well have no representation in the country nor have any possibilities or interest in supporting the machines. Machines purchased in such a manner tend to end up as "orphans" with no spare parts or backup services and, as a result, tend to have a very short operating life. They may be cheap initially but end up being very expensive.

Donations of agricultural machinery

Many African countries have over the years received donations of tractors and implements from many different countries. Unfortunately almost all of these no doubt well intentioned programmes have failed to produce the desired results. This is due to a number of reasons, the main ones being a lack of compatibility between products manufactured in donor countries

BOX 2.1

A rush towards tractorization

In recent years many African countries have directly imported tractors or have established tractor assembly plants. Some examples:

- assembly of tractors by Chinese companies has been undertaken in Mali and Chad and by Indian companies in Cameroon;
- assembly plants in Nigeria, Ethiopia and Tanzania although these have closed some time ago;
- importing to Niger of about 800 tractors;
- importing to the Democratic Republic of the Congo of about 700 tractors.

The reasons given for this are:

- to decrease food imports by increasing food production in order to achieve food security;
- to exploit "tractorization" as a political objective since this can be claimed to be "modernization";
- it is claimed that the importation of the private sector leads to high prices and profiteering and that the public sector can import and manufacture more cheaply;
- To fit in with the framework of the Millennium Development Goals (MDG).

Some of these projects have been carried out without any prior preparation and where the use of tractors is not yet suitable or appropriate. It seems that the same mistakes that were made during the seventies are being repeated!

and machines that are already on the market. Very often there has been no dealer or spare parts available to support the operation of the equipment. The machines that have been donated quickly become "orphans" with no support and once the first breakdowns occur the machines cannot be repaired. In many countries "graveyards" of machinery are still to be found.

Direct importation

Large farmers and agro-industrial companies often import machinery directly from abroad. This is the case when large orders attract high discounts or when the company or farm has sufficient resources to stock their own spare parts as well as to carry out their own maintenance and repairs. It also occurs when particular specialized machinery is required e.g. sugar cane harvesters.

Importation of used equipment

In some countries the importation of used machinery, particularly tractors, combine harvesters and other specialized machinery offers farmers an alternative source of cheaper machinery and offers an additional way to meet demand. However, whether farmers can benefit from this cheap source of machinery depends upon whether the importer is serious in offering a service to farmers including the provision of spare parts and repair services. Importation and sale of used machinery occurs mainly in countries where there are technicians who have a relatively high level of skills and knowledge but where the costs of labour are low. As is the case with new machinery, it is often tempting for the public sector to become involved in the importation of used machinery, however, without specialized knowledge of agricultural machinery these schemes usually end up with disastrous consequences.

Duties and taxes

In many countries, inputs for agriculture are exempted from duties and taxes. However, the regulations are not always clear and can lead to ambiguity and confusion. In particular the terminology used is often unclear. Some hand tools and agricultural implements attract high import tariffs because they have not been coded correctly. Similar problems are faced with imported spare parts for agricultural machinery in that some parts (e.g. filters, bearings, and belts) are also used in the automotive industry and which attract higher import duties. The problem also arises when manufacturers of farm tools and machinery import raw materials. Because the same raw materials are used in other industries they attract a high import duty e.g. steel for the building industry. The effect of this is to make the domestic manufacturing of agricultural equipment uncompetitive with items imported at preferential tariffs.

Bureaucracy

The actual importation procedure is often cumbersome and time consuming due to unnecessary or inefficient bureaucracy. This has a negative impact on the process and increases transaction costs and delivery times. It is not unusual for machinery and spare parts imported by normal freight to take over 6 months and even air freight shipments can be up to 2 months.

2.6.2 Manufacturing of farm tools and machinery

The manufacturing industries in SSA countries produce a wide range of hand tools, farm implements, and processing equipment. However, there is a wide variation in the facilities to be found in different countries. In some countries only the simplest of hand tools are made mostly in the artisan (blacksmith) sector; in other countries sophisticated manufacturing facilities exist. At various times the farm tool and machinery manufacturing has also been supported through bilateral and multilateral cooperation. Unfortunately the sustainability of the manufacturing industry has often been problematic, often caused by raw material supplies, fluctuating demand, quality problems as well as problems caused by bulk ordering from projects.

Currently three different kinds of manufacturer are found: state owned and operated companies; private industrial companies; and the informal artisan level (See Box 2.2).

The presence of state owned manufacturing companies often leads to unfair competition as these industries are often subsidized in that they are taxed advantageously and are often given priority in any state tenders. It is often the case that publicly owned manufacturing companies produce high quality products but the production costs are generally high. This is due to high overheads, cumbersome purchasing procedures, and low production efficiencies.

The private sector also has problems but often of a different nature. In particular the private sector manufacturing industries face several constraints caused by a poor business environment, cash flow and financing problems, high import duties on raw materials and high taxation. For example, in Cameroon a big factory has recently been forced to cease manufacture of tools and animal traction implements due to high taxation of raw materials and spare parts whereas imported finished items are subjected to lower taxes and duties (FAO, 2011b).

In many countries the informal artisan sector is a very important source of tools and machines. This is because the artisans are generally located in the rural areas in close proximity to farmers. Also their products are generally simple and priced at an affordable level. However, many problems exist particularly with poor and variable quality standards as well as poor working conditions. The informal sector generally manufactures only simple products such as tools and animal draught implements whereas larger, structured companies both in the private and public sectors have the facilities and technology to manufacture more sophisticated equipment.

Finally it is important to point that over the last decade, even though some progress has been made, this manufacturing sector has found it difficult to compete with imports of low-cost tools from other countries, mainly China and India. The manufacturing industry also often suffers from an unfavourable business environment.

FIGURE 2.4
Example of a private commercial workshop in Mali

2.6.3 Maintenance and repair services

In general the maintenance and repair of hand tools and animal traction implements is not a problem as it is mostly carried out at a local level by small workshops. The situation has been improved in some countries by the standardization of spare parts, facilitating inter-changeability between tools sourced from different manufacturers. However, for motorized farm machinery and equipment many problems still remain, particularly for tractors. This is mostly caused by poor maintenance facilities and a critical lack of spare parts. This situation leads to long down times, and a consequent under-utilization of equipment and eventually to premature write off. Many years ago, emphasis was given to public sector programmes and projects which developed agricultural mechanization maintenance and repair centres. However, these were not very successful and many have since fallen into disuse.

2.6.4 Hire services

A wide range of operations can be covered by machinery hire services. In addition to crop operations such as soil tillage, planting, and spraying, other hire services such as threshing, shelling, and transportation are also encountered. Similarly, it is important to note that hire services are not only limited to motorized operations but also to operations where the source of power is animal draught.

After independence several countries established public sector operated farm machinery hire services in an attempt to include small farmers into growing markets for high-value commodities. Most of these schemes, which were mainly for the provision of tractor hire services, failed. There are some

remaining vestiges of them which only continue to exist through the provision of government subsidies, but the remainder have disappeared (See Box 2.3). There were many reasons for the failure of these schemes but the main ones were small fields with long travel distances, unaffordable rental charges, problems of non-payment of charges, inflexible and inefficient public sector administration, lack of operator and mechanic incentives, breakdowns, and the non-sustainability of the subsidies that were required to keep the service running. These experiences demonstrated that public sector tractor hire

BOX 2.2

Manufacturing system in Niger

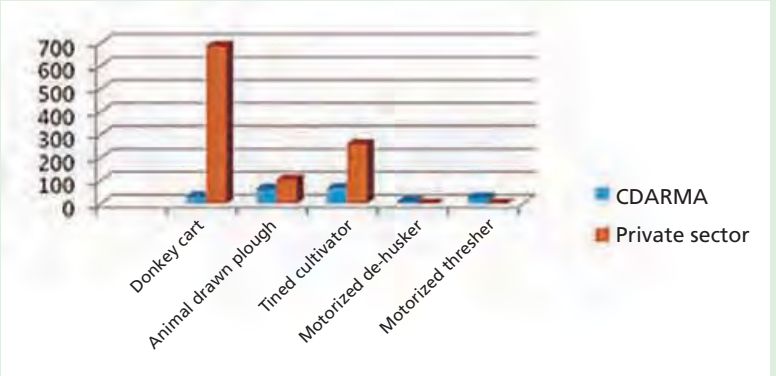
In Niger, as in other countries in West and Central Africa, manufacturing has been developed thanks to the introduction of cash crops (in this case cotton and previously, groundnuts). The marketing is organized by the state which has established several manufacturers who operate in parallel to the private sector.

The data shown in Figure 2.5 (FAO, 2009b) were collected in Dosso district, Niger and compare the output of manufactured products of a state manufacturer, CDARMA with those of three private workshops. The following points may be highlighted:

- The area of Dosso is highly populated (44.49 inhabitants per km2) and carts are the most common equipment sold. It is thought that this is because they are also used for many other non-farm income-generating activities.
- Figure 2.5 also shows the importance of the private sector for all equipment except dehuskers and threshers, but very few of these are made anyway due to a lack of demand.

FIGURE 2.5

Comparison between the state and private sectors in terms of manufactured products in Dosso district, Niger (2004-2008)



services are not sustainable. Unfortunately, these catastrophes were mainly responsible for giving farm mechanization a bad name; a situation which still widely exists today, particularly among aid agencies and donors.

In many countries, the private sector has always been involved in the provision of hire services; mostly on a very small scale and mostly in situations where tractor owners have spare capacity and hire out their machines to generate income and to assist in covering costs. In most cases their clientele are neighbouring farmers who the owner knows and can be confident that he will receive payment for the work carried out. In some cases payment is in kind. In fewer cases but increasingly, local entrepreneurs are investing in two or three machines and running small scale contractor businesses. This again occurs mainly in communities where the contractor knows his clientele.

One way to improve the profitability of tractor hire services is to diversify the number of operations offered and thus ensure that the services can be

BOX 2.3

Hire services in Cameroon

One of the most important institutions involved in hire services in Cameroon is the Centre National d'Etudes et d'Experimentation du Machinisme Agricole (CENEEMA). This state centre, created in 1974, provides services for small producers (less than 10 ha) as well as for agro-industrial complexes. A wide range of activities such as land clearing, ploughing, sowing, harvesting and road construction are carried out. In addition to these activities, CENEEMA also undertakes training, testing and prototype development. CENEEMA has played a key role particularly during the economic crisis of 1987 to 1993 which allowed Cameroon to re-establish agriculture as a major economic activity.

However, during this period, the stations in Bambui, Garoua and Nanga Eboko were closed with only Yaounde remaining open. Other reasons for the closures were:

- Management problems
- Inadequate infrastructure, especially accessibility
- Climatic conditions

Unfortunately the private sector did not take over these activities apart from a few services established in the Northwest region of Cameroon. Here, twenty private contractors with tractors are active, usually operating with second hand machines and mainly offering tillage services. The extent of the services on offer, however, remains marginal when compared to the demand. One of the main issues is the cost of services which are seen as high in relation to farmers' incomes.

marketed continually throughout the year rather than having to concentrate on the seasonal period for land preparation. The question thus arises as to whether such a year-round market exists for other on- or off-farm activities.

2.7 NEW OPPORTUNITIES FOR AGRICULTURAL MECHANIZATION DEVELOPMENT

In many African countries, despite the constraints listed above, the situation for the foreseeable future presents numerous opportunities. After decades of decline in per capita food production, a new climate of optimism exists. In the future, the agriculture sector is projected to be economically sustainable because of on the one hand the rapid expansion of urban centres and the associated demand for agricultural products and, on the other hand, the increases in international food commodity prices. There are many reasons why the new situation will provide opportunities for the adoption and expansion of agricultural mechanization. The main ones are:

Increasing agricultural wages

The development and expansion of off-farm employment and the disenchantment of rural youth with arduous agricultural work (hard physical labour and drudgery) have triggered a rural–urban migration of young people. This has led to a shortage of manual labour, particularly at peak times which has led to increasing levels of rural wages.

New sources of farm machinery more suitable for African conditions

Western technology, which was a very important source of farm machinery in the past, has become increasingly more sophisticated and has become less suitable and affordable by small farmers in Africa. However, the newly emergent industrial economies such as India, China and Brazil have stepped in and have provided new sources of farm machinery which is continually coming on to local markets. This machinery is often more suitable for African conditions and is considerably cheaper than machinery manufactured in Western Europe or North America.

Need for more innovative and energy efficient mechanization concepts

African countries will have to adapt to the world energy crisis and to new energy saving technologies. New ideas on energy efficiency and the use of other energy sources will have to be developed and adopted. With such a large potential for the utilization of solar energy, the continent has been the subject of particular interest regarding the development and use of solar power. Many technologies have already been developed for the drying of vegetables and fruits as well as for pumping water and the provision of electrical energy.

New need for sustainable business models for mechanization in Africa

The development and expansion of agricultural mechanization will take place only within a favourable economic environment. SSA still remains largely undeveloped in terms of economic activities and therefore great possibilities exist for the development and adoption of new ideas for business models adapted to the prevailing conditions.

New requirements for the environmental sustainability of agricultural mechanization

The use of agricultural machinery has sometimes been criticized for the negative effects it can have on the environment. At the same time there is agreement that it is possible to develop new machines and techniques which are more protective of the environment. An example of such an approach is conservation agriculture which maintains a permanent crop cover on the soil and uses direct seeding through the vegetative cover. At no time is the fragile soil exposed directly to solar radiation and high intensity precipitation. This has only been made possible by the development of specialized equipment. Similar developments or technologies can also be expected in the future in order to tackle other emerging environmental problems.

CHAPTER 3

Fundamental requirements for the development of agricultural mechanization

3.1 INTRODUCTION

In the prevailing situation of stagnating agricultural production in many SSA countries, one of the main means to raise production is the use of increased levels of farm mechanization. To these ends, measures will need to be taken to accelerate its expansion. These should take into account the lessons learned over the preceding five or six decades. In Chapter 2 it has been demonstrated that direct intervention by the public sector in mechanization has failed and has led to high financial losses. This will need a strong political will to instigate the changes necessary to ensure that mechanization becomes a profitable and sustainable input into agriculture. The process will also need the involvement of all stakeholders in order to develop the basic conditions for a largely self-sustaining development of farm mechanization within a policy of minimum direct intervention. A blueprint for the successful development of mechanization does not exist; each country will need to develop a different pattern according to its different social, economic, and environmental conditions.

The aim of this chapter is to provide an outline of the principle conditions required for the expansion and development of agricultural mechanization. It demonstrates why the formulation of a strategy is vital and why there needs to be clarity concerning decisions, actions, and priorities.

3.2 FACTORS CONTRIBUTING TO AGRICULTURAL MECHANIZATION DEVELOPMENT

Many African countries have a large agricultural potential which has not yet been fully developed. However, this potential cannot be fully realized without a corresponding investment in agricultural mechanization and the development of associated support systems. How this can be achieved in an effective and sustainable manner will require much thought and careful planning. It will be necessary to identify those factors which are holding back investment by farmers in agricultural mechanization (see Chapter 2) and to replace them with an enabling environment (see Figure 3.1.).

