

Integrating mechanisation into strategies for sustainable agriculture

Summary report and recommendations
CTA Seminar

Ouagadougou, Burkina Faso, 24-29 November 1997

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Technical Centre for Agricultural and Rural Cooperation (CTA) was established in 1983 under the Lomé Convention, between the African, Caribbean and Pacific (ACP) States and the European Union (EU) member states.

CTA's tasks are to develop and provide services that will improve access to information for agricultural and rural development, and to strengthen the capacity of ACP countries to produce, acquire, exchange and utilise information in these areas. CTA's programmes are organised around three principal themes: strengthening ACP information capabilities, promoting contact and exchange of information among partner organisations and providing information on demand.

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Foreword

Introduction and seminar methodology

Mechanisation background and scope

Farm production and rural transport require power. There are three main options: human work, animal power and the use of motors. The choice depends on local circumstances. Human, animal and machine power can complement each other in the same household, farm and village. Agricultural mechanisation involves the use of tools, implements and machines to improve the efficiency of human time and labour. The most appropriate machinery and power source for any operation depends on the work to be done and the relative desirability, affordability, availability and technical efficiency of the options. A hand hoe may be the best tool for intensive vegetable production. However, if much work needs to be done, human power alone is generally slow and tiring. Mechanisation, using animal or motor power, can significantly increase the productivity of human labour and improve the quality of life for women, men and children.

Agricultural mechanisation is not an end in itself, but a means of development. The goal is sustainable and socially-beneficial agricultural production. The hardware is just one component of very complex farming systems. A wide range of social, economic and ecological factors determine whether a technology is practicable, beneficial and sustainable in an area.

Sometimes mechanisation is confused with motorisation and tractorisation. Tractor power is just one option. In sub-Saharan Africa, some of the most successful mechanisation introductions have used animal power. In the CTA seminar and in this report, mechanisation is understood to encompass a range of technologies, using human, animal or motor power.

The present levels of the various forms of agricultural mechanisation in Africa can only be estimated. It is widely acknowledged that most agricultural work (perhaps 80%) depends entirely on human labour. Animals may perform up to 20% of the operations, while in tropical Africa tractors contribute only a small proportion of the total agricultural work.

During the last decade, structural adjustment programmes have changed the economic environment of African agriculture. Changing prices, currency values, government services and policies have affected the profitability of agriculture in both smallholder and large-scale production systems. The conditions for profitable manufacturing/importing, distributing and repairing agricultural equipment have also changed.

In many countries, farmers have appealed to development programmes and governments for assistance with farm power and mechanisation. In some areas, farmers have demonstrated there is a clear economic demand for animal power and/or tractors. In other areas, such mechanisation remains a dream, being economically unsustainable in present circumstances. Government services involved in the development of agricultural mechanisation have suffered from cuts in the national budgets. Some of their activities have been criticised for not generating sustainable effects. Although mechanisation can clearly influence production and the evolution of agricultural systems, its role in national development strategies has often been poorly defined.

In 1996, CTA commissioned a study of mechanisation experiences in Africa that was undertaken in association with FAO by Dominique Bordet and René Rabezandrina. The analysis started with the following key observations:

- Public-sector tractor hire services have failed throughout Africa.
- Private sector tractors have been profitable on large landholdings: tractors have seldom proved viable for the smallholder sector, whether in individual or group ownership or in private hire services. The devaluation of currencies has dramatically increased the price of tractors relative to the value of harvested produce.

- Tractors and machinery supplied under aid programmes have often been unhelpful, being inappropriate and/or unsustainable. They have diverted the work of agricultural engineering departments from more appropriate, sustainable technologies.
- Artisans (blacksmiths) have been largely ignored as agricultural machinery (such as animal-drawn plows and cultivators) has been imported or made in centralised workshops.
- Supply of equipment has been determined largely by public sector organisations and not by the genuine demand of farmers. Research has been top-down and given insufficient consideration to the social, economic and environmental realities of African farming systems.
- Animal power has been a highly successful mechanisation innovation in savannah zones (animal traction increased five-fold in francophone West Africa between 1960 and 1995).
- Some blacksmith training and decentralised manufacturing schemes have been encouraging.

