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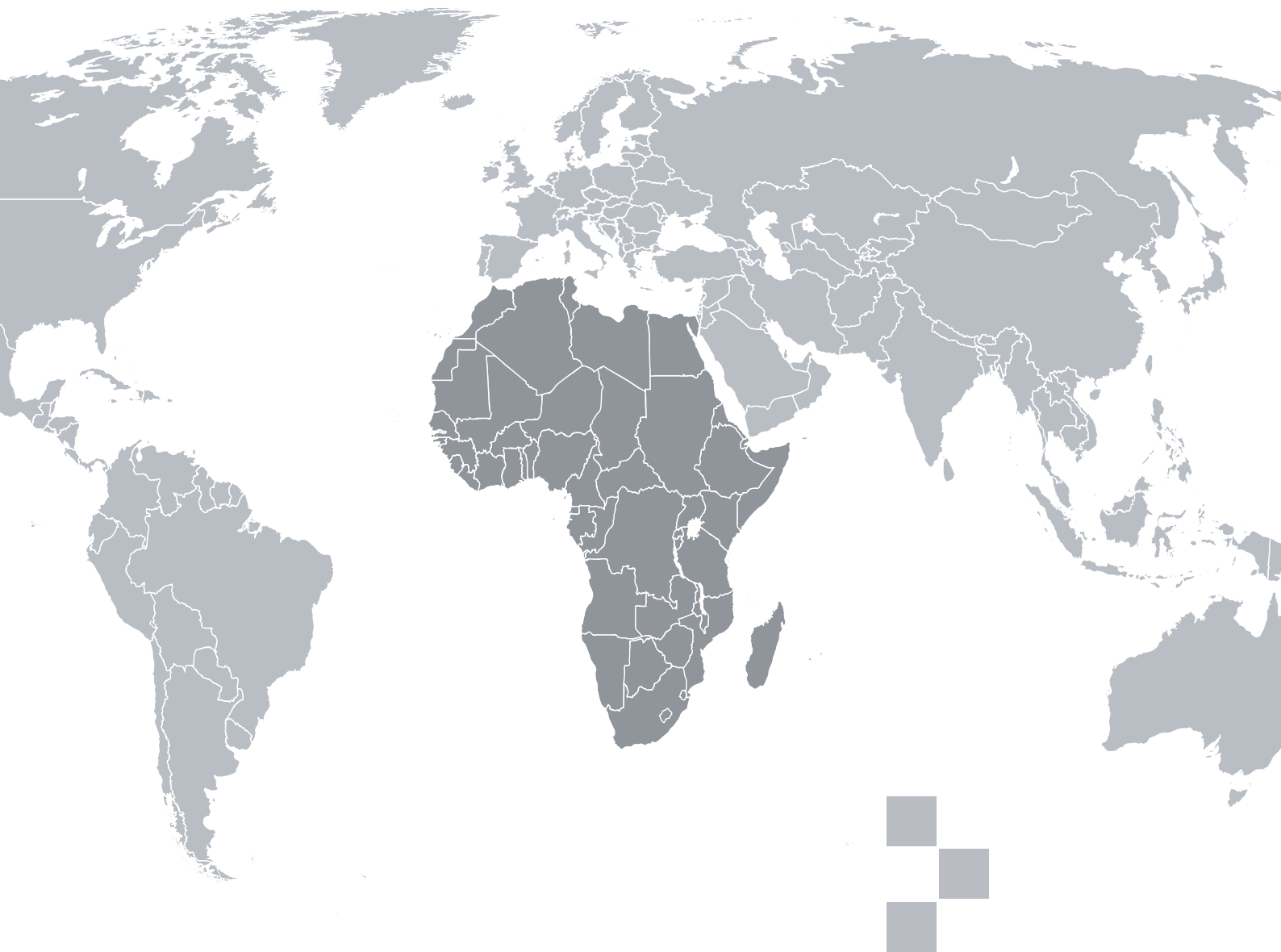
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Agricultural mechanization in Africa... Time for action

**Planning investment for enhanced agricultural productivity
Report of an Expert Group Meeting
January 2008, Vienna, Austria**

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2008

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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Preface

In the last 50 years, few economies have been able to overcome the challenges of development and become truly competitive. In those few cases, there are concrete indications that industrial development, including agro-industrial development, has played a key role. Agricultural mechanization is part of agro-industrial development, and it has either stagnated or retrogressed in many countries of sub-Saharan Africa (SSA). This has occurred despite strong support for mechanization from African political leaders and heavy investments in both animal traction projects and mechanically powered mechanization, such as in tractors, pumps and post-harvest processing equipment.

Given this scenario, FAO decided in 2004/05 to undertake a critical analysis of agricultural mechanization in SSA, by reviewing performance in the last three decades with an eye to the future while at the same time taking cognizance of the experience of other regions of the world. This led to an internal paper titled: *Agricultural Mechanization in Africa: Time for a New Look*. A major objective of the paper was to encourage increased attention on agricultural mechanization in SSA and to raise some of the technical and institutional factors that need to be taken into account. The discussion of this paper coincided with the signing of a memorandum of understanding by FAO and UNIDO in which the two organizations agreed to work together in areas of common interest. Both organizations had been heavily involved in the agricultural mechanization efforts in SSA during the 1970s and 1980s, focusing on different parts of the agricultural mechanization supply chain – with UNIDO covering the industrial end while FAO covered the agricultural end.