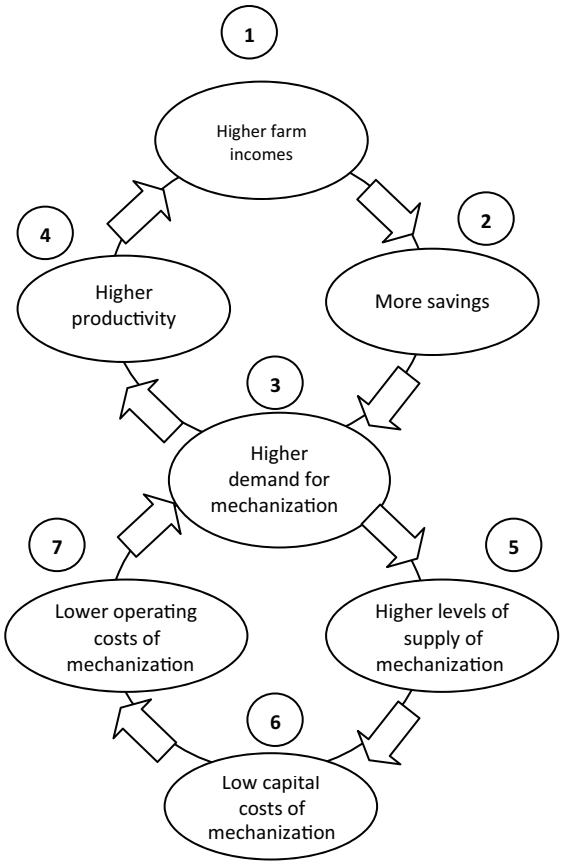
The first set of enabling factors, which are related to farm power demand, pre-supposes that farmers generate sufficient income (1) to allow them to

invest in new technologies (2); this in turn, leads to a higher demand for agricultural mechanization (3). The use of higher levels of mechanization together with the use of other inputs such as improved seeds and fertilizers then will result in higher productivity (4) and generate higher returns.

This increased demand for farm power, machines and equipment (3) will lead to an increased supply of farm tools and machinery on the market (5). This greater supply (as well as greater competition amongst suppliers and greater choice for farmers) will lead to a lowering of the capital and running costs of mechanization (6 & 7). Finally, this lowering of the cost of mechanization will lead back to the generation of greater demand (3).

These enabling factors provide an overview of the ideal future situation to be aimed for. The concept of a vision of an ideal future situation provides a necessary and important framework for defining objectives and actions to be taken. This will be a long term process and pre-supposes that action on inter-related factors will also be addressed.

FIGURE 3.1
An enabling environment for Agricultural Mechanization Development



One of the main questions that emerges is what kind of actions need to be taken in order to remedy these negative factors? Some outline suggestions are presented in the following paragraphs. The specific details however, can only be added at country or even sometimes at local levels.

3.3 INCREASING THE DEMAND FOR AGRICULTURAL MECHANIZATION

The farmer is the key player and must be the first to be taken into consideration in this process. What happens at farmer level will be the catalyst for change and will determine the development of the other links in the chain. All farmers operate in a risky environment and in developing their own strategies for the maintenance and improvement of their livelihoods; one of their first decisions will be which production system to follow. This will be one which combines security with the generation of income and is based on the farmers' perceptions of his technical and financial capacities, as well as the costs of inputs. Farmers should have available the widest choice of appropriate farm tools, machinery and equipment at affordable prices as well as access to spare parts and services to allow them to make the best choices to suit their business and personal aspirations.

3.3.1 Financing investment in agricultural mechanization

Finance will normally be required to assist farmers and organizations to invest in mechanization. Several different means of achieving this exist, the choice of which will depend on the individual country's circumstances and experience. Finance will also be required for the purchase and use of other inputs such as improved seeds and fertilizers.

Credit and finance should be available

In most cases farmers are unable to afford the costs of increasing their level of farm power use and mechanization from their own resources. Therefore access to some form of credit will be necessary for increasing investment in agricultural machinery. This credit should potentially be available for all sizes and types of farms and all types of mechanization. Assessment of whether credit should be made available for farmers should be based on a realistic assessment of risk and the potential for increased returns arising out of the investment. Collateral requirements should be realistic. A condition for the provision of credit should be that the business plan and cash flow projections appear realistic and attainable. This may well mean the development of rural agricultural banks within easy reach of farming communities and/or the promotion of other community savings and credit schemes.

The demand for such finance is likely to initially outstrip the response ability of existing financial service companies and banks. It is therefore vital that the widest range of financial options should be considered to ensure that the most appropriate system is employed.

Whatever form of finance is used for farm machinery purchase, it is vital that the business will be able to afford the investment. In the case of loans, hire purchase, or other finance schemes to be made accessible to the farmer, it is also very important that the lender has confidence in the ability of the farmer to service the loan. The credit providers will normally request the farmer to supply detailed business plans, projected cashflows and machinery investment plans before approving provision of the finance.

Credit providers or leasing companies should have a service available to assist farmers in the formulation of their investment and business plans. If a high risk element exists (such as for small farms, low collateral, marginal profitability etc), then a suitable role for development agencies might be to take over the underwriting of this higher risk. For example, this might be made applicable to marginal agricultural areas.

Despite the overall need for credit for increased mechanization, as a general rule, credit should not be made available exclusively for farm machinery nor should special conditions be made available. Targeted support for particular inputs and investments results in distortions in the agricultural economy and particularly in the rural labour situation.

Subsidies and price support

Subsidies and price support for the agricultural sector are common in many countries in the world. If countries decide to use subsidies to increase levels of mechanization, then their purpose and time limitations should be clearly stated and understood. Subsidies for capital investments for specific technologies (e.g. providing subsidies or preferential interest rates for tractors) should be avoided because it removes from the farmer his ability to choose the type and level of investment best suited for his needs. In their absence, the choice of machine rests under the farmer's control and there will be no other external factors to influence their decisions (e.g. to purchase a particular type of machine or technology with financial incentives rather than directly for pure business reasons).

Subsidies that stay in place for a long time tend to become regarded as an entitlement by the beneficiaries. Subsidies also distort the market. Hastily applied and hastily lifted subsidies also disrupt and distort markets for farm machinery and make financial planning by farmers, dealers and manufacturers very difficult.

3.3.2 Capacity building

The profitable use of agricultural machinery and equipment is influenced by how well it is set up, managed, and operated. Bad quality of agricultural operations results in lower levels of production. In some cases wrong selection and use of machinery can lead to a negative impact on the environment and in particular on the soil. It is recognised that a lack of knowledge and ignorance of the technologies used in agricultural mechanization will generally offset any

expected improvements in farm profitability. This can be overcome by suitable and effective training and education as well as improving the availability of information.

The main aim of educating owners and operators of farm machinery and equipment is to create an awareness of the opportunities that mechanization provides to improve their economic circumstances and their quality of life. This is achieved by improving the levels of knowledge and understanding of the purpose of using machinery as well as training on how to operate it efficiently and safely.

The availability of information related to the performance of equipment is also very important in enabling farmers to make the appropriate choice when selecting and purchasing machinery. Ideally, information and data should be available on equipment which is suitable for local conditions; demonstration or hands-on operation of machinery is an even better solution. It is important that farmers obtain proper impartial advice on options available and the relative merits and drawbacks of those options, be it technical or financial.

Any provision of technical assistance should therefore be at the farmer level. Farmers require advice in all aspects of their activities: agricultural, financial and planning. This may be provided by government services and educational and training institutions or through agricultural banks or other appropriate institutions.

3.3.3 Development of local organizations

Encouraging and facilitating the creation of local organizations among small-scale farmers and small-scale agro processing enterprises is a very effective means of disseminating information on mechanization. Farmers' organizations, which might be informal groups, formal associations, or cooperatives, have two main roles to play in assisting individual farmers with agricultural mechanization issues. First, they can encourage and promote the sharing of machinery among different farm households, enabling individual households to use machinery and equipment which is beyond each individual's capacity to buy. However, the mechanisms for successful joint use of machinery are often complex and often rely on the existence of traditions of sharing and assisting in the particular community.

For the sharing of machinery and equipment to be successful, the beneficiaries must be able to agree on who is responsible for its operation and maintenance and how this is to be paid for in an equitable manner. This is often only possible within small informal but close-knit groups. Secondly, the uptake of machinery and equipment technologies can be facilitated by making extension work more effective through working with groups rather than individuals. The main problem here is that all members of the group must be interested in the topic under consideration and hence be at a similar level of development. Since farmers' organizations are usually quite diverse, it may be

more efficient to work with informal groups. In general though, this is not as effective or efficient as the provision of specialized services by private rental providers.

Technical assistance should be oriented towards the creation of farmer's institutions. In many countries farmers have created informal associations which provide services to their members and also lobby their own governments on matters of farming interest. Governments should encourage this as it creates a means of dialogue. It seems that they may be more successful if they are created and organized through initiatives by farmers themselves.

3.4 INCREASING AND DIVERSIFYING THE SUPPLY OF AGRICULTURAL MACHINERY

All components in the agricultural machinery supply system are inter-connected (Figure 3.2). The different components are manufacture, import, distribution, retailing, spare parts, service, and repair. The development of this supply chain depends on many factors, some of which are specific to each component and others which are common to the whole system.

3.4.1 The manufacturing level

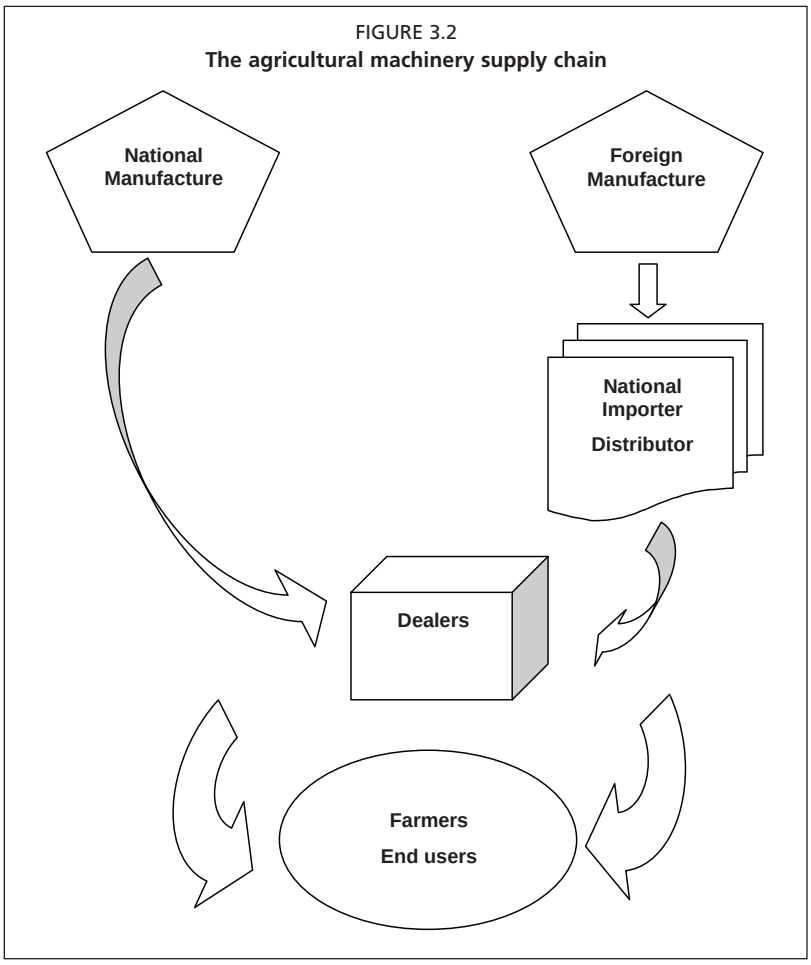
Depending upon local skill levels, domestic manufacturers may be able to produce a wide range of agriculture tools, machinery, and equipment. This may range from hand tools, draught animal equipment, tractor implements, threshers, and processing machinery. Tractors are mostly only produced in industrial countries but sometimes countries have an assembly plant and import "kits" of parts for assembly. Sometimes, selected parts are also produced locally for the tractors. In most developing countries a mix of domestic manufacturing and importation is usually found. There are many types and sizes of businesses found which range from artisans making tools through to large companies manufacturing on a large scale.

The public sector is not generally very efficient at manufacturing and in most countries this is carried out by the private sector. It is therefore important for governments to create conditions to encourage and allow the development of the private sector manufacturing businesses. Market conditions, particularly the profitability of agriculture, will determine the extent and technical level of the industry.

Manufacturers of machinery and equipment cannot produce quality products unless they have access to a reliable supply of quality raw material at competitive stable prices. They also require good communications, and contacts with potential overseas partners (including companies that are willing to grant manufacturing licenses), access to market information, and assistance with product research and development.

In some countries, domestic manufacturers have developed their production capacity by entering into joint ventures with foreign companies. This represents a compromise between 100 percent domestic manufacture and the importation

FIGURE 3.2
The agricultural machinery supply chain



of complete machines. The contribution of the international partner to a joint venture may vary widely but nearly always includes a technical component.

The availability of finance is also generally required for start-up capital, as well as to finance cash flow and stocking levels. Collateral requirements should be as flexible as possible to encourage manufacturers to take risks in starting up a business. Development agencies may be able to assist in these business development programmes particularly by underwriting risk taken by private banks and financing institutions. Access to foreign exchange will be required on a regular and constant basis for the importation of raw materials and whole goods.

Skills required for manufacturing will range from technical skills to financial and business skills. Technical assistance and advice, particularly for businesses should be wide reaching, and cover not only technical aspects but also requirements for financial and business planning, marketing, stock control, book-keeping, contracts and making contacts for the formation of

joint ventures and manufacturing agreements. Technical skills are especially important in cases where the machinery being manufactured needs greater precision in the manufacturing process. Education and training are vital and they must include all actors from different levels of manufacturing from village artisans or blacksmiths to large scale industries.

3.4.2 Importation

Traditionally, importers of farm machinery have been companies that are the officially franchised representatives of overseas manufacturing companies. These franchised companies have sole representational rights for the products they import and sell. They often have a country wide network of dealers which may be owned by them or within which the dealers remain independent. They also import and stock spare parts as well as providing service and repair facilities (Figure 3.2).

More recently import agencies have entered the farm machinery import market. These companies are general trading companies which have no special expertise in farm machinery. They simply import a batch of machines that they then sell; alternatively they may import on behalf of other people or on-sell to other retailers.

The traditional importer/distributor provides a very valuable service but, in order to flourish and to be able to offer a comprehensive package, they require a suitable, stable, competitive, commercial environment in which to develop and carry on their businesses. This will include a stable market in which to sell their products, access to foreign exchange at undistorted rates, foreign contacts, and removal of any unfair competition from the public sector. In newly developing markets, these companies may also require access to business and marketing development assistance, access to credit for business and cash flow development.

Any external or government assistance for financing farm machinery, tools or equipment, is best channelled through a distributor/dealer network and not by direct importation or tendering by government or state owned banks or other public sector organizations. Importers should be allowed free and undistorted access to markets. This will create a stable, competitive market and create a situation in which the domestic manufacturing industry will be stimulated to produce quality and functionally advanced machinery and tools at competitive prices. This will ensure a greater choice for farmers

At the end of this supply chain are the dealers (retailers) who interact directly with the farmers. The dealers are an important component in the supply chain because they form the crucial link between the manufacturer and farmer. The farm machinery dealership is the place where the farmers can go to and see what is on offer and where they are able to buy at least some of the tools and machines they need to carry out their farming operations. Dealers might be expected to keep stocks of spare parts, and provide service and repair facilities.