The provisional CTA-FAO report discussed key issues influencing mechanisation choices in Africa. These included social, economic, political and technical factors. The study concluded with recommendations on the integration of mechanisation in agricultural development strategies. Issues addressed included mechanisation strategy formulation, the roles of the public and private sectors, reorganisation of government services and the increasingly important roles of stakeholder groups (farmers, artisans, NGOs) and networks.

Seminar objectives

This seminar was planned to share the findings of the CTA study and to make recommendations relevant to sustainable agricultural development. The specific objectives were:

- To share experiences and information, to develop cooperation and to construct a framework for facilitating further exchanges.
- To enable participants to become more familiar with the role of mechanisation in agricultural development and its interrelations with other development factors.
- To evaluate future prospects for current mechanisation activities.
- To recommend mechanisation strategies (programmes, actions, measures) that are compatible with strategies for sustainable agricultural development.

While the importance of post-harvest mechanisation was acknowledged, practical considerations meant that the study and seminar concentrated on the mechanisation of cropping systems.

Seminar planning and participation

An International Steering Committee (Chaired by CTA) was responsible for seminar planning.

Schematic view of workshop implementation

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This worked in conjunction with a National Organising Committee (Chaired by the Director of Plant Production, Ministry of Agriculture). The participatory methodology employed was facilitated by a consultancy firm (Stimulans International b.v.).

The seminar was held 24-29 November 1997 in Ouagadougou, Burkina Faso. Sixty invited participants from 19 African countries took part. Most were senior professionals working in the public sector (technical specialists from agricultural ministries, universities, research institutes and development projects). There were also representatives from private sector equipment manufacturers (large and small), NGOs, farmers' associations and national and international networks. Participants included African agricultural engineers (the majority), socio-economists, animal scientists and extensionists, as well as a few technical specialists from the European Union. Six of the participants were women.

Seminar methodology and programme

A schematic diagram of the seminar process is shown below. The participatory processes started several months before participants arrived in Ouagadougou. All participants were sent a 40-page summary report based on the CTA-FAO study. A paper prepared by Stimulans and Dominique Bordet followed. This presented the major themes of the seminar, highlighting how the various issues had been discussed in the summary report. This presentation was accompanied by a searching, 8-page questionnaire on participant experience relating to the major themes. Since completion of the questionnaires necessitated significant cross-referencing with the study, all participants were obliged to review and comment on all the preparatory material during the run-up to the seminar. In addition, one participant per country was asked to submit a report on their national agricultural mechanisation situation.

The seminar started with introductory sessions of group work followed by some overview papers. These included a summary of the CTA-FAO study, analyses of participant responses and a paper highlighting socio-economic issues. A summary of country papers was presented, followed by a more detailed analysis of the mechanisation experience of Burkina Faso.

Methodology of group discussions

Participants agreed to discuss three crucial mechanisation themes in small working groups. The

Schematic view of workshop implementation

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topics were economic liberalisation issues (structural adjustment and free trade), the evolution of farming systems and social development concerns (the role of stakeholder associations). Parallel English and French language sub-groups were established for efficient group deliberation. Simultaneous translation during plenary sessions allowed the groups to share their conclusions. An innovative group process was used to allow all participants to contribute to each theme. Participants first joined the group of greatest interest to them. They prepared provisional reports of the main issues on flip charts. They then left these for the other groups to discuss and to add comments. The groups rotated in sequence, giving everyone the opportunity to review, discuss and comment on the provisional conclusions of all groups. Finally, the groups returned to their original subjects to consider the new suggestions and to make final reports.