Both UNIDO and FAO recognize that the experience of SSA mechanization has generally not been very successful while there is currently great renewed interest on the subject. There is a risk that the absence of sound mechanization strategies and policies may lead to a repetition of earlier mistakes, such as investing in government tractor operated and managed schemes. In the view of FAO and UNIDO, if SSA is to be successful in this area, then there is a need to learn from both the positive and negative experiences of the past four decades in developing and implementing mechanization programmes in Africa as well as from other regions such as Asia, where the uptake of mechanization was quite successful in the 1970s and 1980s.

The two organizations therefore decided to convene an expert group meeting [EGM] with the objectives of reviewing the current situation and constraints on agricultural mechanization in Africa and of recommending ways through which these could be tackled to support economic growth and poverty reduction. This EGM, attended by participants from all over SSA as well as other parts of the world, was held in Vienna, Austria on 29 to 30 November 2007.

FAO and UNIDO do welcome the conclusions and recommendations of the EGM. Both organizations will, to the extent that resources allow, endeavour together to implement the specific recommendations directed at them over the period of the next 3–4 years and beyond.

FAO and UNIDO are particularly pleased to note that the African Union (AU), through its Commission for Agriculture and Rural Development, participated fully in the EGM. Both organizations look forward to increased collaboration with the AU in developing new initiatives on agricultural mechanization in SSA. Agricultural machinery and implements are an essential input in African agriculture. The publication of this report will hopefully move the discussions on agricultural mechanization from being on the banks to the mainstream of the debate on agricultural development in sub-Saharan Africa. Now is the “Time for a New Look” at agricultural mechanization in this region.

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1. Introduction

This paper presents the conclusions of an Expert Group Meeting (EGM) jointly hosted by the United Nations Industrial Development Organization (UNIDO) and the Food and Agriculture Organization of the United Nations (FAO) in Vienna, Austria, on 29 and 30 November 2007. The topic of the meeting was “*Agricultural Mechanization in Africa – Time for a New Look*” and it was subtitled “*Planning Investments for Enhanced Agricultural Productivity*”. A list of participants to the EGM is appended.

The objectives of this EGM were: to review the current situation and constraints of agricultural mechanization in Africa; and to recommend ways through which these could be tackled in order to support sustainable economic growth and poverty reduction. The EGM considered, among other things, pathways through which African farmers and rural communities can achieve higher intensities of agricultural production through investment in mechanization. It is only through appropriate mechanization that African farmers will be able to feed not only themselves but also the continent’s burgeoning urban population. Productivity will have to increase dramatically if African farmers are to be able to feed their families and spare some of their production for the market. Food production must increase in order to cope with the expected population increase, while at the same time addressing pertinent global challenges such as environmental degradation and climate change. Overall, action is acutely necessary to resolve today’s problems in order to prevent them from becoming tomorrow’s catastrophes.

Agricultural mechanization is the application of mechanical technology and increased power to agriculture, largely as a means to enhance the productivity of human labour and often to achieve results well beyond the capacity of human labour. This includes the use of tractors of various types as well as animal-powered and human-powered implements and tools, and internal combustion engines, electric motors, solar power and other methods of energy conversion. Mechanization also includes irrigation systems, food processing and related technologies and equipment. Mechanization is not an “all or nothing” process. Levels and types of improved mechanical technologies need to be appropriate, that is, compatible with local, agronomic, socio-economic, environmental and industrial conditions.

Some progress has been achieved in Africa in the last two decades with regard to agricultural production. Nevertheless, agricultural operational efficiency and productivity, and, therefore, the prosperity of a very large proportion of the African population, has remained a problem. Recently, a number of the factors that hindered mechanization efforts and processes in the past, be they socio-economic, technological or political, have moderated. Africa’s institutional, industrial and financial knowledge and capacities have improved since the turn of the century. Therefore, it is timely to give agricultural mechanization a new look.

This paper summarizes the EGM’s overview of the mechanization scenario with a view to setting the new strategies to meet today’s challenges towards transforming African agriculture.

Critical issues that need to be considered by governments and other stakeholders in the quest for attainment of sustainable agricultural mechanization from a value chain perspective are presented. Possible actions to be taken by governments and various stakeholders are proposed, including highlighting new and emerging opportunities.

The EGM concluded that agricultural mechanization in Africa, as elsewhere in the world, is a viable economic activity and, indeed, the missing link in efficient utilization, preservation and value addition in exploiting natural resources for improved quality of life. Therefore, agricultural mechanization is a priority area requiring urgent and strategic investments by all African governments. The EGM defined, albeit briefly given the time constraints, the strategic approaches that Africa can uniquely use while learning from the experience gained and practices developed elsewhere in the world.

Development and modernization of Africa's agriculture and its agro-industries will depend to a large extent on the transformation of policies for education and entrepreneurship. It is argued that for sustainable agricultural growth to take place in the short to medium term, there is the need to urgently develop mechanization policies or adjustments that will set Africa's farmers on a sure and sustainable path to commercial farming. The creation of growth environments that place emphasis on support to professionalism and entrepreneurship in agricultural mechanization are likely to be the key driver to the sustained development that African agriculture needs. Much valuable time has already been lost; the time for action is now.

2. Overview of agricultural development and mechanization in Africa

2.1 CONTRIBUTION OF AGRICULTURE TO THE NATIONAL ECONOMY

Most developing countries and, indeed, African countries have an economy strongly dominated by the agriculture sector. Agriculture generates up to 50 percent of gross domestic product (GDP), contributing more than 80 percent of trade in value and more than 50 percent of raw materials to industries. It provides employment for the majority of Africa's people. Despite this domination and the fact that agriculture is backed with good policy documents and statements, investment in the sector is still grossly underdeveloped in most African countries. Furthermore, 30 to 40 percent of agricultural produce is lost owing to poor post-harvest handling, storage and processing methods. Therefore, there is high potential for lateral expansion of the agriculture sector at all levels. The low level of engineering technology inputs in agriculture has been cited as one of the main constraints hindering the modernization of agriculture and food production systems in Africa.