An ideal farm machinery market situation is where farmers have a wide choice of makes and models of machines at competitive prices and within easy reach. Farmers need to see and inspect tools and machinery that they are thinking of purchasing and also obtain information by discussing their merits with dealers and other farmers. The second important feature of the distribution system is the range and mix of goods each dealer sells. Ideally, each dealer would wish to offer customers a complete service including a wide range of tools, implements, and equipment to satisfy all operational needs.

Although sales of machines (so called "whole goods") is a vital function of the dealer, the provision of after-sales service, and particularly sales of spare parts, are often equally or more important from the point of view of revenue and profit. It may be more appropriate, therefore, to view the dealer's role as marketing a range of mechanization inputs including support services and technical advice as well as machines.

Dealers are important participants in the information cycle that includes market research and the dissemination of product knowledge. They regularly have the task of introducing new models of machines, using demonstrations and advertising as marketing techniques. They participate in shows where the most up-to-date machines are displayed. In the process of expanding the use of agricultural mechanization, the machinery dealers have to assume a vital role in training farmers to appreciate modern technology as well as persuading them to buy the machines and use them properly.

Dealers can also supply credit for sales of their products (so-called "supplier credit"). This is a very effective method of making credit available because the dealer is part of the local community and therefore often knows the financial situation of his clients and is able to judge whether a particular client is credit worthy. The dealer may also be better placed to collect credit repayments.

It is for this reason that the role and function of dealers needs to be supported and expanded. In general, the skills required are of two kinds. Firstly, general business skills are needed which can be learned through formal training or through experience gained. Secondly, specific skills and knowledge related to farm machinery are needed. Skills of various types are needed according to the functions to be carried out:

- sales staff need in-depth knowledge of the products they are selling as well as management and sales skills;
- parts staff need skills in the identification and function of parts systems; in judging patterns of consumption and in storage and retrieval techniques; and
- service staff need skills in machine assembly, repair, and adjustment and in diagnosing faults.

3.4.3 Machinery contract hire

Hire services offer an affordable and cost-effective means for farmers to obtain the use of farm machinery and equipment. Hire services usually come in two forms; farmer to farmer services where a farmer will assist a

neighbour; and, services offered by a specialized contracting company where machine hire is the main business. The most commonly offered services are for land preparation, crop sowing and planting, threshing and for post harvest operations. For owners, machinery hire also offers a way to increase cash income and to reduce the costs of ownership. Hire service constitutes another way to increase agricultural mechanization demand and, when it is well organized, it can also provide a form of technical assistance for farmers.

Machine hire services in the private sector should be encouraged and supported by governments. In doing so the following factors should be taken into account:

- Legislation which regulates the business relationship between hire service providers and farmers;
- Profitability of hire service operations;
- Technical and management skills of hire service providers.

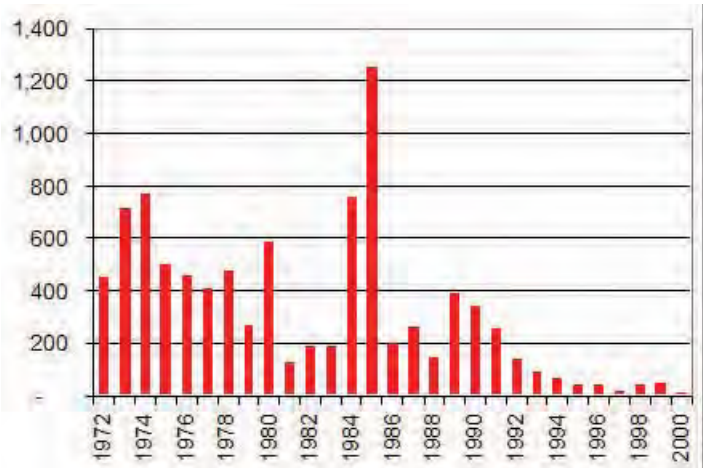
3.5 CREATING AN ENABLING BUSINESS ENVIRONMENT

An enabling business environment is an essential requirement for the development and expansion of the mechanization sub-sector. Improving the business environment must cover all stakeholders involved in agricultural mechanization. It is brought about by putting in place an enabling mix of the different policies that directly or indirectly affect the sub-sector. At farmer level, improving their income also requires an enabling environment through appropriate taxation and pricing for agricultural products. For the agricultural machinery sub sector, a favourable environment is one which allows the creation of a free market based on fair and undistorted competition in which transaction costs can be kept low. In this context, improving governance is imperative.

3.5.1 Exchange rates

Policies relating to exchange rates have traditionally been set by governments to address much wider objectives than just promoting or discouraging mechanization. Prior to the implementation of structural adjustment programmes carried out by many governments in the 1980's exchange rates were fixed or pegged to the US dollar (see also Chapter 2). Some governments set multiple exchange rates to encourage certain imports at the same time as discouraging others. These exchange rate policies had the effect of causing shortages in foreign exchange, which were then addressed by some form of rationing. This situation, which had been in place for many years, had led to relatively low import prices and high export prices. After the structural reform process, exchange rates were allowed to float. This led to a massive devaluation of many currencies. One of the effects of this was a drastic increase in the cost of agricultural inputs including agricultural machinery. This led to greatly reduced imports of tractors and farm machinery in most countries (see Figure 3.3).

FIGURE 3.3
Tanzania - Imports of tractors



Source: FAO 2004 – Unpublished Internal Report: AGSE – Tanzania - Imports of tractors

In most countries now, foreign currency is freely available with exchange rates governed by demand. In some cases, though, governments maintained partial control over exchange rates by transferring control of exchange rates to the central bank, which is then charged with controlling inflation. Relaxation of exchange rate control caused rapid initial devaluation, but invariably resulted in improvement to the utilization of resources.

3.5.2 Price intervention

Price intervention generally occurs in three main policy areas: agricultural inputs; agricultural market prices; and agricultural credit and finance.

a. Agricultural input prices

The costs of inputs influence farmers purchasing decisions. Governments should be continually aware of the profitability of farming and how this affects farmers' decisions on investment both in capital and seasonal inputs. The existence of market information systems for farmers is essential for this.

Policies which affect agricultural input prices are one of the most effective means of influencing the direction and pace of agricultural mechanization. For example, where wages are increasing rapidly relative to the prices of other inputs, changes in relative prices can induce labour-saving mechanization. Governments can influence this process (known as "induced mechanical innovation") by promoting policies that change the relative cost of labour to mechanization and thus affects the rate of mechanization.

b. Agricultural product prices

Farm households may respond to short-term movements in the prices of agricultural commodities by altering the proportions in which they use labour and capital (machinery and equipment). For example, a relative increase in the price of an output whose production process is relatively capital intensive may lead to increased production and hence increased use of capital relative to labour. Long-term trends in agricultural output prices can encourage changes in the input mix between labour and capital by making the adoption of labour-saving mechanical innovations more profitable.

Long-term trends in agricultural output prices can also influence mechanical innovations. An increase in the price of a crop encourages farmers to adopt output-increasing innovations for the production of that crop. These may include mechanical innovations, which typically affect both input and output levels.

Long-run increases in agricultural commodity prices can also influence the intensity of production. Increases in commodity prices reflect the interaction of supply and demand factors that are major determinants of the intensity of land use. As previously indicated, there is a clear link between the cost of labour and the adoption of mechanized technologies, and hence one might expect to find an association between intensification and mechanization.

c. Financial markets

Governments have often attempted to encourage farmer investment in machinery and equipment by intervening in credit and finance markets. The most common types of interventions have been:

- Subsidies for agricultural credit (subsidized interest rates, long repayment period, low or zero down-payments)
- Targeting of credit for specific groups (e.g. poor farmers).

These interventions are rarely effective or sustainable. Subsidizing agricultural credit generally results in its rationing, with beneficiaries re-allocating expenditures so as to take the greatest advantage of low interest rates. In such situations, the larger, more economically, socially, and politically powerful farmers have been better able to obtain credit, with poorer, smaller farmers missing out, despite the oft stated aim of targeting the credit to the latter. Where poor farmers have been able to receive credit through targeting, it has often been provided in an inflexible manner which leads to high transaction costs which dwarf the interest payments and can actually discourage investment in mechanical technologies.

3.5.3 Policies on land tenure

One of the critical constraints relating to agricultural mechanization is the extent to which uncertainties about land tenure hold back investment. The issue of ownership rights of land can have a major impact on investment in

mechanization. This is irrespective of whether machinery is owned or rented since land is widely used as collateral for the provision of credit. Security of tenure gives farmers the confidence to invest and make commitments and leads to increased farm output. Emphasis should be given to creating conditions whereby it is possible for any person, company, or group of individuals to create and develop a farm business. It is vitally important that farmers have sole title to their land and property so that they feel secure.

3.5.4 Infrastructure policy

The level of development of the farming infrastructures (roads, water supply, communications, markets etc.) has a great effect on the level of agricultural activity. Therefore policy on rural infrastructure has an influence on the expansion in the use of farm mechanization. However, investment in infrastructures can only be justified if potential for generating returns from agricultural production exists.

Rural transport and marketing infrastructure

Rural infrastructure policy influences agricultural mechanization in three principal ways:

- through its effect on mechanized transport and motive power;
- through its impact on the level and state of rural infrastructure. This determines the accessibility farmers have to support services, especially in remote areas;
- through the development of infrastructure for the marketing of agricultural products thus making commercial agricultural production more profitable.

In many countries the existence of major constraints related to increased agricultural production can be noted. Lack of storage facilities, poor inter-urban roads and rural roads and the associated lack of transport vehicles mean that many agricultural areas are effectively isolated. As a consequence many markets remain under-developed.

Irrigation infrastructure

Government policies on investment in large scale irrigation have implications for the use of machinery and equipment in the agricultural sector, both in the construction and maintenance of infrastructure but also at the production level. The development of irrigation infrastructure leads to increased levels of production which opens up the possibility to invest in mechanization. Effective and efficient operation of machinery and equipment can also have a major impact on water use. This combined with other complementary inputs such as high-yielding varieties, fertilizers and chemicals will raise levels of farm production. On the negative side, machinery and equipment use in irrigation systems can present ecological dangers, both direct and indirect. Careless use

of earthmoving and other machinery and equipment in the construction of irrigation systems can directly damage the ecosystem. Indirectly, together with the operation of pumps and other on-farm equipment, mechanization encourages levels of agricultural intensification, which unless properly managed can lead to soil degradation and salinity.

Other infrastructure

For mechanization based on animal traction as a source of power markets must exist for access to veterinary services and feedstuff supplies. For tractor based mechanization, fundamental support services such as fuel stations and repair and maintenance shops are required. A convenient and low-cost electricity supply at village level for operations such as pumping and transformation processes is also a vital requirement.

3.6 STRENGTHENING INSTITUTIONAL SUPPORT

The creation of an enabling environment for the development of mechanization will involve the strengthening of many institutions including education and training, extension, research and testing.

3.6.1 Public sector departments of mechanization

Public sector mechanization departments should be primarily responsible for advice to the government on the formulation of mechanization policy and strategy, as well as the planning and oversight of programmes for the development of the sector. Another important function is to be intimately involved with the collection of data and statistics and the dissemination of information. Once an overall strategy has been defined, governments can easily identify components where resources are required and where appropriate outside assistance may be advantageous.

It is suggested that the objectives of a mechanization department should be:

- to ensure an intra-disciplinary engineering approach to public sector technical support for all aspects of engineering in agriculture, including mechanization;
- to improve inter-disciplinary cooperation within the ministry of agriculture;
- to facilitate more effective collaboration with related disciplines in other government organizations and the private sector and;
- to strengthen the understanding of agricultural engineering, of which mechanization is a part, as an important element in rural development.

3.6.2 Research and development

The term "Research and Development" can cover a wide range of activities from fundamental scientific research through to practical machine development and testing. In general, the private sector does not engage in scientific research; it is mainly interested in putting on the market new or improved products to increase their business activities.

By the same token, it is now generally accepted that the public sector is not very suitable for either developing machines or marketing them. It is thus better for the private sector to carry out machine development as it will have a more focussed approach as well as direct knowledge and understanding of (a) its clientele and (b) its own capabilities with regard to production technology and costs.

Scientific research on the other hand is generally carried out in the public sector, sometimes with funding from the private sector, and is carried out in universities or in government research institutions. Whether governments become involved in these activities is a question for them to individually prioritize and decide upon. However, in some instances, because research and development is expensive and requires skills and expertise which may not be affordable by developing businesses, it may be advisable for governments and the private sector to cooperate in order to ensure that activities are closely linked to the identification of markets and subsequent manufacture.

The technical expertise required for production should be placed in the company itself. It is not appropriate for the public sector to run development workshops because they tend to become isolated and have little connection to the private sector or the market.

3.6.3 Testing

Testing of farm machinery is a controversial subject. The main issue is whether testing serves any useful purpose and whether testing programmes adversely affect the free development of the private sector and thereby restrict choice for farmers. Testing programmes are undertaken with the professed intention of protecting the end-user. In most case the outputs of testing and evaluation centres have been of little practical value to farmers.

The standards and testing procedures used are often taken over from industrialized countries and have little or no relevance to the local end–user. The testing institution often ends up by repeating tests already carried out or setting their standards so high that locally manufactured machinery and equipment is disadvantaged.

In deciding whether to carry out testing and evaluation, the requirements of the various clients should be taken into account; often those requirements are very diverse and therefore, when if consideration is being given to introducing or continuing with a testing and evaluation program, it is crucial to establish its purpose, its cost effectiveness, and to understand the requirements of the different clients.

3.6.4 Extension

Extension has traditionally been considered to be a function of the public sector. However, it is now being recognized that many governments do not have the resources to provide free extension services to all farmers and that government schemes may not be the most effective in providing these services.

While the solution in many developed countries has been to introduce charging for advice to farmers, a more workable approach may be to pass the extension role to the private and NGO sector (non-government organizations).

Agricultural extension, when carried out by the public sector, should operate in collaboration with institutes and private sector companies involved in mechanization. This requires the existence or establishment of an effective research-extension link. Education and training have key roles to play in promoting these linkages.

3.6.5 Education and training

Governments may well find it advantageous to develop integrated education, training, and extension programmes. The type and level of education and training will need to be geared towards both the requirements of the farming sector as well as the agricultural manufacturing and production sectors.

Skills development training might best be based on a supervised, hands-on practical approach in which trainees learn by doing. The instructor should be able to demonstrate the skills they are teaching and also be a master-craftsman. This requirement may seem obvious but observations in many countries shows that some instructors attempt to teach skills by telling rather than doing – this is usually because they are inadequately trained themselves or the Centres lack the resources necessary to purchase practical teaching aids. Effective education and training programmes improve the skills and knowledge of people who manufacture, market, service and use agricultural machinery and equipment, as well as those who formulate policies relating to these activities.

A final item requiring mention is the training of trainers. There is growing recognition that few countries have the capacity to provide all of the training required, and that reliance on foreign or local experts for low-level training is a particularly expensive option. Hence there is a need to train local staff as trainers who will subsequently provide training to a broader audience. This "Training of Trainers" is best carried out in the form of short, practical courses.