Field visits

The field visits were designed as an integral part of the seminar programme. They permitted detailed discussions with a range of stakeholders associated with agricultural mechanisation in the host country. Six different groups of participants each visited one or more farmer, blacksmith and manufacturing workshop. Many observations were made and discussed, and summaries of key points were subsequently presented in a plenary session.

Group conclusions and recommendations

On the fourth day of the seminar, participants reviewed their progress and identified the topics of greatest priority for further analysis, with the aim of reaching some concrete recommendations. Three main topics were identified for work in parallel language groups. In addition, it was agreed that all those working in the private sector should work together on common issues (with translation facilities). Following the plenary presentation and discussion of all group conclusions, a multi-disciplinary reporting group met to extract key points. On the final day, these were refined by participant discussion into a list of agreed recommendations.

Additional activities

Although the programme was full, the seminar provided numerous opportunities for formal and informal networking exchanges. Plans were made for information exchange, visits, collaborative activities, joint studies and new publications. Steering committee members of the Animal Traction Network for Eastern and Southern Africa (ATNESA) met to plan new actions. Participants from West Africa also met to strengthen regional networking. Members of the Southern and Eastern African Society of Agricultural Engineers (SEASAE) discussed their next international conference. Many other valuable meetings and interactions took place during the week.

Participant expectations and reactions

Prior to the seminar, participants had been asked for their expectations and concerns. Participants anticipated useful interaction and information exchange and increased networking. They were concerned that mechanisation was not being given a high priority by national authorities in Africa. Previous workshops on mechanisation issues did not seem to have had any influence on governments or farm practices. Participants felt that this seminar ought to result in some practical conclusions or recommendations that had a realistic chance of making an impact.

There was no formal evaluation of the seminar, but from participant comments, it was clear that the value of the workshop would be judged largely on its eventual impact. This will partly depend on the influence of the various output publications. However, the long-term impact will also depend on the attitudes and actions of the participants themselves, and the national and international networks and organisations with which they work.

Defining the context of agricultural mechanisation

Introduction

Prior to analysing the issues within working groups, seminar participants benefited from a number of studies and keynote presentations. These influenced subsequent discussions and conclusions, and some of the main points raised are highlighted in the following paragraphs. Further details will be available in the final study report and seminar proceedings.

Economic, environmental and social context

In discussion material circulated before and during the workshop, it was stressed that agricultural mechanisation must be seen in three important contexts: economic, environmental and social. For farmers to invest in mechanisation, they had to generate income and profit from their production. Productive agricultural income was needed to fund the supporting services (eg, equipment suppliers) and these had to be profitable businesses also.

Sustainable farm profitability needs to be based on sustainable agriculture, notably the maintenance of soil fertility. Agricultural mechanisation can lead to land degradation. In some ecosystems, removal of soil cover and plowing causes serious erosion. Mechanisation can also assist conservation, for example through the construction of bunds and terraces.

Mechanisation must also be seen in a social context. The introduction and adoption of technological developments invariably result in social and economic differentiation. This is true of agricultural mechanisation. Those able to profit from investments in farm power and equipment will have greater productive capacity than those who cannot. Depending on the circumstances, this might affect use and control of land, employment and gender differentiation. Most governments and aid agencies have social goals, relating to equality of opportunities and improvements in the quality of life (food security, raised living standards, drudgery reduction, etc). Mechanisation can form part of wealth creation and wealth redistribution programmes.

The sustainability of agricultural mechanisation

In his keynote paper, Dominique Bordet maintained the theme of the economic, environmental and social components of mechanisation. Farmers need access to natural resources, appropriate machinery, credit and a market for agricultural produce. Sustainable mechanisation has often been associated with organised markets for crops such as cotton and groundnuts. Many African countries tried to introduce agricultural mechanisation through state-owned companies. Many failed and distorted the market making it difficult for sustainable private enterprises to develop. Experience suggests that mechanisation is most successful where there is private ownership of the mechanisation inputs.