2.2 AGRICULTURAL PRODUCTION

Africa is the only region in the world where agricultural productivity is largely stagnant. Yields of maize and other staple cereals typically remain at about 1 tonne per hectare (1 000 kg/ha), which is about one-third of the average achieved in Asia and Latin America (Table 1). In the years ahead, global warming is expected to exacerbate seriously the current constraints on African farmers.

Table 1: How Africa compares with other developing regions

Region	Cereal yield kg/ha	Fertilizer use kg/ha	Irrigation % 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

¹ Africa less Egypt and Mauritius.

² Bangladesh, Brazil, China, India, Pakistan, Philippines, Republic of Korea, Thailand, Viet Nam.

Source: World Bank, World Development Indicators, Table 32, Jan. 2007.

2.3 EXPERIENCE IN OTHER CONTINENTS

Experiences in other continents and especially in the developing economies of Asia and Latin America show that agriculture has been transformed in recent years into a progressive

commercial industry. Investment in agricultural mechanization has enabled farmers to intensify production and improve their quality of life as well as contributing to national and local prosperity. In countries such as India, China, Brazil and Turkey, the rapid expansion in farm machinery demand has stimulated the growth of local machinery manufacture to the point where these countries are now major producers and world leaders in farm machinery exports. Much the same could happen in Africa, if African farmers could be helped to intensify their farming through increasing levels of mechanization. This would lead to improved land use, increased food production, enhanced rural prosperity and, on a national scale, greater export potential and less reliance on imports.

2.4 AGRICULTURE AND URBAN MIGRATION

In a world where agriculture is increasingly a commercial activity, SSA exhibits historical patterns of subsistence farming in a deteriorating physical environment. Agricultural communities are thereby locked into poverty, food insecurity and excessive reliance on food imports. Increasingly, rural youth, who associate subsistence and even potential commercial farm activities with hard physical labour and drudgery, are disenchanted with the meagre opportunities for a rural livelihood, worsening an already marked tendency to rural–urban migration.

2.5 FARM POWER IN AFRICA

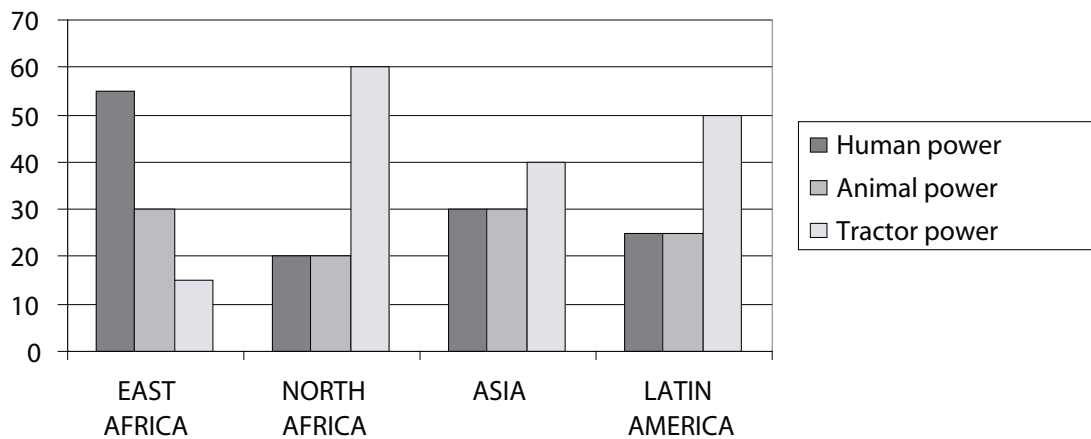
Farm power in African agriculture, especially SSA, relies to an overwhelming extent on human muscle power, based on operations that depend on the hoe and other hand tools. Such tools have implicit limitations in terms of energy and operational output in a tropical environment (Figure 1). The relationship between hand, animal and engine power sources in Africa compared with other developing regions is shown in Table 2. In general, animal and tractor power have both declined in African agriculture in the past few years, making agriculture yet more reliant on manual methods in a continent where constraints such as severe health problems and demographic shifts make manual labour a scarce and weak resource. These methods place severe limitations on the amount of land that can be cultivated per family. They reduce the timeliness of farm operations and limit the efficacy of essential operations such as cultivation and weeding, thereby reducing crop yields.

Table 2: Farm power sources (percentages)

Region	Hand	Animal	Engine
SSA	65	25	10
3 other developing regions*	25	25	50

* Asia, Near East and North Africa, Latin America and Caribbean.

Source: FAO, 2005, *World Agriculture, Towards 2015/2030*, Table 4.16.

Figure 1: Farm power sources (in percentages) in Africa, Asia and Latin America

2.6 COMPARATIVE INCREASES IN MECHANIZATION INPUTS

In the 1970s, Asia advanced in prosperity tied to increasing commercialization of agriculture by supporting massive investments in irrigation, fertilizer and high-yielding varieties (the green revolution). This went hand in hand with increasing power inputs, mainly in the form of tractors for land preparation and diesel engines for irrigation.

In mostly semi-arid Africa, where farming systems were more complex across variable agro-ecological zones, quality seed and fertilizer were not backed by irrigation support or mechanization inputs. Therefore, Africa missed out on the green revolution. Table 3 illustrates the greater advances in mechanization in other regions compared with SSA. This suggests a major opportunity for Africa to catch up with other regions.