CHAPTER 4

Strategy formulation: Process and tools

4.1 INTRODUCTION

When carrying out the formulation of an agricultural mechanization strategy, the methodology to be used is very important. Strategy formulation is a complex activity which requires inputs from people of many different disciplines and organizations. In particular, participatory and multidisciplinary approaches will have to be adopted. The process and procedures for strategy formulation have been developed and refined over the last two decades. The staff of the Agricultural Engineering Service of FAO have taken a leading role in these developments and during this time much experience and information has been gathered.

In order to fulfil the current requirements of agricultural mechanization strategy formulation in widely differing geo-political zones, a wide array of techniques have been developed. These facilitate the generation of information in a structured manner, and then set the methodology to work through successive stages from the formulation of the strategy through to its implementation and follow-up. An important part of this process is the development of paths of communication between the different stakeholders at all stages. Dialogue between the different partners is facilitated by the standardization of work methods.

4.2 PRE-CONDITIONS FOR THE FORMULATION OF A MECHANIZATION STRATEGY

Prior to a decision being taken to carry out a strategy formulation, it is necessary to define the conditions which should initially be in place. Firstly, the reason and need for the strategy formulation must have been expressed at the political level. The broader agricultural community and industry have to be convinced that its formulation is necessary and that they understand that their participation in a full and open exchange of views will be crucial at all stages of the process.

A broad consensus has to be reached that the development of the agricultural sector is hindered by bottlenecks and constraints that exist within the agricultural mechanization sub-sector. This consensus should ensure the

FIGURE 4.1
Main steps in a strategy project

commitment and adherence of all partners and lead to a greater chance of success for the project as well as the later implementation of the strategy. The availability of experienced and qualified personnel as well as sufficient resources is also a pre-requisite. It must also be kept in mind at all stages that the strategy to be formulated should be relevant to the needs of agriculture and the country as a whole.

4.3 STEPS TO BE TAKEN

The formulation of a typical strategy is comprised of several steps. The first step is the **preparation** of a detailed work plan. The second is to undertake a **detailed analysis** of the existing national situation. This will include an up-to-date assessment of the existing level of mechanization, as well as a detailed record of domestic manufacturing and assembly. Chapter 5 gives further details on the inputs required.

The third step is to **define strategic goals** and objectives and to identify and prioritize issues that will impact on the implementation of the strategy. The result should be a strategy document that defines an overall plan to move from the existing situation to one in the future which will let mechanization contribute to greater agricultural output as well as providing better livelihoods for farmers and other players in the sector. This is dealt with in more detail in Chapter 6.

Finally, the fourth step is to **establish a plan of action**. This plan should clearly define follow-up actions and activities which will provide policy makers, planners, and implementers with a "road-map" for implementation of the strategy. The follow-up activities will generally consist of policy adjustments to correct distortions in the sub-sector and to create a favourable business and farming environment, as well as investment plans to promote the development of manufacturing, commercial companies and farm mechanization. Finally,

realistic and realizable government actions and activities required for the development of the sub-sector will be defined.

4.4 PREPARATION

In order to ensure a successful outcome, thorough preparation is crucial before actually commencing. Experience has shown that the procedure for the preparation of an AMS cannot precisely follow a "blueprint" approach. The process is evolutionary and progresses through a number of stages, the exact number and content of which will vary depending on local circumstances and conditions prevailing in the country in question. The objective at this stage is to secure a common understanding, agreement as to what will be undertaken and achieved, and to obtain a commitment for the resources required.

The institutional location of the project will need to be decided; the team to carry out the formulation should be established; a steering committee appointed; funds allocated; and an AMS project plan of action drawn up. The organization of the preparation will usually determine the degree of commitment of the various players including government. A luke-warm or even lack of commitment means that insufficient priority exists to carry out such a strategy formulation.

During this preparation, an important step is to call together the various players for a workshop so that face-to-face discussions can take place and commitments made. The aim of the workshop should be to inform all participants about the issues involved in developing a strategy and the methodology which will be adopted during process.

4.4.1 Institutional location

The first issue to decide is who will take the lead role. This is generally undertaken by a sector planning unit which usually exists within ministries of agriculture, or else by a similar unit elsewhere in government. This planning unit is usually the most appropriate one because they generally have appropriate analytical skills as well as the responsibility to address policy and institutional reform matters. Experience has shown that technical universities, engineering departments, and institutes are not usually suitable because of their primary technical orientation and possible vested interest.

4.4.2 Designation of a Project Coordinator

A project coordinator must be designated, usually an official within the Ministry of Agriculture or Rural Development. This person will play a vital role in ensuring the success of the strategy formulation and should have a broad experience of agricultural mechanization at a national and preferably at an international level. An intimate knowledge of the organization and function of the government is required particularly in respect to national programmes and projects. An essential task will be to coordinate all of the activities of the formulation team. The technical knowledge and active participation and

contribution of the coordinator will be crucial in order to provide advice and guidance for the project team.

4.4.3 Establishment of a Project Team

Formulators of an AMS should take a holistic approach. This means that not only the manufacture, distribution and operation of all types of tools, implements, machines and equipment, farm production, harvesting and post-harvest activities should be covered, but also agricultural production systems, economics, and sociological aspects. Hence a multidisciplinary team will need to be put together. The process should not be driven solely by one discipline such as agricultural engineers or agricultural economists; it needs a multidisciplinary team with analytical skills and experience in macro and micro economics, farming systems, agricultural engineering, manufacturing, business and enterprise development, policy and institutional reviews, and the private sector. The number in the team may well range from two key staff (ideally an agricultural engineer and an agricultural economist supported by a series of specialist short term inputs), to four to six members providing comprehensive coverage of the key areas of expertise.

The project team should be supervised by the national coordinator and a chief of mission who must have a broad vision and knowledge of agricultural mechanization projects, including experience of AMS formulation. Each consultant should be recruited according to individual specific terms of reference. These terms could include the following:

- Collection and analysis of information on the particular discipline based on an established methodology. The methodology could be based in essence on the elements of analysis presented in this guide;
- Participation in workshops organized at the different phases of the project. Consultants should adopt an advisory role as well as analysing and reporting on the information collected.

The role of the mission leader will be to:

- Coordinate, advise and instruct the consultants on their respective tasks based on the methodology adopted for the project;
- Organize workshops and meetings at the various stages of the project;
- Write the main report and supervise and provide inputs for the specialist reports;
- Organize the dissemination of the results and outputs of the strategy formulation.

Each consultant will carry out a work programme according to their expertise, however, because of the holistic approach and the resulting overlapping between many of the subjects covered, a coordinated approach must be adopted. This can be achieved through the holding of regular

meetings to exchange information. This will avoid consultants taking up conflicting positions.

4.4.4 Elaboration of a Project Plan of Action

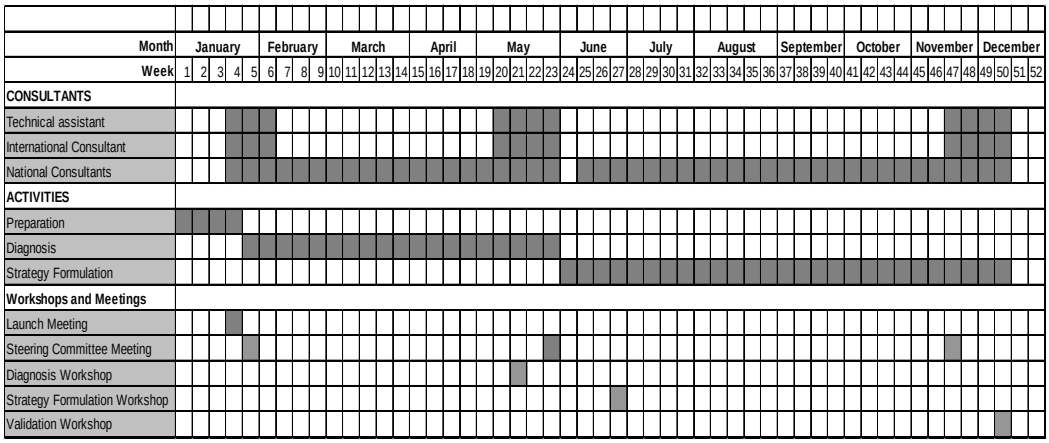
An agricultural mechanization strategy formulation should be conducted according to a clear and pre-established work plan. An outline of such a plan which should define the different phases of the project is shown in Figure 4.2. It should specify:

- Periods corresponding to the different activities of the project;
- Periods of organization and timing of the different events of the project such as workshops, meetings and deadlines for the production of reports;
- Recruitment and periods of work of the various consultants.

Account must be taken of the availability of the different participants in the project. For example, it is very difficult to invite farmers to attend workshops during the peak periods. It is also essential to take into account the different national and cultural dates such as national and religious holidays, and political events (elections) that sometimes can disrupt the activities of the project team.

In a general document such as this, it is very difficult to state with accuracy the duration of such an agricultural mechanization strategy formulation project. This will vary from one country to another and will depend on the availability of the different partners and the availability of related data as well as seasonal factors. It is, however, difficult to complete such a project in less than a year.

FIGURE 4.2
Example of a work plan



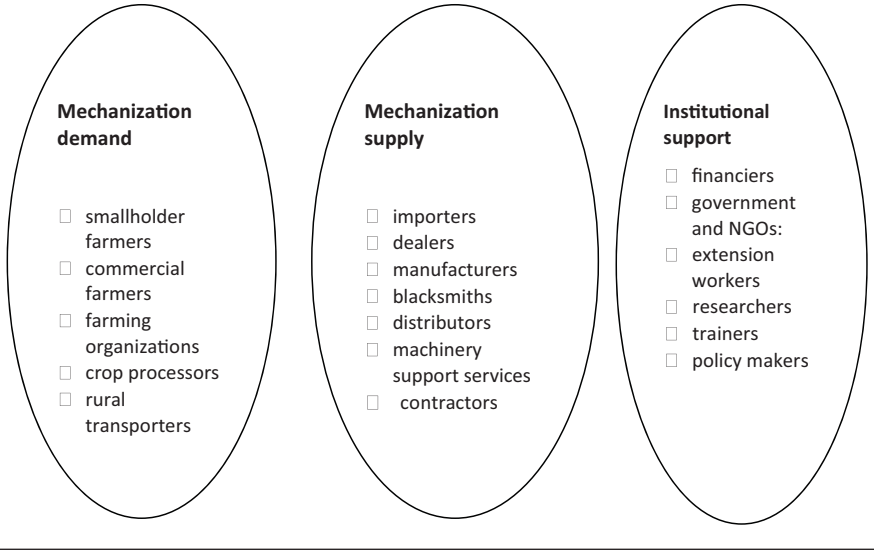
4.4.5 Stakeholder analysis

Agricultural mechanization strategy is a complex matter requiring the cooperation of several diverse groups of people as well as the involvement of

many diverse organizations. Their interests and their potential to contribute as well as their shortcomings and other features should be taken into consideration at the conception phase as well as during implementation of the project.

Each of the individual stakeholders should be identified beforehand. This can be achieved though a stakeholder analysis. This technique consists of defining categories of actors and studying their relation to agricultural mechanization. Criteria for the categorization of different groups must be adopted. This will help to define the partners of the project who will be consulted at the different phases and different activities of the project.

FIGURE 4.3
AMS Stakeholders



Generally, the stakeholders in the formulation of an AMS cover a broad cross-section of the agricultural, industrial, and institutional community, both in terms of their activities and size of businesses. These stakeholders may be categorized into three groups defined by their involvement in agricultural mechanization - Mechanization demand, Mechanization supply, and Institutional support (Figure 4.3). The strategy should be prepared in close association with these groups and the process will only be effective if there is consensus and commitment amongst the stakeholders to act upon the findings.

Secondly, it is essential to establish a steering committee whose members are from the different stakeholder groups. This committee will have the responsibility for overseeing the project and is generally made up of senior representatives from relevant ministries, such as agriculture and industry,

together with the private sector. The committee will also provide a vital link between strategy formulation and the subsequent implementation.

4.5 INFORMATION COLLECTION AND ANALYSIS

Information collection is one of the most important tasks in the formulation of a strategy. Information forms the basis for the resulting outputs and recommendations. However, at the beginning of the project, it is important to select the type of information to be collected. It is inefficient to collect information that will not be useful. The experts in the team should collect information related to their own particular area of expertise. It is also important that the collection methodology is appropriate where the overriding objective is to collect sufficient and relevant information to prepare a strategy within a reasonable period of time.

In the formulation of mechanization strategy, the objectives of information collection are aimed at understanding:

- the present situation in respect of what is being done, why it is done in a particular way and what results are being obtained;
- the potential and desire for improving the present situation, based on the project team knowledge of what others in similar circumstances are achieving and what the respondent sees as a development goal; and
- the constraints on achieving potential improvement as seen by the people directly involved in the activity, by the members of the project team, or as related to factors outside the respondent's control.

In order to identify and understand the needs of the farming and manufacturing sectors in more detail, it is necessary to work with those communities. While there will generally be insufficient time to conduct a full and detailed survey, informal data collection methods such as Rapid Rural Appraisal (RRA) techniques can be very effective. The sampling frame should cover all major classifications, particularly within the farming and manufacturing sectors.

4.5.1 Review of existing information

Collection of information is a continuous activity:

- In the initial phase, the information collected will largely be used to identify the present situation of mechanization, to identify the main issues and to give an indication of the potential benefits of expanding agricultural mechanization;
- At the formulation phase, the information will be used to define a realistic future situation to which the implementation of the strategy will lead.

For practical purposes, information can be classified as primary or secondary. Primary information is derived from national statistics as well as the results of formal tests or trials carried out in the country. This information

can be taken as reliable because it is normally generated using scientific methods. Secondary information is derived from published and unpublished sources such as reports, records, maps, or censuses which have been produced for other purposes. This information should be screened and where possible, double checked, and an assessment made of its reliability. The use of such material must be used with caution. Similarly, anecdotal information needs to be treated with extreme caution and double checked where possible.

The collection of information will only be worth the effort if it contributes to the overall analysis and outcomes. Unfortunately it is not always possible to judge how useful information will be before it has been collected. This leads to a great deal of information being collected much of which may never be used. It is therefore important that the team leadership is always in touch with the team so that there is a continual review of information collection. This should avoid the situation where excessive amounts of information are collected by individual team members and which leads to inefficient utilization of the time resources available. This is especially important in a multidisciplinary team, where there is the risk that each consultant concentrates on their own work area to the exclusion of the overall objectives of the project.

The starting point is the collection and review of existing information, for example, from government departments, research organizations, national associations, and NGOs. This secondary data will give an overview of the broad parameters within which the mechanization sub-sector operates. It is rare to find a single source of all the information required. Also, information that is 100 percent complete and reliable does not generally exist - even in the most advanced countries of the world. Therefore, an overall picture must be put together by critically selecting, cross checking and combining different bits of information so that it becomes progressively more complete and reliable.

The first step is to make an inventory of potential relevant sources of information. Typical sources will be institutions, government departments, private companies, aid organizations, NGOs, banks, farmer's associations, universities and interviews and discussions with knowledgeable individuals. Among the problems that often arise for a project team is the question of reliability of the information. Time must therefore be spent on verifying this reliability with crosschecks and comparisons with several different sources when possible.