Animal traction has been very successful for small-scale farmers in Africa. The adoption of animal power in savannah zones has been associated with increasing human populations, pressure on land and reduced fallow periods. Further expansion of crop cultivation in savannah areas could lead to a vicious circle of extensification and land degradation. For sustainable animal-powered mechanisation, greater emphasis is needed on intensification, crop-livestock integration and effect management of natural resources. There should be increased attention to soil conservation measures and greater use of crop residues, fodder crops and manure.

Agricultural mechanisation leads to social and economic differentiation in rural areas, which can encourage urban migration. Socially-orientated programmes are needed to stimulate rural employment and development. Labour intensive technologies may be most appropriate.

Socio-economic aspects of mechanisation of family farms

The importance of the socio-economic context was further stressed in a keynote paper by Paul Kleene. While the promotion of large-scale motorised equipment has often failed in Africa, the promotion of animal traction has generally been successful. In the past 30 years, animal traction has become part of normal agricultural, economic and social life in Southern Mali and elsewhere. Although agricultural mechanisation accelerates social differentiation, this is not pronounced in the transition between manual and animal-powered systems. This important transition should be encouraged. Animal power is particularly appropriate for tillage and transport on family-based farms. Motor power is more important for post-harvest operations and pumping. Most Sub-Saharan African economies are changing from government dominated to less regulated market economies. New national strategies for agricultural mechanisation should create incentives for private enterprises and farmers associations. A wide range of possible technologies should be available. Blacksmiths have close relationships with farmers and are important in decentralised rural development. Cross border technology transfer should be facilitated.

Agricultural mechanisation in Burkina Faso

In a keynote presentation, Gouyali Son noted that in Burkina Faso (as in many other African countries) government departments and agencies had dominated the processes of mechanisation. The public sector had been involved in the introduction, maintenance and manufacture of machinery and equipment. The process was accelerated by the development programmes that followed the droughts experienced since 1960. The state also played a role in training artisans. Despite the difficulties experienced by state-owned enterprises, significant progress was made in the development of animal traction for cultivation and for rural and urban transport. About 30% of farmers now own animal-drawn implements. In recent years, private enterprises have started to distribute mechanisation inputs. The government has responsibility for formulating policies and putting in place infrastructure to facilitate the operation of the private sector. Some private sector tractor services are now available but their long-term viability has yet to be seen.

Seminar participants had an opportunity to gain further understanding of the situation in Burkina Faso during field visit discussions with farmers, blacksmiths and manufacturing workshops. The farmers visited cultivated up to 10 ha of rain-fed cereals and legumes. Oxen and donkeys were used for tillage and transport (tractor use was not common in the areas visited). The important agricultural role of animal-drawn carts was noted. Women used donkey carts for carrying farm produce, water, fuel wood and marketing. Blacksmiths were generally trained as apprentices by their artisanal families. Some had also received formal training. Blacksmiths produced and repaired animal-drawn implements and other items. Their constraints included lack of credit and the cost of raw materials. The urban-based manufacturers produced a range of agricultural machinery, including animal-drawn implements and carts. Implements made by the workshops were more expensive than artisanal products, but of higher quality and standard.

Mechanisation experiences from other participating countries

From the country papers and answers to seminar questionnaires, many similarities are evident. Most countries have national development strategy documents that refer to sustainable agricultural development. Only some countries specifically refer to agricultural mechanisation. Countries with important large-farm sectors (eg, Côte d'Ivoire, Zimbabwe) make distinctions between small and large-scale sectors. Other countries do not (eg, Benin, Senegal). Most countries once had tractor-hire schemes for smallholder farmers. These were unsustainable and were abandoned. Most countries reported cutbacks in agricultural engineering services. In most countries recent mechanisation initiatives have related to animal traction technologies (one exception was donor-sponsored tractors for resettlement in Zimbabwe). There is high demand for small-scale equipment for the production of cereals and cotton.

Participant analysis of key themes

Introduction

Seminar participants debated the selected issues within working groups. The discussions were wide-ranging, building on keynote papers, resource materials and diverse experiences. The following summaries are based on the presentations of the main discussion groups.