Table 3: Growth in tractor numbers between 1961 and 2000

Region	Increase %
Asia	500
Latin America and Caribbean	469
North Africa and Near East	1 350
Sub-Saharan Africa	28

Source: FAO, 2004, Agricultural Mechanization in sub-Saharan Africa.

2.7 NEED FOR MECHANIZATION PLANNING

One of the major reasons for the disappointing performance and low contribution of mechanization to agricultural development in Africa has been the fragmented approach to mechanization issues. This can be attributed to poor planning by government agencies and over-reliance on unpredictable or unsuitable, one-off aid-in-kind or other external mechanization

inputs. Lack of teamwork or coordination within and between governments and the inherent competition with private-sector business initiatives in mechanization services have not helped the situation. Formulation of national agricultural mechanization strategic and implementation plans has been seen as the solution, but even these have hardly come to fruition. Strategic national and regional plans would bring about the critical mass that is needed to make machinery contractual services viable, hence fertile ground for entrepreneurship. They would bring about holistic and system-based mechanization plans and processes where comparative advantages and roles of key players in the social, technical and economic environment would be clear and, therefore, effectively exploited. In most African countries, no serious planning for sustainable mechanization has taken place. In many cases where mechanization has made a positive contribution to agricultural development, it has been a question of getting the right machine on the right enterprise by chance, not by credible project or programme design.

3. Key issues and challenges of agricultural mechanization in Africa

3.1 AIMS OF MECHANIZATION

As a major agricultural production input and a catalyst for rural development, mechanization aims to:

- increase the power inputs to farming activities, hence putting more land into production;
- reduce drudgery in farming activities, thereby enhancing lifestyles;
- improve the timeliness and efficiency of farm operations;
- accomplish tasks that are difficult to perform without mechanical aids;
- improve the quality and value of work, produce and processed products;
- provide employment (entrepreneurship) and sustainable rural livelihoods;
- provide agriculture-led industrialization and markets for rural economic growth.

3.2 TRACTOR NUMBERS

Table 1 suggests that other developing countries have about ten times as many tractors per unit of farmland as those in SSA. Current statistics indicate that there are about 470 000 tractors in Africa, but little is known about their age or working condition. The total number of working tractors would have to be about 3.5 million (7 times more) to put Africa on a par with other regions. Assuming that the existing tractors are all functional, the annual replacement rate should now be about 47 000 units/year (assuming a ten-year life). A simple calculation suggests that to bring the level of power to agriculture to that which other developing countries have achieved, this annual market would have to expand by a factor of about ten to approximately 400 000 tractors per year. Such a growth in tractor sales cannot be achieved immediately but could be in, say, 10 or 12 years. This would require urgent action to stimulate the market to attain sales of the order of 100 000 units per year within two or three years. As a comparison, tractor sales in India in 2005–06 were 264 790 units.

3.3 IRRIGATION AS A CATALYST FOR MECHANIZATION

Apart from low power inputs, African agriculture suffers from a lack of investment in irrigation compared with other regions of the world. Only about 5 percent of Africa's arable land is irrigated, while in India the figure is 40 percent. Other parts of the developing world average about 30 percent. In a changing climate, irrigation is likely to become even more important. This suggests that increasing the irrigated area in Africa by a factor of about ten would not be excessive, and it would make a major contribution to agricultural productivity. Investment

in large irrigation schemes would be a long-term process but much might be achieved in small schemes for small groups of farms. In mechanization terms, this suggests a substantial opportunity for sales of pumps, diesel engines and related equipment. This is a parallel mechanization opportunity, a challenge for local African manufacturing industry to take on.

3.4 THE AGRICULTURAL MACHINERY INDUSTRY

In Africa's hand-hoe-powered agriculture, it is hardly surprising that very little industrial development has taken place to manufacture or even assemble machinery for agriculture. A few farm tool and implement factories have been established, mainly in South Africa, Zambia, Kenya and Zimbabwe. Few efforts in other countries have survived competition from the importation of low-cost tools from countries in other continents (e.g. China and India). The manufacture and even assembly of tractors and irrigation pumps has been limited to a very few underperforming enterprises, mainly in North Africa. It is clear that, if the tractor and irrigation markets could be expanded, the opportunities for African manufacturing industry would also expand. In fact, if the tractor market envisaged in Section 3.2 could be established, there would be ample scope for tractor assembly, component substitution and, eventually, tractor manufacture in Africa. At the same time, the number of implements that would be required could stimulate the growth of implement manufacture on a wide scale across the continent.

3.5 FOOD PROCESSING AND VALUE ADDING

Farmers produce raw materials for the food market. Agro-industries add value to produce, and they are an essential component of the value chain in modern economies. The development of small-scale processing industries in rural communities would help add value close to the source of raw materials. Rural industry would grow to benefit the rural communities, initiating the path towards commercialization of agriculture. This would reduce the current high levels of waste of fresh produce and would encourage producers to participate in rural commercial economies.

3.6 PAST MECHANIZATION EFFORTS

Past efforts of various African governments and donors to accelerate the use of mechanization inputs have produced mixed results. Compared with other regions, Africa has not had the large-scale investment in agricultural infrastructure, such as irrigation, or other inputs needed to intensify crop production. This is partly because Africa is fragmented into relatively small farming regions and even countries, unlike countries such as Brazil, India and China, which are large enough to create a critical mass for investment on a subcontinental scale. Investment in mechanization has been limited to large commercial farms or government schemes. In many cases where governments established tractor-hire schemes to serve small-scale farmers, planning was very short term and management was poorly trained and poorly supported. Such schemes, although relatively few across the continent, failed miserably, denting the image of agricultural mechanization in general.