4.5.2 Field Visits

The second step in information collection is the carrying out of field visits. This activity must be preceded by the preparation of a field action plan by the project team that shows clearly what, where, when, and by whom action will be carried out. The key element in the plan is the delineation of zones. This means the division of the country into zones or areas each having similar

agricultural characteristics. Field visits should be carried out as an 'Exploratory Diagnosis'. This is an informal approach derived from the well known Rapid Rural Appraisal (RRA) method of farming systems investigation. This method recognizes and respects local knowledge but at the same time combines modern knowledge with it. Information collected through RRA is used as a guide for action based on a community approach to problem solving. This method is straightforward, flexible, and cost effective and consists of two basic activities:

(a) Direct observation and measurement

This is an absolute requirement for collecting information for a strategy project. It provides an overview of particular systems or sub-systems and provides an overview as well as an insight into existing constraints and development potential within that system. These aspects are varied but will probably include:

- The state of the machinery used by the farmers (source, type of equipment, service and maintenance) and its field use (conditions of work, operator skill, output, end-results),
- Manufacture of farm machinery and equipment (technological level, scale of production, skills, manufactured equipment, business environment, availability of raw materials)
- Existence and state of repair shops (scale of operations, skill and knowledge levels, equipment used, source of spare parts and other supplies, business environment)
- Suppliers of farm equipment (staff skills, infrastructure, management of spare parts).
- Education and training (technical level, facilities, effectiveness, availability).

The main shortcomings of direct observation and measurement are that quantification is difficult and the opinions of the people involved are not always easily obtained or reliable.

(b) Informal interviews

To overcome the shortcomings of direct observation and measurement as well as to obtain a fuller picture, informal interviews with all the concerned players must be carried out. The interviews should be semi-structured, and checklists and lists of questions should be prepared in advance. Most of the questions should be designed to encourage respondents to freely discuss specific topics in their own words. Questions that can be answered with a simple "Yes" or "No" should be avoided. The main objective is to gain a feeling for attitudes, customs, ideas, and opinions and so questions should be formulated so that persons being interviewed provide their own actual knowledge and opinions. One of the most important qualifications of an interviewer is the ability to

listen. If this ability is not well developed then there is the danger that the information collected may be subtly biased towards the interviewer's ideas and opinions rather than those of the respondent.

4.5.3 Information Analysis

After the information required has been collected, it will need to be analyzed so that conclusions can be drawn as to what can and should be done to ensure an appropriate role for agricultural mechanization in the country's development programme. The analysis should be presented in such a manner so that it provides a clear overview of the main aspects in the national mechanization strategy:

- Demand for agricultural mechanization;
- The supply chain for agricultural machinery, tools and equipment; and
- Institutional support.

It is beyond the scope of this guide to cover the methodology concerning how information should be analysed in detail. Making sense of the information collected for strategy formulation is generally not a precise science; rather it depends on the judgement and experience of the involved persons. In general, the information obtained will be unsuitable for a full statistical analysis and even if it were, most mechanization strategy teams do not have the resources to include a statistics specialist. Also the set time frame for the project would prevent the carrying out of such an analysis. For the most part, a common sense approach to the information based on experience is all that will be necessary. A critical point though is that data should be presented in a clear and easily understood manner. Formal data collection and analysis should be planned as part of the activities instigated during strategy implementation.

The analysis carried out should aim at identifying simple structures and patterns in the information collected and should assemble and present the information according to important variables such as distinct groups of farmers, machinery manufacturers, institutional support entities, and development objectives and policies. Farmers for example could be grouped according to farm size, the level of mechanization technology used, and types of crops grown, and so on. Manufacturers could be grouped according to number of employees or the type and quantity of tools or equipment produced. Support institutions may be grouped according to the type of activities and support provided (e.g. credit, research, extension, education, and training).

The analyses will seek to identify constraints and opportunities related to the farmers' objectives and to national development objectives, goals, and policies. For example, one of the main constraints for emerging farmers is likely to be the lack of farm power. One opportunity or alternative for overcoming that constraint might be the use of tractors but, this choice could well conflict with overall national development policies as reflected in

planned allocation of financial resources. The project team task will be to first identify the constraints and then make a judgment based on complimentary information as to the appropriate means of overcoming the constraint.

4.6 PARTICIPATORY WORKSHOPS AND OTHER MEANS

4.6.1 Workshop principles

One of the advantages of participatory workshops is the positive involvement of all of those attending. These workshops should be presided over by a professional chairperson (the Moderator); an expert who coordinates and promotes discussion while maintaining a neutral position. Each participant is required to write his or her idea on a card, which is then posted on a board. All participants can then read each others ideas and then participate in the analysis as a team. At the workshop the project team members should play a very important role as advisers, each according to their own particular expertise.

Participatory workshops are useful not only to seek the views and opinions of stakeholders but also to discuss information and data and to make a contribution to the final outcomes of the strategy. Within these workshops, other tools such as SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) and log-frame analysis are commonly used as they offer the advantage of being flexible and can be adapted to a wide array of situations. They have been developed and refined by several international organizations as effective tools in carrying out development projects. The use of such tools, however, is not an objective in itself and its success depends on several factors such as the quality of participants, the accuracy of the available data and the engagement and commitment of the participants.

These tools contribute to achieving a certain level of standardization in carrying out development projects particularly at the formulation stage as well as for ongoing evaluation and supervision. It does not mean, however, that these methods must always be applied in a rigorous way; they must be adapted to suit the specific circumstances. Some principles are presented below but without much detail as there are already many documents on this subject available.

4.6.2 SWOT[1] analysis

A SWOT analysis is a very powerful, valuable, proven, and effective tool to use in the formulation and evaluation stages of a strategic planning exercise. A SWOT matrix is first created in order to summarize the existing situation and to define objectives. The analysis consists of organizing data into a logical order that assists in an improved process of understanding, presentation, discussion, and decision-making. It permits the analysis of the current situation in terms of Strengths, Weaknesses and identifies external factors as

[1] Strengths, Weaknesses, Opportunities and Threats

Opportunities, and Threats. In some cases, for greater effectiveness, others tools are combined with the SWOT analysis. A SWOT analysis should be carried out as soon as field investigations have been completed. The analysis consists of 3 steps:

(i) Selecting the level of analysis

Generally an analysis such as a strategy formulation is considered to be a sub-sector level activity and therefore an internal factor; country and international levels are considered as external factors. This leads to a split in the participants into three groups: (a) farmers, (b) farm machinery manufacturers and retailers, and (c) institutional.

(ii) Constructing the SWOT matrix

The SWOT matrix should be constructed by discussing, proposing, and analyzing ideas related to each component:.

- Strengths are positives and controllable aspects of the organization, territory, or sector on which one can build the future: availability of natural resources, geographical locations etc.
- Weaknesses are negative but controllable aspects of the organization, territory, or sector, and are to be taken into consideration when a potential for improvements exists.
- Opportunities are possibilities appearing externally and which can be used in the context of the Strengths and Weaknesses.
- Threats are outside obstacles that the organization, territory, or sector faces in trying to accomplish its Strategic Goals.

(iii) Defining strategies

To develop strategies, the most effective way is to combine the information in the SWOT Matrix. It consists of matching external opportunities and threats with internal strengths and weaknesses. This will result in many actions which may be categorized into four possible sets of strategic alternatives.

4.6.3 The log-frame matrix

The log-frame matrix is an analytical tool which can help planners to elaborate a plan to implement a strategy. It aims to:

- establish a logical hierarchy of objectives;
- structure ways and means by which these objectives can be achieved;
- identify the potential risks to achieving the objectives and expected outcomes; and
- establish how outputs and objectives might be monitored, reviewed, and evaluated.

A log-frame matrix uses data for analysis steps (SWOT analysis) to establish a very simple frame presenting the main ideas related to the strategy.

The analysis covers Objectives, Objectively Verifiable Indicators (OVI), Sources of Verification (SV), and Assumptions.

As far as possible, the OVIs should be quantifiable in clear units of measurement (SMART: Specific, Measurable, Achievable, Relevant and Time-bound) while the SVs refer to either primary or secondary sources that could provide data of acceptable quality. With regard to assumptions; the aim is to identify external factors that will affect the success of the strategy.

The construction of a Log-Frame Matrix may be used as a tool and should be commenced during the second workshop (formulating step) and typically completed by the project team working in coordination with the stakeholder groups.

CHAPTER 5

Analysis of the present situation

5.1 INTRODUCTION

In order to formulate a strategy for agricultural mechanization, a detailed overview of the present situation in the sector must first be obtained. This chapter presents an outline of how this might be carried out. To achieve this overview, the sector must be studied in some detail; not just statistical data but also analyses of the policy framework, the economic situation, the business environment, and the agricultural sector and the interactions between them established. The definition of the kind of information that has to be collected, and how it is collected, are the first tasks in the formulation of strategy. This must be very carefully defined at the beginning as unrestricted collection of information is wasteful of both time and resources. The findings and conclusions from this step should not be drawn up solely by the strategy team but from the results and findings of participatory workshops whereby a contribution by all stakeholders is incorporated.

5.2 PRELIMINARY STUDY

It is very difficult to pre-identify a specific set of data that should be collected since this varies according to the country in question. None-the-less, from experience, it can be said that an analysis of the present situation of agricultural mechanization in a country should be focused on the following elements:

- General economic data.
- Agricultural production systems and associated agricultural mechanization;
- Agricultural mechanization supply (manufacturing, importation, distribution, retailing, provision of services);
- Institutional framework.

5.2.1 General data

Agricultural mechanization strategy formulation calls for a general data set which describes the physical, economic, and political environment of the country. This data will provide valuable indicators of the situation regarding mechanization as well as indicators as to the potential for mechanization development and investment. Such information can be utilized during the diagnosis phase as well as later, during the formulation phase of the strategy.

a. Physical environment

Information should be collected on the soil and its importance according to region; climatic and vegetation zones; rainfall and temperature; the moisture holding capacity; fertility, and seasonal variation of the climate throughout the year; length of growing seasons, and the number of available days of field work per month.

b. Demographic data

Population, and the rate of growth of the population, rate as well as population movement data should be collected. Most countries carry out regular censuses that can provide all of the required information. Demographic data provides insights into future population pressures and the effects they are likely to have on the economy and natural resources. For example, a population with a significant proportion of persons under the age of 15 indicates that there will be a rapid expansion of the workforce during the forthcoming ten year period. If this additional labour cannot be employed in farming or other income generating activities in rural areas, many will migrate to the cities. Indeed, this urban drift is already occurring in most sub-Saharan African countries. Young people do not see a future in farming in the way it is presently being carried out i.e. mainly by manual labour. However, as the proportion of the total population residing in urban areas increases, greater demand is placed on the agricultural community to produce marketable surpluses. Indicators reflecting the general health and well-being of the population should also be considered. Increased life expectancy brought about through improved heath, diet and nutrition as well as higher levels of literacy is an indicator of human development and is not always captured by purely economic data. The relevance of the population with regard to agricultural mechanization is in terms of labour availability, productivity, and wage levels. But also literacy, levels of education, and the capacity to accept new ideas and the reluctance to carry out certain types of manual labour, particularly tasks that are particularly arduous such as manual land preparation, should be taken into account.

Information on the total population should be disaggregated by age, sex, and place of residence (rural/urban). Data on population growth rates, projections for the future, life expectancy, nutrition, caloric intake, health, and literacy will also be required. All of this data can be presented in tabular form but, for ease of presentation and interpretation, it may be useful to present the data in the form of diagrams, graphs, and maps.

c. Infrastructure

In this context, the term rural infrastructure includes roads, railways, air transport facilities, telephone and internet connections, buildings, storage facilities, irrigation works, and waterways. The collection of information and data on infrastructure and the assessment of that information constitute a very

important task and will determine if the state of the country's infrastructure is a constraint for the development of agricultural mechanization. The quality and extent of the road network are major factors affecting the adoption and expansion of agricultural mechanization. The road network (and to a lesser extent railways) influences the movements of equipment within the community as well as the provision of services to keep farm machinery and equipment operational. Roads are also essential for rural transport and the movement of inputs and outputs between urban centres as well as to and from rural areas. Air transport constitutes an increasingly vital communication link for human travel in most developing countries but has a lower importance for mechanization than roads and railways. In some cases, however, the timely importation and delivery of spare parts can only be effected by air freight.

The following information has to be collected:

Road network:	extent of the road network, state of repair, quality, rural roads
Transport facilities:	haulage companies, rail transport
Railway network:	maps of network and condition of the railways, condition of the rolling stock
Supply storage depots:	importance, distribution service quality,
Animal health services:	location, facilities, competence, importance,
Telephone/Internet Connections:	coverage of the country
Irrigation Infrastructure:	dams, water resources, water distribution

d. The economy

If an economy is relatively homogeneous then data taken at the national level will normally suffice. If, however, there are significant regional differences then it may be necessary to disaggregate the data. Key indicators will include, amongst others: growth rate, main agricultural exports and imports, place of agriculture in the economy, exchange rates, rates of inflation, balance of trade, per capita income, levels of unemployment. In order to obtain a meaningful overview it will be necessary to collect several years of data.

The key indicators of economic performance are:

Gross Domestic Product (GDP):	total GDP (preferably real GDP since it is expressed in constant prices, thereby removing the effects of inflation) and GDP per capita
Economic growth:	annual percentage increase in GDP
Unemployment:	percentage of total labour force and by age group
Wage rates:	average wages for agricultural, rural non-farm and urban employees
Inflation:	annual percentage rate
Trade:	balance of payments and value of domestic currency
International debt:	debt servicing

The performance of the economy and the development of the agricultural sector are closely related. If the economy is buoyant there may be opportunities

for farm mechanization. This is because labour will become scarcer due to the development of the non-farm sector. Wage rates will rise and people will move from farming into other, more attractive occupations which provide a better standard of living and quality of life. Similarly, demand for more nutritious and varied food products as well as the growth in the urban population will lead to higher prices in the market place. Under these conditions farmers will find it increasingly profitable to introduce new forms of technology including the introduction of new crops. In contrast, during periods of economic stagnation characterized by high rates of unemployment and low wage rates, there are few incentives for people to leave farming and little opportunity to introduce new tools and equipment into farming systems. High rates of inflation will also adversely affect economic activity.

The performance of an economy may also be reviewed from an international perspective, by examining the balance of trade and exchange rates. If there is a trading imbalance and access to foreign exchange is limited, this has implications for importing raw materials, machinery, and spare parts for agricultural tools and equipment. Similarly, high levels of international debt servicing will constrain investment in other economic activities.

e. The policy environment

At the macro level, governments typically pursue four overall policy goals: income growth, equity and income distribution, employment generation, and sustainability. Individual policy goals are quantified through a range of overall general policy objectives, such as the elimination of poverty, achieving national food security, or achieving greater self sufficiency in manufactured goods.

A review of government policy will identify those ones which are relevant to, and affect, agricultural mechanization. The macro economic framework defines the planning rules, procedures, and regulations regarding foreign exchange, trade, pricing, taxes, subsidies, quotas, and tariffs. The scope of the analysis should not just be confined to agriculture and industry since many other sector policies, such as trade, energy, employment, and transport, will also affect the manufacture, sale, and use of farm machinery and equipment. Possible information sources include: national medium and long term development plans, annual sector development plans, public and parliamentary speeches and statements, as well as provincial government policies, where relevant.

The purpose of the policy review is to develop an understanding of the following:

- the policy goals of government;
- how the government plans to achieve those goals as well as the time frame for achieving them;
- an overview of the budgetary resources that will be needed and what mechanisms are to be introduced in order to promote their efficient allocation;

- what are the policies of the government regarding the public sector, the private sector, and the free market;
- government policies that affect agriculture, and how it affects agricultural mechanization in particular.

Recent years have seen a significant shift in the policy of many countries to a more market oriented economy. Economies have been deregulated, state owned industries privatized, and government interventions significantly reduced. Despite these moves to a free market, some level of government intervention remains necessary. There will be a continuing role for the public sector to facilitate open and fair competition at the same time providing adequate protection for consumers and workers. There will also be opportunities for direct intervention when the market proves to be an inappropriate means of delivery, such as installing rural water supplies, building roads, or carrying out targeted social programmes.

f. The role of Agriculture

Agriculture is the mainstay of most economies in SSA as well as being the main means of livelihood for the populations. The net contribution of agricultural exports to foreign exchange earnings will depend on the nature and value of those exports. Agriculture is also a supplier of raw material for the development of agro-industries.

Key indicators for the agricultural sector are as follows:

GDP by sector:	percentage contribution of agriculture relative to industry and services;
Employment by sector:	percentage of the population engaged in agriculture relative to industry and services;
Trade:	value of agricultural exports and imports as a percentage of totals;
Food self sufficiency:	proportion of total food consumed which is produced domestically;
Farm gate prices:	movements in prices for main products sold by farmers;
Intensity of agricultural land use:	cropping patterns, length of fallow periods of cultivable areas, frequency of cultivation;
Access to markets:	flow of goods and information between farming community and markets;

In countries where a policy goal is to become self-sufficient in food, it is relevant to consider the food self-sufficiency ratio. This gives an indication of the current pressure to produce food to satisfy the domestic market and to achieve self-sufficiency. An indication of future potential growth in agricultural production may be determined by the current intensity of land use, the potential to increase total cultivated area, and the potential to increase land area that is irrigated. With the drive to increase food production, fallow periods will be reduced, cultivation practices changed, and investments in land improvement undertaken.

5.2.2 Demand for agricultural machinery

An accurate overview of the structure of farming in a country is central to an analysis of the potential for development of agricultural mechanization. Patterns of production, the ownership of resources, participation by household members in farming, gender division of labour, and the profitability of farming, influences the range and scope of the potential to develop and invest in agricultural mechanization.

Farming systems should be classified on a basis which accurately reflects the agricultural sector and which is relevant when looking at farm machinery and equipment. Classification criteria to be used will include agro-ecological zones, crop/livestock production systems, principal sources of farm power, farm size and layout, and land tenure. The level of analysis should not be unduly complicated but sufficient to identify groups of farmers with similar resource endowments and patterns of utilization, while facing common constraints and having a similar potential for development. The information used for classification should be relatively easily available and reliable.

Once the criteria for classification have been established, basic statistics for each farming system are collected. This covers not only farm data but also information on the household since this is the core of the farming system. It is at the household level that goals are established, food and cash requirements are determined, labour is allocated, and where crop and livestock production systems are designed. Whilst it will not be possible to conduct a full survey of all farming systems in the time available, it is essential to ensure the principal ones are identified.

Typical information on farming systems is as follows:

Description of each farming system:	summary of the main farming systems with a brief description including cropping calenders
Holdings in each farming system:	number
Average farm size:	total area, area cultivated, length of fallow
Dominant crop/livestock production systems:	types of crops/livestock, cropping patterns, and production methods, irrigated and rainfed
Use of inputs:	traditional, alternative (e.g. seeds, organic and inorganic fertilizers, agro-chemicals)
Use of farm power and equipment:	inventories of farm tools and equipment by power source
Labour:	family, hired, exchange, tasks performed by age and gender, cost of hired labour
Crop and livestock budgets:	gross margins per crop and type of livestock ;
Machinery and equipment costs:	purchase price, fuel usage and cost, replacement rate, repair and maintenance costs, hire charges, contractor charges, government schemes ;
Land tenure:	owner, tenant, commune, state;
Household characteristics:	family size, composition by age and sex, labour availability, migration, goals, preferences, decision making, traditions;
Performance of tasks by family members:	household duties, subsistence food crops, cash crops, livestock, storage, marketing, off-farm activities;
Household income:	farm and non-farm sources, average farm income, average household income.

In preparing an AMS, specific attention must be given to establishing an accurate picture of the existing state of agricultural mechanization. Constraints in the production system, particularly those caused by shortages of farm power and machinery, should be identified and the underlying causes of the constraints identified. For example, uncertainties regarding legal title to land can inhibit on-farm investments in soil and water conservation structures or farm buildings. Any specific assistance by government or other bodies to encourage or directly support the use of certain types of machinery or equipment should be identified.

While the principal users of farm machinery and equipment are farmers and agricultural businesses, it is important to recognize the interface between the agricultural machinery industry and other sectors of the economy. Other end-users of agricultural machinery include government departments engaged in public works (such as soil and water conservation), farm machinery contractors and private hire services, civil engineering contractors (road construction and maintenance), and forestry businesses. These organizations may also face constraints which are attributable to weaknesses in the agricultural mechanization sector.

Alternatively, farmers' decisions regarding farm power and machinery may be influenced by non-agricultural considerations. For example, if a decision to purchase a tractor is based partly on an ability to establish a rural transport service, the quality of the roads and location of markets will affect the profitability of this choice.

5.2.3 Supply of agricultural machinery and equipment

It is important that the existing farm machinery and equipment supply chain should be thoroughly investigated, clearly understood, and analyzed. This will mean an in-depth collection of data on domestic manufacturing, importers of machinery and equipment, artisan manufacture, and national, regional, and local distribution and retail systems, and service and repair facilities. The analysis will lead to an understanding of the constraints and problems faced by the different individuals, companies and organizations engaged in these activities.

Constraints in the supply chain should be identified as well as the reasons for the existence of those constraints. If constraints exist, they can often be caused by the effects of one or more government policies. The identification, recognition and understanding of the effects of policy therefore forms an important part of strategy formulation. Special attention should be given to government activities and interventions in the sub-sector, particularly subsidies, both direct and indirect and their effects. Other government activities in such areas as training, education, extension, credit, research and development as well as any external interventions (projects, NGO's, bi-lateral gifts, etc.) should be identified. From this, a clear picture of the sub-sector and what affects it should emerge.

The scale and activities of the agricultural machinery industry vary substantially between countries. At one end of the spectrum, local manufacturing is dominated by blacksmiths and artisans producing a limited range of hand tools and animal drawn implements. These countries rely mainly on imports to meet their powered farm machinery needs. In those countries with a moderately developed mechanization sector, a reasonable range of farm machinery may be manufactured locally and those items which cannot be manufactured domestically are imported. At the other extreme, some countries will manufacture all, or almost all of the machinery utilized in the country and may also export some items. It should be pointed out, however, that with very few exceptions, no country is entirely self sufficient in farm machinery manufacture. In all free economies with large and comprehensive farm machinery manufacturing facilities, there is still an open import and export of farm machinery. The distribution network also varies greatly from country to country: some countries benefit from a comprehensive sales, repair and maintenance sector, while in others, poor delivery and backup services adversely affect the timely and sustained use of machinery and equipment.

The level of analysis will depend on the size of the industry and level of complexity of a country's economy. If large scale manufacturers and importers are limited in number, it may be possible to describe them individually. However, this would not be practical in countries with many large and medium sized manufacturers. Specific initiatives by government to support the agricultural machinery industry should also be critically reviewed. There needs to be a radical appraisal of domestic manufacturing potential and capabilities so that a realistic picture of likely trends for the industry in the future can be formulated.

Information required on the agricultural machinery supply sector is as follows:

Importers:	volume and value of imports of finished goods, goods in a partially knocked down state (i.e. need assembly) and raw materials;
Manufacturers:	range, quality, and quantity of hand tools, machinery, equipment and spare parts produced by blacksmiths, local artisans, commercial manufacturers, joint ventures. Technical level and skill of manufacturers and employees;
Import Duties and Taxes	identification of any import duties and local taxes; duties on raw materials;
Machinery distributors:	number and location of dealerships, marketing arrangements;
Maintenance and repair services:	number and location of facilities, links with manufacturers, source of spare parts, adequacy of service, skill levels and training;
Fuel and lubricants:	availability, quality, cost;
Draught animals:	availability, breeding, training, veterinary services, animal feed;
Public Sector involvement:	government assistance to agricultural machinery industry and other public sector services.

The objectives of the review are to determine:

- the current manufacturing and distribution capacity of the industry;
- possible constraints to the expansion of production, including the acquisition of raw materials, equipment and manufacturing designs;
- training, research, credit and extension needs; and
- weaknesses in the availability and quality of repair and maintenance services.

5.2.4 Institutional Support

The information on available institutional support that is required will cover credit, research and development, education and training, agricultural, and industrial extension. Other items which may be covered in less detail are human health care, communal crop protection services, and livestock health services. Collecting information on some of the institutional entities - such as research and development centres, education and training institutions and agricultural and industrial extension services - may be particularly difficult. Although statistics showing the numbers and characteristics of each of the entities will be fairly easy to obtain for most countries, assessment of their current effectiveness and level of performance will be more difficult since it will be subjective and will be reliant on personal opinions. The team will often have to rely on the views of respondents or investigators who are closely linked to the institution, or have colleagues working for them, and who therefore may be reluctant to express opinions that might reflect adversely on the institution or their colleagues. To illustrate the problems of evaluating institutions, it may be observed that while information on the number of universities with Agricultural Engineering Departments is easy, and the number of graduates from each department can be obtained from records, the quality of the graduates will be more difficult to assess. Even more difficult is assessing the feasibility of increasing the levels of capacity or performance.

The type of information to be gathered for each of these topics is summarized as follows:

Credit:	credit for farmers for the purchase and use of machinery as well as credit for commercial companies to develop and manufacture machinery, credit to finance cash flow for retailers, credit terms, credit duration, and collateral requirements.
Research and development institutions:	will include universities, regional centres, national centres and international centres; programmes, staffing, facilities, and budgets; crop and livestock conditions, practices, production performance, and research; agricultural engineering research, development, testing and evaluation.
Education and training programmes:	available courses, student numbers, curricula, staff, facilities, student follow-up, budgets, and development plans. Matching education and training facilities to the number of trained people required by government and industry, dissemination methods, links with beneficiary groups.

Agricultural and industrial extension in the public and private sectors:	activities, services provided, structure of systems, staff numbers, and qualifications, contacts with target groups (farmers, manufacturers, distributors, and blacksmiths), budgets and development plans, effectiveness.
Consumer Protection:	legislation regarding protection of the consumer from undesirable and illegal business practices, information dissemination, credit protection, machinery testing. This will include laws, rules, and regulations which provide or contribute to the protection of the consumer or end-user. An appreciation of the potential for encouraging changes in existing policies must be developed.
Institutional Framework:	the various institutions associated with the agricultural and manufacturing sectors, particularly with regard to agricultural mechanization, should be identified and their principal activities determined. These activities may be undertaken by private commercial, NGOs, and public sector bodies. The review should identify any major institutional constraints which limit the performance of agriculture at present or may inhibit future initiatives. Any institutional strength which may facilitate strategy implementation should also be noted.

5.3 PARTICIPATORY WORKSHOP OUTPUTS

Workshops held during the diagnosis stage should be based on the initial SWOT analysis (see Chapter 4). Box 5.1 shows one example of a summarized SWOT matrix. The ideas presented in this matrix seem to be of a very general nature which is why more precision is required for every idea so that the analysis may become more specific to the country.

Finally, the SWOT matrix participants, through matching Strengths, Weaknesses, Opportunities, and Threats, should define ideas on actions which should be categorized in the strategy axes or pillars.

BOX 5.1

Example of SWOT Matrix

The present SWOT matrix has been prepared during the Niger AMS project. It presents the outputs of the farmers group (irrigated areas farming system).

Strengths	Weaknesses
- Practices using fertilizers; - The presence of farmers organizations; - Land is available; - Land is suitable for powered motorization.	- Problems of water management; - Weak crop yields; - Transport constraints; - Crop production market constraints; - Problem of payment for services; - High cost of energy.
Opportunities	**Threats**
- High demand for agricultural products; - Become independent of rainfall.	- Increased cropping intensity; - Silting of reservoirs; - Flooding; - Invasive weeds; - Salinity; - Unstable socio-political-economic context.

CHAPTER 6

Analysis of the future situation and the formulation of a strategy

6.1 INTRODUCTION

This chapter focuses on the final steps in the formulation of a strategy for mechanization; a strategy that will lead to the creation of an enabling environment in which agricultural mechanization can freely develop. The first step in the process is a definition and analysis of the existing situation which will reveal those policy, legislation, and planning constraints which adversely affect the development of mechanization. This was covered in Chapter five.

The second part of the strategy process is to define an ideal future situation; a situation in which the mechanization sector contributes to the overall development of agriculture in the country but which will also contribute to improving farm incomes and living standards. This chapter deals with how this future situation can be identified and defined. Emphasis is given to the individual roles of government and the private sectors and how these interact with each other. The outcome will be a framework of policy and institutional recommendations, supported by programmes and projects where appropriate.

6.2 OVERVIEW OF THE FORMULATION PROCESS

The first task of the strategy team was to identify in detail the present situation in the country. This included the principal farming systems; types and use of farm power, tools and equipment; costs and returns of mechanization; profitability of farming; the potential to expand and increase production; and the identification of constraints. Detailed information should also have been collected and understood about how tools and machinery are presently manufactured or imported and how they are made available to farmers (the supply chains). Weaknesses and opportunities in local manufacture and importation of farm machinery and equipment, and their distribution, repair and maintenance will be also need to have been identified and understood. These points have been covered in detail during the review of the agricultural engineering sector by both the strategy team and at the ensuing participatory workshop (Chapter 5).

Following the identification of the existing situation, a second participatory workshop should be held in order to set out objectives of the strategy formulation exercise. Following this workshop and according to its findings,

the strategy team must establish a vision of what a strategy should aim to achieve i.e. a vision of how the future farm power and mechanization sector in the country should look like. It will set out broad statements of intent which will include development plans for the sector made possible by an enabling policy framework. How the actual position will evolve, however, will be the result of interactions within the overall economy, both at national and international levels; actual changes in the population (numbers, composition and urban/rural split); as well as other exogenous factors. Each development scenario will have implications for the agricultural sector and, in turn, for farm machinery and equipment requirements.

Finally, it will provide a strategy on how to achieve this future vision for mechanization. Of major significance will be the respective roles of government and the private sector. Initiatives may be required to support the development of the private sector manufacturing and distribution systems, and to strengthen the role of supporting institutions. While some recommendations will almost certainly need to be addressed at the policy level requiring changes in legislation, others objectives may be realized through programmes and projects.