3.7 SUCCESS CASES

Mechanization schemes have been successful in many countries in Africa, particularly when coupled with irrigation. For example, the Gezira Scheme in Sudan has a history of mechanization that goes back to 1924 when steam was, for a few years, the motor power before internal combustion engines took over. By the 1970s, 100 000 tenant farmers were cropping 760 000 ha with the assistance of mechanized cultivation services provided by the scheme under contract.

Elsewhere, mechanized schemes with tenant farmers or outgrowers for crops such as cotton and sugar have been successful. Individual farmers in many African countries have taken the opportunity to acquire machinery, often second hand, for their own farm operations and to contract cultivation services to neighbours. These have been isolated cases but they do indicate that African farmers have begun to recognize the usefulness and operationalization of machinery services.

3.8 THE NEW “FARMER EMPOWERMENT” AND AGRIBUSINESS SCENARIO

Farmers are increasingly learning and accepting that “farming” is a business like any other. However, in order to gain strength and minimize risks, it has been shown that group formation has been a powerful tool for risk reduction and empowerment. When farmers become organized, they find themselves in a better position to control their business. A farmer group (perhaps a Farmer Field School) can more easily open a bank account to gain access to rural finance providers. Members of groups have a better chance to branch out and become agricultural equipment service providers to their own group members. In this way, business and entrepreneurship can evolve from the bottom up and may spread to medium-scale and larger-scale sustainable agricultural mechanization scenarios.

3.9 MEETING THE CHALLENGES

Some other challenges facing Africa in the effort to raise agricultural productivity and rural prosperity are:

- how to make agriculture more of a commercial enterprise so that it generates the cash needed for continued and sustainable investment;
- how to strengthen the investment climate to attract funds from international investors;
- how to overcome the fragmentation of markets;
- how to exploit the food chain and value addition opportunities at rural level, to create employment;
- how to overcome the skills bottlenecks so that modern technology may be adequately supported;
- how to approach climate change, recognizing its dangers and planning cultural and technical adaptations in mitigation of potential problems;
- how to approach the possibility of energy shortages resulting from the future scarcity and cost of fossil fuels;
- how to mechanize agriculture in a sustainable way without precipitating environmental deterioration.

4. Time for a new look

“If agricultural mechanization efforts are to succeed in Africa, there is an urgent need for all concerned, be they farmers, supporters, planners or policy-makers to understand and contribute to agricultural mechanization efforts across the entire farming system and with a value chain perspective.”

A new look and perspective to address mechanization issues in Africa is urgently called for. This will require deliberate government intervention in creating an enabling environment and a strong mechanism to support farmers, manufacturers and other entrepreneurs, such as contract hirers, in leading the way in mechanization efforts.

4.1 DEVELOPMENT PARADIGM SHIFT

Many African countries have suffered in international development terms from characterization as Heavily Indebted Poor Countries (HIPC), and the development paradigm resulting from that status has been one of poverty alleviation rather than investment for economic growth. A new look at development planning is needed in which the focus is on sustainable economic growth.

4.2 CURRENT MACHINERY INPUT STATUS

Among European and North American farm machinery manufacturers traditionally responsible for supplying equipment to Africa, two problems have reduced their interest in the continent. First, the machines they produce are for Western large-scale and capital-intensive farming markets, and these are increasingly sophisticated, large and expensive. Second, the African market is perceived as declining relative to two decades ago, hence, not worthy of investing marketing resources in. On the other hand, emerging economies, especially in Asia, are producing machines more suited to Africa in terms of both specification and price. What is needed is for the producers in Asia to adopt the marketing and technical support practices that hitherto have made European manufacturers highly successful in worldwide machinery marketing.

4.3 CURRENT OPPORTUNITIES

If the mechanization challenges can be tackled successfully, there are several opportunities that can be exploited. These include:

- the new-found climate of optimism already evident in many African countries, supported by generally positive economic growth indicators;
- new sources of farm machinery, more suitable for African conditions, from the newly-emergent industrial economies such as India, China and Brazil;
- the growing use of intermediate and non-motorized means of transport including draught animals and carts, bicycles or motorbikes;
- conservation agriculture and its advantages in reversing soil degradation and loss, increasing fertility, and reducing the power demands for cultivation;
- efficient manual and animal-powered minimum and no-till direct-seeding and chemical-application systems in conservation agriculture establishments (Zamwibe, animal-drawn direct seeders, pedestrian and animal-drawn sprayers, knife rollers, etc.);
- alternative energy sources such as biomass, wind, solar, microhydropower and biodiesel;
- the information technology explosion, including the Internet as a ready source of information and the cell phone as a means of communication for rural communities;
- new crop varieties and new cropping opportunities resulting from climate change concerns.

4.4 FOCUSING THE NEW LOOK

The focus should be on the farming family and the rural community in which such families operate. This has new opportunities under the newly found and growing Farmer Field School system and other common interest group (CIG) empowerment approaches. Engagements with this level of actors should be conducted with the intention of boosting the entire value chain by:

- transforming agriculture from a subsistence to a commercial activity;
- attracting investment in agricultural infrastructure, particularly irrigation and roads;
- adding value to farm outputs through agroprocessing at community level;
- fostering the demand for high-quality inputs, be they seeds, fertilizer, and agrochemicals and all forms of farm equipment;
- fostering the demand for mechanization technology and services by exploring ways of mechanizing more operations such as crop spraying, hay baling, silage production, and farm transport;
- fostering the financial sector, including rural finance networks to recognize the immense need for medium-term finance schemes, especially for production and processing equipment and farm power (tractors and draught animals);
- fostering market access, information and trade networks.