6.3 PARTICIPATORY WORKSHOP FINDINGS

Prior to commencing strategy formulation it is important that all stakeholders participate in this process by organizing a second workshop; a log-frame analysis tool is often found useful for these purposes. The first steps in the strategy identification process will have already been obtained from the SWOT analysis that was undertaken at the end of the first workshop (Chap 5). This second workshop will therefore consist of an in-depth analysis of these findings leading to decisions on the final objectives of the strategy formulation. It is therefore very important that the participants in the second workshop should be the same as those who attended the first workshop.

During the discussions it will be very important to assess and verify that the objectives of the strategy formulation are feasible and realistic, and that the strategy will not have any adverse effects when implemented. Finally, the project team will need to investigate all these findings by using elements of analysis which are presented in the points below.

6.4 THE FUTURE SITUATION OF FARM MECHANIZATION

6.4.1 Developments in the National Economy

Based on the recent performance of the economy, in combination with stated development goals and objectives, it is possible to make general predictions on the course that the economy will take in the next five years. Without any extreme exogenous shocks, economic trends tend to be fairly stable in the medium term. Some exogenous factors may provide a window of opportunity for economic development (for example, if export prices rise) whereas other

negative factors may disrupt local production (e.g. through drought, political instability or an unexpected rise in import prices).

Policy objectives may make specific reference to the role envisaged for agriculture, in terms of export earnings and/or import substitution, securing food self sufficiency, poverty alleviation, and employment generation. Similarly, the local manufacturing base may have a role in import substitution, employment generation, and human resource development.

Projections of demographic change are central to the analysis; a high population growth rate will cause a rapid growth in the demand for food. If this is accompanied by a proportionally higher growth rate in urban areas caused by migration from the rural areas to urban centres, then even greater demands will be placed on the agricultural sector. At the same time, despite high birth rates, the productive capacity of the agricultural population may be threatened by chronic malnutrition and illness.

There are four key issues to be addressed by the agricultural sector:

- Will the agricultural population be able to meet and maintain their own food needs?
- Will the agricultural sector be able to produce and market surpluses to meet the food needs of a growing urban population?
- Will the agricultural sector be able to produce sufficient cash and industrial crops to support the development of agro-industries and generate or save foreign currency?
- Will the agricultural sector be able to respond to shifts in labour availability and provide employment opportunities at a rate which makes the best use of the nation's human resources and offer working people acceptable and satisfactory conditions of employment?

6.4.2 Farming systems development

How will systems of farming be able to respond to the demands placed on them?

The first step is to understand how farming systems are likely to evolve over the next five years. Factors which may bring about changes in the distribution of holdings between different farming systems are:

- population growth;
- changes in land tenure;
- cultural and social factors;
- relative profitability of farming versus other employment opportunities;
- investment;
- infrastructure developments.

For example, if the profitability of farming increases then greater investment opportunities will arise leading to an increase in the numbers of bigger, more commercial, agricultural enterprises. Alternatively, the subsistence sector may grow, and yet at the same time, struggle to provide sufficient food for a

growing population with limited non-farm employment opportunities. The result will be that holdings will become more and more fragmented and the area cultivated per person will decrease. Changes in land tenure may also affect the size and distribution of holdings.

The primary concern of the subsistence sector will be to ensure that they are able to meet their own food requirements and that their households remain intact. Particularly vulnerable groups are single and female headed households. Faced with the challenges of a reduced household size and declining labour availability, they may look for cropping patterns that are less labour intensive, as well as to seek labour saving technologies and practices. Some small landholders may be able to bridge the gap between subsistence and commercial production but may require support, such as changes in land ownership and access to credit, to enable them to do so.

Due regard should also be given to the impact that an intensification of production may have on the environment. Intensive cultivation methods may lead to increased soil degradation; irrigated areas may be at risk from salinity; and increased use of agro-chemicals may lead to an increase in the pollution of groundwater supplies and put wild life and insects at risk, not to mention the human population as well. However, introducing measures to sustain and improve the environment may also be part of the solution: some new land will require conservation measures, such as terracing, in order to bring it under sustainable cultivation.

6.4.3 Requirements for farm power and equipment

What will be the farm power requirements under these different scenarios?

The demand for farm power and machinery stems from four sources. These are:

- replacement of existing stocks of machinery
- increase in stocks of machinery due to growth in number and sizes of farm businesses
- adoption of more advanced and varied mechanization inputs
- substitution of traditional sources of power (animal and human)

Regardless of any drive to increase production, there will be an annual demand for tools and equipment to maintain existing stocks. Thus it is important during the review of this sector to identify the economic life of equipment and to identify their rates of replacement. Increasing total production will almost certainly require additional inputs of farm power in order to prepare larger areas more quickly, to bring marginal lands into production, to adopt more intensive cultivation methods, and to harvest, transport and process greater volumes of output. The demand may be supplemented by growth in the number of farm holdings. It may be possible to

meet some of these additional demands from existing under-utilized resources. For example, the introduction of double cropping or new cropping patterns will demand greater inputs of labour, draught animals or tractors. In many instances it will be necessary to introduce additional power and equipment into the production system. This may be achieved through individual or group purchase, or by hiring-in additional power when and as required. This will present opportunities for the development of machinery contracting services. There may be opportunities for exchanging labour or equipment but this will be of limited benefit if households are operating similar farming systems in which labour and work peaks coincide.

In addition to considering the total stock of tools and equipment, it is also relevant to consider equipment design. Improved designs can both reduce environmental impact of more intensive farming methods as well as improve operator productivity and yields. An understanding of the conditions under which farmers adopt new technologies is central to the analysis of future scenarios. The main factors influencing farmers' decisions to adopt new technologies are:

Technical performance:	work rates, implications for cropping and livestock systems, scale of production, impact on yields, complementary technologies.
Financial factors:	gross margins, break-even analysis, returns from hiring, machine/contractor versus ownership, individual, or group ownership, sources of finance.
Social implications:	total labour requirement with new technology, division of tasks between household members (by age and gender), division of tasks between family members, hired and exchange labour, impact on quality of life.
Environmental implications:	timeliness of operations, impact on soil structures, use of natural resources (e.g. water), cultivation of marginal lands.
Machinery support services:	ability of existing infrastructure to maintain and repair new technologies, access to spare parts, technical information and advice, training.

In some farming systems, producers have to substitute one power source for another due to a decline in the availability of their traditional sources. Tractors will replace animal draught, and animal draught will replace human power. Migration, long term malnutrition and illness all take their toll with regard to household productivity. Similarly, any sustained decline in the health and productivity of draught animals may force farmers to use tractors. Alternatively, they may seek labour saving solutions to keep their households intact, such as adopting less intensive production methods or cropping patterns, or reducing time spent on household tasks.

In summary, farmers and other end-users are looking for the widest choice of appropriate farm tools, machinery, and equipment at affordable prices, as well as access to spare parts and maintenance services. They may also require information to assist in their choice, legislation to protect them from commercial exploitation, and credit to facilitate their purchases.

6.4.4 Implications for the agricultural machinery industry

The review of the sector described in Chapter 5 provides information about the current capacity of the manufacturing sector and its scope for expansion. The agricultural machinery industry requires a competitive commercial environment in which manufacturing, importing, distribution and repair businesses can develop profitably, free from any unfair competition from the state. Growth rates in the industry will be influenced by the state of the national economy, the development of the infrastructure and ancillary industries, improved communications, skills acquisition, and profitability of manufacturing, importing and selling agricultural machinery and equipment. The absence of a thriving agricultural machinery industry can often be traced back to a lack of profitability in one or more of the groups operating in the sector.

In those countries that have an established or emerging agricultural machinery manufacturing base, the next step is to consider how the industry will evolve. Can it and will it grow at a sufficient pace to respond to demand arising from the foreseen changes in the agricultural sector? Will the industry be replacing imports with domestically manufactured tools and machinery; will it be developing export markets, or will imports remain the main source of supply?

6.5 STRATEGY FORMULATION

6.5.1 The strategy framework

The premise for deciding to carry out an agricultural mechanization strategy formulation is that the sector is not functioning satisfactorily. That is, the sector is not fulfilling its role in increasing agricultural production as well as increasing and improving the livelihoods of the end-users (the farmers) and the livelihoods of the people involved in supplying the farmers with these inputs (the manufacturers, blacksmiths, importers, retailers, service providers etc). A decision to carry out a strategy formulation must therefore be based on the premise that there is something wrong with the sector and that it should be performing more effectively. This is all rather vague and no doubt there will be many different opinions as to why the sector is not performing well. Therefore the first step is to identify how and why the sector is not performing i.e. to identify and analyse constraints and distortions which are preventing the sector performing i.e. an in depth statement of *the present situation* (see Chapter 5). The second step is to identify how the sector could and should ideally perform in the future i.e. *the future situation*.

The strategy to be formulated will be the definition of the actions required to move from the present (unsatisfactory) situation to the future (ideal) situation.

6.5.2 The roles of the government and the private sector

The principal role of government is to establish conditions which will enable the development of a largely self sustaining agricultural engineering sector within a policy of minimum direct intervention (Clarke, 1997). The purpose of any intervention should be clearly identified and fall within the framework of the strategy. Explicit attention should be paid to the effects that other policies have on the level and use of engineering inputs in agriculture.

With the widespread move towards market based economies, the new challenge is to formulate and implement policies and strategies which lead to a type and level of government intervention that is both consistent and efficient. Policies must be aimed at removing the most damaging forms of market failure and leaving market forces to operate where they can be effective in promoting both growth and rural poverty alleviation.

Thus, the continued use of many of traditional forms of intervention may not be appropriate in the future. In most countries, exchange rate restrictions have already been lifted thereby facilitating trading at market values (rather than being artificially fixed). However, in many countries, taxes and/or subsidies which distort the market continue to be applied. This distorts the demand for inputs as well as the markets for outputs. While this may appear to offer benefits in the short term (for example, subsidies that promote the use of selected inputs), they usually lead to distortions making one input more attractive to use than others. This becomes unsustainable in the long term. Similarly, the future role of government in providing agricultural extension is uncertain; many governments do not have the resources to continue to provide free extension services to all farmers.

Nevertheless, areas remain in which there may be justification for government involvement. These are mainly in areas that are considered to be "for the common good" and cannot be expected to be provided by the private sector. Possible roles for government are:

- health and safety
- labour laws
- education and training
- industrial extension
- standards
- machinery testing
- licensing
- credit
- business promotion and development
- market information
- trade

In addition, large scale infrastructure investments (such as irrigation and drainage), agricultural marketing infrastructure, and selected research and development activities are often considered important and legitimate areas for

support. Governments will also have a continuing role in ensuring consumers have access to market information and adequate protection against undesirable and illegal business practices (consumer protection).

If the government has traditionally pursued central planning of the agricultural engineering sector and largely discouraged the development and involvement of private businesses, it will take some time for entrepreneurs to come forward and fill the gap. Under these circumstances, the development of the private sector may require programmes and institutional support over the medium term. Capital will need to be mobilised, business skills strengthened, and infrastructure developed.

6.5.3 Policy and institutional recommendations

Existing government policies which influence the farm mechanization sector need to be reviewed to determine if any changes are required to be able to implement the proposed strategy. In this respect the strategy team may suggest improvements and formulate alternatives to support the implementation of the strategy. Similarly the institutional framework will also need to be reviewed to see if any changes are required.

However, it must be recognized that the ultimate decision to implement such changes rests with the government and, in some cases there may be a requirement for fundamental changes in legislation.

6.5.4 Programmes and projects

The formulation of an agricultural mechanization strategy usually includes the identification and preliminary formulation of supporting programmes (Box 6.1) and projects (see Annex 1 as an example of project proposals for Tanzania). These may be specifically oriented towards farm power and equipment or define components that can be incorporated into other agricultural development projects. The key items and issues are detailed in the strategy document in order to provide guidance for subsequent project formulation. Where relevant, implementation of each project should be coordinated with other projects in the programme and with complementary projects in other development programmes.

The process to formulate projects should be carried out within the framework of a small workshop with selected participants. The output of this workshop should be based on the elaboration of a plan of operation which constitutes an effective tool for project implementation and management. It will also provide important data for the monitoring and evaluation of the projects. The format will vary slightly according to the type and nature of the individual project, however, normally the format will include the expected results, a schedule, the department in charge, the inputs (personnel, equipment and cost), as well as indicators for monitoring and evaluation purposes.

6.5.5 Strategy Documentation

While there is no prescribed format for the layout of the strategy document, the following is a format that has been tried and tested.

Executive summary. The summary briefly sets out the main findings and recommendations. No more than three pages, this section should briefly present the most important elements of the diagnosis analysis and the main issues that were raised during the study. It should also list the strategic goals, highlight the objectives, and set out the action plan. The executive summary should be concise and self contained.

Main report. This concentrates on the analysis of the current situation, the projection of future scenarios, and the identification of the means by which this is to be achieved (Box 6.2).

Appendices. This covers others documents which have been elaborated during the project and serves as important reference material.

6.5.6 Steps towards Implementation

Immediately after the final workshop (validation workshop) and the incorporation of any agreed changes, the final report will be submitted to the government. A checklist prior to completion of strategy formulation should contain the following points:

- Has there been the opportunity for the views from all key players in the agricultural engineering sector to be heard during strategy formulation?
- Have they had the opportunity to express their opinions regarding the future scenarios identified and recommendations of strategy formulation?
- Has the interpretation of the policy environment been discussed with the appropriate authorities?
- Are there any policy inconsistencies or institutional constraints which will make implementation of the AMS ineffective unless acted upon?
- Have policy makers participated in the preparation of the strategy? Are they willing and committed to act on the recommendations?
- Who is perceived to own the strategy document?
- Will the implementation of the strategy require complementary activities in other sectors and, if so, will they be likely to be forthcoming?
- Have linkages been identified with other development or planning initiatives?
- Has the steering committee provided timely guidance and advice?
- Has a mechanism been set in place to see through strategy implementation, including provision for monitoring and any revisions?

BOX 6.1

Main outputs of an agricultural mechanization strategy project in Cameroun (TCP/CMR/3204, 2010)

In Cameroon, farmers are poorly equipped and the demand for agricultural mechanization is very low compared to a high agricultural potential. Similarly, the private sector involved in agricultural machinery supply is not well developed given the low demand for agricultural equipment. However, other factors both intrinsic and extrinsic seem to be equally important. So many issues have been raised among which is worth quoting organizational issues, tax policy on imports of agricultural equipment and raw materials, the involvement of the state in certain activities which should be done by the private sector. To overcome this situation three programmes were proposed:

Program 1. Strengthening the state structures in charge of agricultural mechanization

This program aims to strengthen the institutional capacity of state structures in the management of agricultural mechanization. The proposed actions aim at capacity building to conduct and manage the various activities related to the development of agricultural mechanization. It covers the following actions:

- Develop and strengthen national training in agricultural machinery,
- Strengthen the agricultural extension on farm mechanization,
- Develop research and development in agricultural mechanization,
- Develop and disseminate national standards for agricultural machinery.