4.5 SUSTAINABLE MECHANIZATION

To achieve sustainable mechanization levels in agricultural production and processing, Africa needs its own crop of entrepreneurs to seize the market and technical opportunities of the twenty-first century. The entrepreneurial potential of the African farmers, agricultural engineers, artisans and traders should be enhanced systematically and as proposed in the following chapter.

5. Recommendations and the way forward

5.1 THE WAY FORWARD: TIME FOR ACTION

No longer can Africa remain subject to the limitations of manual labour and subsistence farming. Demographic shifts mean that a decreasing rural population is becoming increasingly responsible for feeding an ever-growing urban population and market. Population growth and population migration will soon be compounded by other problems, such as climate change and energy supply issues, to make the situation even more unsustainable. Therefore, it is essential that governments pay urgent attention to the situation so as to understand the issues, tackle the challenges, and take a fresh look at the opportunities available for devising a new way forward.

5.2 STRUCTURAL AND INSTITUTIONAL CHANGES

Before the mechanization opportunities can be fully exploited, a number of issues need to be addressed, such as:

- Structures of landholding and landownership: Farmers should be able to buy and sell land and enjoy full entitlement of their holdings. In this way, they will have security of tenure and the possibility of using their farms as collateral for loans. With funds, they can develop the land, buy machinery or even buy more land to make mechanization viable. Larger farms should be the goal, and further fragmentation of farms should be discouraged where possible.
- Fiscal regime: The development of commercial agriculture and the industrial enterprises associated with it need a supportive fiscal regime in which taxes are low and barriers, such as import duties on agricultural machinery, spare parts and raw materials for local manufacturing, are minimized.
- Finance: Increased capitalization of agriculture needs sources of finance on favourable terms, whether from the private sector alone or from a blend of private and public capital, possibly including international donor funding. The financial sector, with agribusiness-type intermediaries, should work with commercially-oriented farmers and entrepreneurs in order to strike the necessary financial deals that are required for increasingly commercialized farming.
- Education and training: Training is necessary and paramount, not only for farming skills but also for management of farm machinery and other technologies, finance, forward planning, marketing, etc. Credible training schemes are necessary. Farmers cannot learn overnight, and they need regularly updated processes of lifelong learning, as exemplified by Farmer Field Schools.
- Research and extension: The technology that farmers require needs to be locally sourced and adapted to local conditions in a continuous process of research, adaptation, extension,

monitoring and evaluation. “Certification” of machinery is also needed in order to give relevant information to farmers and extension services on the actual performance of machinery in local conditions of use. The examples of OECD and Nebraska tractor test codes should be examined and adequately adapted for Africa’s simpler situations. Impartial testing for the whole range of nationally-manufactured farm equipment will be needed to support manufacturers in producing good quality products. Manual and animal power systems will need to be included in all aspects.

- Input sourcing: Farmers must have local access to the inputs they need, including seeds and fertilizers, electricity and water as well as machinery and the supporting infrastructure that mechanization requires (e.g. repair services, parts supply, fuel and lubricants). The private sector has a vital role to play in this respect in partnership with farmer organizations.

5.3 BUILDING PARTNERSHIP

A broad partnership is required between the public-sector and private-sector agencies and actors. Governments should be encouraged to facilitate and support such initiatives. Special government tasks will cut across infrastructure, education, health, transport, water resources, fiscal measures and legislation. The ideal situation has been described as the “Triple Helix Model” in which government, public institutions and industry are entwined in a mutually supportive cooperative endeavour.

Governments have a role in the broad field of education and training, in the creation, funding and management of institutions responsible for the acquisition of knowledge (research), and in its dissemination. Specialized institutions are needed, geared to supporting agriculture in general or farm mechanization in particular. They may be national in character, or regional for countries facing common problems with possible common solutions. Government should facilitate the process of agricultural mechanization development.

The private sector is better equipped to look after the day-to-day provision of farm inputs including farm machinery and the associated vital machinery support services. Operations are best conducted under commercial enterprises requiring adequate investment and offering the opportunity to make profitable commercial returns. Local manufacturing can be logically preceded by profitable importation, assembly and distribution support businesses. Building close relationships with the farmers, assessing needs and satisfying demands, while competing with peer companies, are all part of the business venture. In this kind of operational scenario, demand for mechanization is likely to be satisfied and agricultural productivity enhanced.

Government may have a role in facilitating trade relationships with new suppliers of technology or equipment. Government may need to make the first moves, such as importing the first consignment in partnership with the private enterprise, and thereafter allowing it to take over. Support with supply and demand contacts, management and finance securities or tax waivers would help the private sector to come up to speed in a relatively short period.

Box 1 illustrates the situation in Ghana, where government identified the need to play a direct role, but only in finding new sources of machinery.

Box 1: Mechanization in progress

In Ghana, the Government has embarked on a programme of mechanization to relieve labour shortages in parallel with the expansion of irrigated agriculture from 8 000 ha to 20 000 ha. In the three years 2004–06, 3 000 tractors were imported, and for 2007 additional imports of 2 000 tractors were anticipated. These are 30–50 kW tractors from India, China, Japan and Czech Republic. They are being sold to farmers on a full-cost-recovery basis with a 50 percent downpayment and term payments, with interest, over three years. To take advantage of the scheme, farmers have to convince the district agricultural authorities that they have the necessary land and business skills. Demand from farmers is high as they are involved in commercial agriculture and able to create opportunities for multifarm use in the community. The history of tractor use in Ghana suggests that the infrastructure exists for maintenance, repair and parts supply.

Governments also have a role in maintaining standards. In the case of farm machinery, standards may be specified in relation to the local conditions and, more generally, to quality and the provision of service support. Standards may also be laid down in regulating the farm output marketing infrastructure and in maintaining food quality and hygiene.