Programme 2. Supporting the increased use of farm power and land use in agricultural production regions

This program aims to facilitate access to agricultural machinery services, taking into account the ecological and socio-economic environment and the development of lands in agricultural production regions. It covers the following actions:

- develop agricultural lands for the benefit of farmers;
- develop partnerships between the actors involved in agricultural mechanization and strengthen their capacities;
- design and implement an adequate financing system;
- promote conservation agriculture

Programme 3: Strengthening the capacity of the private sector to supply farm power and agricultural mechanization services

This program aims to stimulate the private sector so that it is able to offer farmers the necessary farm power and adequate service in a sustainable manner. It covers the following actions:

- facilitate the importation of farm power;
- structure and strengthen the local production of agricultural machinery and tools;
- promote the supply of agricultural mechanization services

Important decisions will be required regarding the final acceptance of the strategy; how it is to be implemented; what funding is required; and what are the potential funding agencies for specific programmes and project? One way to facilitate implementation is to identify linkages with other development initiatives, where appropriate. Aspects of the strategy recommendations may be incorporated into other programmes or projects.

It must be recognized that strategy formulation and implementation is a dynamic process. As the economy develops and farming systems change in a country, the need and demand for farm power and mechanization will change. Moreover, government policies will adjust to reflect new circumstances and development philosophies. New programmes and projects will need to be identified, and new ways of incorporating farm power into broader development projects will have to be developed. Thus, the strategy will need to be monitored regularly and revised to reflect key changes in the economic, policy and institutional environment.

BOX 6.2

Example of a strategy report

Content: The main report should be brief, providing a ready reference to the main features of the strategy. It should contain:

1. INTRODUCTION
General data of the country

2. AGRICULTURAL ENGINEERING SECTOR
2.1 National Economy
2.2 Policy Environment
2.3 Role of Agriculture
2.4 Farming Systems and Agricultural Mechanization
2.5 Other End-Users
2.6 Agricultural Machinery Industry
2.7 Institutions

3. FUTURE SCENARIOS
3.1 Developments in the National Economy
3.2 Developments in Farming Systems
3.3 Farm Power and Equipment Requirements
3.4 Implications for the Agricultural Machinery Industry

4. STRATEGY FORMULATION
4.1 Strategy Framework
4.2 Role of Government
4.3 Role of the Private Sector
4.4 Policy and Institutional Recommendations
4.5 Programmes and Projects
4.6 Timetable and Review

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Annex 1

Tanzania - Example of proposals resulting from an FAO farm power and business support project - 2001

SUMMARY OF FOLLOW UP PROJECT PROPOSALS

INTRODUCTION

Increased and improved levels of agricultural inputs will be needed to increase agricultural production, as well as to increase land and labour productivity, food security and reduce post-harvest losses to meet a growing population's demand for food. Manual labour, agricultural tools, draught animals, tractors implements and equipment are essential farm inputs. They are so essential that without them food production would be impossible. In many situations the main constraint to increased crop production is not improved seed or more irrigation water or more fertilizer; it is simply that the farmer does not have sufficient labour or machines to make the best use of his existing resources.

The proper selection, utilization, and management of farm power resources are crucial factors in the agricultural production process. Additional farm power, or an increase in its efficiency, is in many cases required to eliminate labour shortage bottlenecks, in particular in multiple cropping systems or areas of low or erratic rainfall. In turn, increased output will further augment the total demand for labour for crop husbandry, harvesting and post-harvest related work.

Forty percent of the total land area in Tanzania is designated as agricultural land. But only about 11 percent of the total land area is used for arable cultivation. One of the main reasons for this under utilization is a lack of power to till the land and for other farm operations. Large increases in farm power inputs are required to bring a significant area of this unused potential into production. Furthermore, increases in production demand better post-harvest techniques and technologies (for example, for storage, drying and processing), particularly for multiple cropping systems and cash crop farming. Similarly, improved rural buildings are needed to properly store harvested crops and to house livestock.

In 1995 the FAO started the pilot phase of its Special Programme for Food Security (SPFS) in Tanzania in 24 villages in two regions: Morogoro and Dodoma. SPFS uses a participatory approach bringing together farmers, input suppliers and extension workers. Farmers are encouraged to form savings and credit groups which enable them to purchase the required inputs. Response to the programme has been good and yield increases of 50-100 percent are reported using the currently available inputs and production techniques

The shortage of farm power has been identified by SPFS as one of the major bottlenecks for increasing production as it directly affects both the areas cultivated and the timeliness of planting. The Department of Agricultural Engineering MAC, with financial and technical assistance of FAO agreed to further investigate the farm power problem in Tanzania. Phase I of the project with a duration of 6 months made a detailed assessment of the current situation in the SPFS areas and formulated proposals for interventions for implementation under phase II.

Under phase I of the project, national and international experts were engaged to analyse specific topics such as hand tools and draft animal technologies, profitability of tractor hire services, the effects of existing tillage methods and the business environment in which suppliers of agricultural inputs are operating. The project findings and recommendations are laid down in various field documents and were presented in a project workshop held in Morogoro in February 1999 and attended by, among others, senior Government officials and representatives of the private sector.

The proposal for phase II summarized in this document, draws on the major findings and recommendations are discussed and amended during the project workshop. Immediate objectives of phase II have been split up into four distinctive topics:

a) Support to private sector development, channelled through the Tanzania Chamber of Commerce, Industries and Agriculture (TCCIA) with direct support to the association and business and skills development training for agricultural input suppliers.
b) Support to the Ministry of Agriculture and Co-operatives (MAC) and specifically the mechanisation unit and extension services.
c) Support to appropriate technologies which included wider application of animal traction, soil and water conservation tillage techniques and small powertillers as a source of power for paddy production.
d) Support to increased tractor utilization through development of private contract services and rehabilitation of tractors.

SUMMARY OF PROJECT PROPOSALS FOR PHASE II

The project interventions to improve private sector involvement in the provision of agricultural inputs will directed along two ways:

i. support to and through organisations representing the interests of the agricultural commercial sector; and

ii. support to Government services to improve extension, and specifically in the area of agricultural mechanisation, both to the end users and to the suppliers of inputs particularly in the rural areas.

Objectives:

Long term:

- Increased investment in farm power, tools and equipment to enhance agricultural production.
- Reinforce capacity of the agri-business sector in the supply, manufacture, distribution and marketing of agricultural inputs.
- Active involvement of the private sector in the development of more sustainable farming systems, able to withstand climatic fluctuations, through more sustainable tillage systems, increased timeliness of operations, reduced losses, better storage and less drudgery for farmers.
- To provide for farmers a wide range choices of tools, machinery, implements and equipment as well as post-harvest and rural processing technology options and to ensure reliable private input supply chains and services.
- Local manufacturing and repair facilities of farm tools, implements equipment and machinery.
- Increased buying power of the smallholder farmers through better yields, increased area under cultivation, and value adding crop processing.
- Increase practical and management skills of all stakeholders.

Short-term:

- Awareness creation within the agri-business sector about development opportunities.
- Determination of different training requirements of the agri-business sector, the MAC and NGOs and extension staff to facilitate private sector development;
- Awareness creation of a wide range of proven Mechanization, DAP (draft animal power), post-harvest and processing technology options among farmers and the existing/potential supply channels (local machinery agents/dealers, small and medium scale manufacturers, extension officers, NGOs, etc.).
- The promotion of more sustainable tillage operations that improve water infiltration and reduce run-off.
- To make available on a pilot basis sets of implements and machinery for evaluation and demonstration, prior to local manufacturing and/or importation.
- Assistance to the private sector in organising on-farm demonstrations in collaboration with MAC and NGOs extension staff.
- Technical assistance to local manufacturers in the production of appropriate equipment (training, provision of jigs, etc.).
- Training of suppliers and retailers of farm inputs in business management, training of farmers (mainly on-the-job training) and extension staff of MAC and NGOs.

- Exchange of relevant information between all stakeholders.
- Support to the mechanisation unit within the MAC in information collection, data base development, analysis and information dissemination.

The **stakeholders and clients** of the project will include among others:

- farmers and local communities in the project area;
- stockists of agricultural inputs such as tools, animal drawn implements, agricultural equipment and spare parts but also of other agricultural inputs including fertilisers, seeds etc.;
- workshops and mechanics;
- owners of tractors who provide hire services;
- importers, manufacturers, distributors and retailers of agricultural equipment; and
- agricultural extension officers of MAC.

Components

1. Support to private sector development

- increased representation of the interests of the agri-businesses in political making processes at regional and national level;
- to increase business management and marketing skills among agri-business services providers, especially those in the rural areas; and
- to increase capacity of suppliers of agricultural input to provide information to their farmer customers on improved agricultural practises, technologies, products and sources of supply.

2. Support to the ministry of agriculture and co-operatives

- to strengthen the policy and strategy making capacity of the MAC in the area of agricultural mechanisation; and
- to improve the quality of agricultural mechanisation field extension services in FAO Special Programme areas.

3. Support to the introduction of appropriate technologies

- increased and sustainable agricultural production through introduction of appropriate land preparation technologies;
- wider application of animal traction, soil and water conservation tillage techniques and small power tillers as a source of power for paddy production;
  - weeding with draft animals such as oxen and donkeys using special weeders;
  - land farming techniques using animal traction using rippers and ripper planters;

- dry land farming techniques using tractors equipped with tined implements instead of the commonly used disc ploughs to increase soil and water conservation; and
- powertillers for primary tillage and farm transport in paddy cultivation as an intermediate alternative to hand hoes and four wheel tractors in areas where animal traction has not been introduced.

4. Support to tractor rehabilitation

- rehabilitation of selected units of existing tractor fleet.

5. Support to the development of agricultural machinery contractors

- identification of a number of contractors to support their development;
- assistance with activity and business planning, and cash flow management;
- identification of equipment packages including additional machines and attachments to enhance profitability through better tractor utilization (e.g. rural road maintenance);
- training in operation and maintenance;
- assistance in obtaining financing for the machinery and equipment;
- assistance in identifying customer base and negotiation of contracts with local authorities (e.g for a contract for road maintenance); and
- training in alternative (conservation) tillage and other mechanized techniques (e.g. weed control using hand tools, DAP and tractors).

6. Support for sustainable draft animal power, on farm storage and agro-processing

6.1 Diversification of crop cultivation, storage and processing technologies, and related equipment

- distribute information about the project goals and objectives to all (potential) entrepreneurs who could participate in the programme (starting networking activities);
- identify individual constraints and opportunities in developing their required agri-business support services;
- familiarise the entrepreneurs (local manufacturers, retailers, etc.) with the needs of their surrounding smallholder farming sector;
- determine the different training requirements of the agri-business sector, MAC and NGOs extension staff to facilitate private sector development;
- create awareness of a wide range of suitable DAP, post-harvest and processing technology options among farmers and the existing/potential supply channels (local machinery agents/dealers, small and medium scale manufacturers, extension officers, NGOs, etc.) by offering a choice of suitable implements and equipment;
- promote more sustainable tillage operations that improve water infiltration, reduce run-off and increase crop yields;

- make available sets of implements and equipment for demonstrations, prior to local manufacturing;
- assist the private sector in organising on-farm demonstrations in collaboration with MAC and NGOs extension staff ;
- allow farmers to use the new technologies during a few seasons;
- assist local entrepreneurs, retailers, extension staff and farmers in assessing the suitability and affordability and subsequently to assess their efficiencies and acceptance by farmers;
- assist local entrepreneurs in manufacturing adopted equipment (training, provision of jigs, etc.); and
- train importers, suppliers and retailers of farm inputs in business management, farmers (mainly on-the-job training) and to train extension staff of MAC and NGOs.

6.2 Importation, local manufacturing, assembly and distribution of low-cost implement attachments and crop processing equipment

- selection of items that are suitable for local manufacture and those which should be imported;
- transfer of manufacturing know-how, supply of jigs and where necessary assistance in procuring tools and workshop equipment, and materials;
- initiation of first series of production by ordering a number of items which will be distributed to rural retailers (pilot-scale implement/equipment and spare parts supply programme);
- guidance to manufacturers and retailers, and data collection about product quality and profitability (feedback of information from farmers);
- monitoring of private sector initiatives and acceptance of the new (locally made) products by farmers;
- in co-operation with the manufacturing and trading sector and MAC, to establish an affordable marketing information system; and
- networking between all stakeholders, including credit institutions (e.g. data collection and exchange of information).

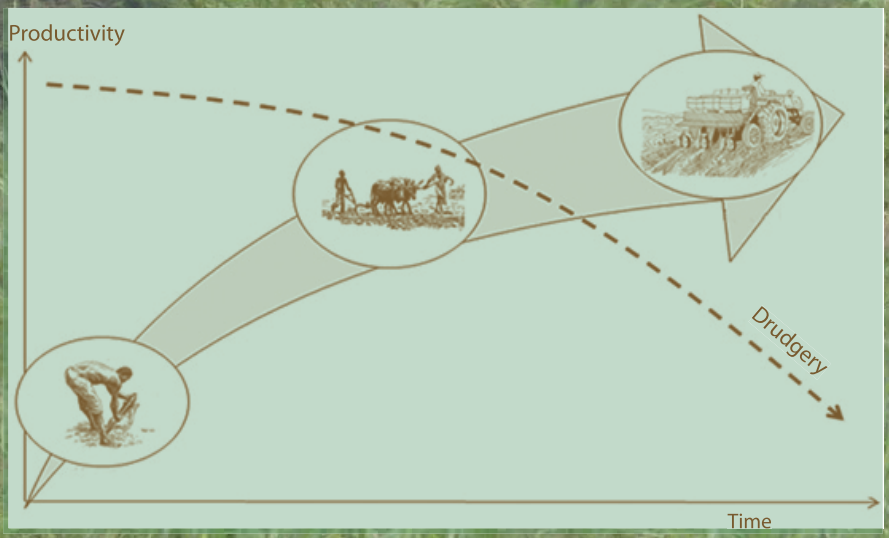
6.3 Training

- detailed survey of training needs among all stakeholders;
- survey of institutions offering training courses relevant to agri-business services development;
- establishment of an effective partnership with some (specialised) training institutions;
- participation in curriculum development and (tailored made) training courses;
- practical and on-the-job training of rural workshops' staff in engineering skills required to manufacture and assembly of implement parts and attachments;

- practical training of retailers, MAC extension staff and farmers in proper use and maintenance of implements, among others, as part of the demonstration programmes envisaged;
- tailored made training courses for the agri-business sector, including business planning and management training for workshops in small towns, rural workshops and retailers/stockists; and
- in co-operation with MAC extension staff, development and dissemination of simple extension materials such as operation manuals, leaflets and training videos, appropriate for farmers, importers, manufacturers and retailers.




Agricultural Mechanization in Sub Saharan Africa: *Guidelines for preparing a strategy*



The manual work carried out by farmers and their families is often both arduous and time consuming and in many countries this is a major constraint to increasing agricultural production. Such day to day drudgery is a major contributory factor in the migration of people, particularly the young, from the rural countryside to seek the prospect of a better life in the towns and cities.

Farm production can be substantially increased through the use of mechanical technologies which are both labour saving and directly increase yields and production. The necessary inputs are carefully selected tools, machines, and equipment. Such technological interventions are commonly referred to as agricultural mechanization and a judicious choice is crucial for farmers to achieve optimum profitability from their businesses and to attain an acceptable quality of life for themselves and their families. The choice can also have a major impact on the environment; only the use of those which have a positive effect can be sustainable over the long term.

It is therefore important to identify appropriate mechanization strategies with particular emphasis on increased production, farmers' livelihoods, and environmentally sustainable options. This document provides guidelines on the development and formulation of an agricultural mechanization strategy and forms part of FAO's approach on sustainable production intensification.

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