Farmers are the key actors. African farmers need assistance to expand their horizons to the opportunities that may be exploited to farm on a larger scale. They need to intensify their cropping and productivity by investing in inputs such as seeds, fertilizer, irrigation and farm equipment, with a view to fully participating in the cash economy and bringing its benefits to their families and communities.

International technical institutions such as UNIDO and FAO have a role to play in bringing their expertise to bear on the problems and challenges described above. In particular, UNIDO and FAO can offer a holistic approach developed over many years in a wide range of situations. FAO can assist in producing Agricultural Mechanization Strategies (AMSs) for specific countries or regions. UNIDO has developed analytical tools to put the whole Agricultural Machinery Industry System (AMIS) in perspective for development purposes.

International financial institutions such as World Bank (WB), the African Development Bank (ADB) and the International Fund for Agricultural Development (IFAD), as well as foreign government sources, may be invoked in tackling the funding needs of the plans suggested below.

6. Proposed action plan

6.1 OBJECTIVE

The objective of the proposed action plan is to achieve substantial increases in agricultural productivity through:

- farmer empowerment and increased numbers of commercially active farmers and agriculture-related rural entrepreneurs (female farmers and entrepreneurs are included);
- improvements in mechanization patterns, including irrigation and special applications such as weeding and chemical application;
- a major increase in the power available to agriculture;
- stronger networks for input supply and technical support;
- a major increase in land under cultivation;
- parallel increases in crop yields;
- growth in the agriculture sector with environmental protection and long-term improvements in soil and moisture conservation;
- a major increase in farm produce marketed;
- an increase in value added to raw materials in rural communities;
- a major increase in cash flows to the rural communities;
- development of a viable agricultural machinery industry, including manufacture of a range of agricultural implements and, eventually, diesel engines, pumps and tractors.

6.2 SUSTAINABILITY

The plan must be seen as a long-term, persistent effort, needing time to evolve, harnessed to the rhythms of agriculture and the pace at which agriculture responds to market stimuli, soil improvement, investment in irrigation and the realization in the agricultural community that change can be beneficial.

The required productivity improvements will arise through a process of evolution at the grassroots level if adequately supported at an institutional level. Although some public-sector institutions will have a role to play, the main driving force for the plan will be demand from farmers anxious to expand newly found opportunities into commercial agriculture.

The plan will succeed best where it is associated to parallel improvements in agricultural infrastructure, agrobiological, and technical and economic management skills among farmers. The momentum gained will depend on the strength of the institutions supporting agriculture.

6.3 OUTCOME

The outcome of the plan should be a prosperous rural community geared to local market requirements with access to sufficient power to maximize crop production. Such a community should not be constrained by labour shortages, and it should give proper regard to sustained environment protection for truly long-term benefits. Model countries will be selected to establish and trial the needed support systems and provisions for a viable mechanization scheme. Similar progress will follow in neighbouring countries, stimulated by successes in model countries where the efforts will have been proved. In national and, eventually, regional terms, food supplies should be more secure, with minimal need for imports and enhanced opportunities for tapping into the export market. In parallel with the development of commercial agriculture, the plan would engender development of agro-industries, mainly in rural communities, geared to the conversion of agricultural raw materials into marketable products and manufacturing inputs, such as tools and machines for local agriculture.

6.4 BASIC PLAN

The basic plan elaborated by the Vienna EGM proposed substantial investments to strengthen selected existing institutions based on a regional focal-point approach. Institutions identified and supported to be centres of excellence will be engaged in agriculture and agricultural engineering efforts in order to improve their capabilities in:

- adaptive research: – finding the most appropriate methods, machines and equipment;
- education and training: – creating a cadre of trained and specialized technicians, farmers and operators;
- extension services: – providing farmers with the technology they need, under farmers' terms;
- communication: – extending successes achieved to a wider audience.

6.5 REGIONAL PLANNING APPROACH

Owing to the diversity of the African continent, and on the basis of existing major political-economic regional groups, e.g. Economic Community Of West African States (ECOWAS), Common Market for Eastern and Southern Africa (COMESA), Southern African Development Community (SADC), West African Economic and Monetary Union (UEMOA), and Arab Maghreb Union (UMA), in Africa, it is proposed that key pilot institutions should be selected to lead the way in each of the five regional groupings, namely: North Africa, West Africa, Central Africa, East Africa and Southern Africa.

These key Institutions will be developed as regional centres of excellence in agricultural mechanization. They will be selected for their perceived readiness for improvement and for their location in relation to regional needs. A key element of the plan is to create a ripple effect, starting locally then widening to achieve productivity enhancement over increasingly greater areas – first on a national scale, and later on a regional scale.

6.6 KEY INSTITUTIONS AND RADIATION FROM A CLUSTER

At least one institution or a set of institutions per region will be established as a centre of excellence. Typical institutions might include an agricultural engineering institute, university or research centre. It is important that the selected institutions in each region form a cluster and work together for maximum effect. One among them might be chosen as the lead entity, with a title such as Rural Mechanization Lead Centre (RMLC). They might all be within one country (the core country) within the region. The principle to be followed is that the influence of the chosen institutions in increasing agricultural productivity and rural prosperity should be radiated first within the core country and then throughout the region.

6.7 MAIN FUNCTIONS OF THE KEY INSTITUTIONS

The tasks of the RMLCs and associated centres of excellence for agricultural mechanization will be to research and adapt the most appropriate mechanization technologies for the area, and to promote the technologies through the deployment of a cadre of trained technicians among increasingly wide circles of farmers and rural communities. The extension service so constituted would create a sustained flow of information to and from the farming community, thus ensuring:

- the work of the centre is attuned to the needs of the farmers;
- the farmers benefit from a process of lifelong learning that will equip them to modernize, intensify and commercialize their agricultural operations.

6.8 FRAMEWORK FOR RURAL FINANCE, LED BY THE FINANCIAL SECTOR

Rural or agricultural credit mechanisms are needed in order to provide the finance to farmers and rural agro-industries so that they can buy the equipment they need. The financial institutions required to provide this function may need to be strengthened or, where they are absent, they will have to be put in place. Issues relating to land security need to be resolved. Financial services are important in any development activity. Experience has shown that farmers and agroprocessors, as well as manufacturers, will require funds to enable them to carry out the proposed activities.

6.9 INDUSTRIAL DEVELOPMENT ROLE

The key institutions should also work with local entrepreneurs, artisans and manufacturing industries in two important areas:

- agro-industrial conversion of agricultural raw materials into marketable products for local or export markets;
- development of the AMIS for production of agricultural tools and machines for local or regional farm use based on their interaction with farmers and their assessment of the industrial manufacturing potential of the mechanization scenario.

6.10 INTERNATIONAL SUPPORT

Once the key institutions or centres of excellence for agricultural mechanization have been chosen and the core countries identified, financial support for implementation of the action plan will be sought. This will be done with the assistance of international and regional bodies such as ECOWAS, COMESA, SADC, UEMOA, New partnership for Africa's Development (NEPAD), FAO and UNIDO.

FAO will ensure that an up-to-date AMS for the core country is available to the RMLC in order to guide its selection of mechanization technology.

UNIDO will assess the AMIS for the core country and identify input networks and industrial opportunities in the agricultural engineering sector. It will also support the development of the AMIS through capacity building, technology transfer, promotion of standards for testing and evaluation, etc.

International funding agencies will assist with the capital cost of bringing the RMLC and associated institutions up to a satisfactory condition. Funding for whatever programme of projects may be indicated in the AMS/AMIS, and possibly assistance with the running costs of the RMLC programme, will be sought.

Machinery manufacturers worldwide will be contacted with a view to offering competitive opportunities to participate in developing the new inputs market and associated potential in Africa.

7. Concluding remarks

It is generally agreed that agriculture will continue to be the most important sector in the economy of most African countries. Therefore, it is logical to re-direct efforts towards this sector. Some of the key driving factors for the uptake of mechanization in Asia in the 1970s and 1980s have been highlighted elsewhere, and these include:

- The presence of a sizable number of farms in business able to invest in machinery and to provide mechanization services to neighbouring farmers.
- Availability of registered land that affords farmers an opportunity to use the title deeds as collateral for credit to purchase machinery or more land.
- Farmers' entrepreneurial skills and adaptive management capacity to changing markets, technologies and policies including opportunities to use agricultural machinery for off-farm and non-agricultural activities such as transportation and infrastructure maintenance.
- Policies encouraging industrialization resulting in high levels of demand for mechanized equipment, leading to the development of low-cost equipment (e.g. power tillers and diesel engines).
- Mechanization of power-intensive processing and pumping operations that complement the mechanization of crop husbandry and harvesting operations.

The paper recommends the following actions be put in place to enhance the mechanization inputs in African agriculture:

- Support and encourage the existing advanced and successful commercial farming sector.
- Place more emphasis on the development of small-scale farmers particularly in the following areas:
 - a. the use of appropriate and affordable power options;
 - b. credit acquisition;
 - c. effective supply of agricultural inputs (including spares);
 - d. marketing systems;
 - e. encouraging the formation of farmer groups with increased capacity to participate in the commercial sector.
- Strengthen input supply networks and promote the manufacturing base on agricultural operations and processing technologies. The goal is to increase the availability of agricultural machinery and equipment for land preparation, agroprocessing and other operations.
- Promote environmentally friendly mechanization practices that will result in sustainable economic growth. The outstanding success of no-till and conservation agriculture practices in Brazil and India is a good example of the approach to be taken.
- Provide in-service training for extension officers, artisans and other entrepreneurs to improve their understanding of the different power and mechanization options available to farmers and to expose them to new technologies and opportunities.

- Develop a comprehensive agricultural mechanization strategy (AMS) and industry development strategies (AMIS) for the countries at regional level.
- The importation and distribution of farm machinery is basically a private-sector function. Most countries have a range of competing machinery importers, distributors and dealers that will service input supply networks. They will enable the expansion of the farm machinery market as projected in this plan. Part of the function of the AMS and AMIS studies will be to identify the strengths and weaknesses in the existing structures and to suggest pertinent improvements. Help will be needed from governments to re-align emerging mechanization networks with new sources of supplies, hopefully, not at the expense of traditional sources. Government-level trade negotiations may be required with new supplier countries. Efforts may require adjustments in the import tariff structure, import licensing regulations and the imposition of national or regional standards with regard to specification, quality, guarantees and service support. The establishment of adequate repair, maintenance and parts supply lines, as well as local stocks, is particularly important.

“In order to reverse the trend and end the hunger in the region and lift millions of people out of extreme poverty and sustain Africa’s economic growth, what is required is nothing less than an African green revolution.” Jacques Diouf, 2007

African leaders understand the importance of mechanization in the future vision of Africa. Therefore, efforts to accelerate mechanization will require substantial long-term political and financial commitments. The African leaders will need to take a long-term perspective of mechanization as Asian government leaders did in the 1960s and 1970s. Otherwise, African agriculture will be doomed to continue using ancient tools to the detriment of the environment, food security, overall agricultural development and economic growth.

“It is the time for a new look at agricultural mechanization in Africa.”

Annex

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"AGRICULTURAL MECHANIZATION IN AFRICA - TIME FOR A NEW LOOK"
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