Role of mechanisation in the evolution of agricultural systems

Assumptions

Mechanisation is a powerful tool in achieving sustainable agricultural production. Human, animal and motor power sources can be complementary in an area or in a farming system. Mechanisation enhances human capacity, it does not necessarily increase productivity in terms of yield, return on capital and return on energy input. If land is plentiful, mechanisation tends to lead to extensification, and reduction in yield per unit area. Mechanisation can improve timeliness and/or precision of tillage, seeding, weeding and harvesting which may increase production and productivity. The potential users or beneficiaries of mechanisation can be men, women and children. A sustainable production system is one that maintains optimal production without jeopardising the production factors in future. To avoid accelerating erosion and soil degradation, sustainable agricultural mechanisation must include measures to conserve soil fertility.

Preconditions

Certain environmental, agricultural, social and economic conditions favour investment in mechanisation technologies and their sustainable use. Other factors may discourage such mechanisation. These factors need careful analysis by the various stakeholders, and associated development agencies.

Mechanisation (with animal power or tractors) is favoured where the timeliness of tillage and planting, weeding and/or harvesting is critical, and where affordable labour is insufficient to permit timely operation. Mechanisation is risky where the climate is unreliable and variable. Mechanisation may not be appropriate in fragile ecosystems, including hilly and sloping areas. In forest areas, clearing and de-stumping land is a major investment. Other key factors that influence successful mechanisation include:

- Socio-economic factors: Capital/credit; Labour costs and availability; Population density; Land tenure; Profitability (input/output relationships); Trade and tariff conditions; Foreign exchange; Cultural traditions.
- Supporting infrastructure: Roads, transport, fuel, spare parts, etc; Access to inputs (seeds, labour, fertilisers, implements, etc); Markets for produce.
- Land and agro-ecological conditions: Appropriate soil types; Environmental protection measures; Grazing land available; Suitable work animals available; Animal disease status.
- Technical skills and service; Animal health services; Repair services (blacksmiths, mechanics); Extension; Technical education and training.

Adoption of mechanisation

If the various favourable conditions are in place, the adoption and spread of mechanisation is likely to take place spontaneously, with no need for interventions. However, in most situations there will be clear limiting factors, such as lack of capital/credit, lack of inputs or support services, or lack of profitable markets. One role of development agencies (governmental or non-governmental) is to identify the crucial limiting factors in an area (using participatory techniques) and, where appropriate, overcome the problems in partnership with local communities.

Mechanisation, rural societies and the role of stakeholder associations

Rural populations with farming as their main activity can benefit from mechanisation for carrying out agricultural operations and transport. This can reduce human drudgery and be cost-effective. People with access to mechanisation can be more productive, so that mechanisation (using animals or motor power) leads to economic and social differentiation. Although mechanisation benefits can be shared (by loan, hire or group cooperation), those owning or controlling the technologies receive the greatest benefits. Equitable development does not seem possible, and compensating programmes may be needed to assist disadvantaged groups.

Mechanisation creates demands for new support services. In free market conditions, user demand stimulates the supply of a wide range of mechanisation inputs by artisans, hire services, peri-urban workshops, industries and traders. State regulations and services affect free markets. The provision of government-supported services may prevent sustainable private services developing. Sustainable services can be assisted or undermined by the practices of financial institutions and the influence of donor organisations. Donor-subsidised equipment and services can be particularly disruptive.

The advice and ideas of farmers are seldom heard and often forgotten in the processes of mechanisation development and extension. Farmers' organisations can represent farmers and facilitate information exchange. They can improve communications relating to training, extension or funding requests. However, they are not always strong, and specific assistance can sometimes bring major benefits. This may include training in literacy, management and information provision to increase their professional competence and confidence. The liaison and advocacy roles of farmers' associations should be developed. Frameworks can be created for consultation to improve feedback between suppliers and end-users. This should influence and improve implement supplies. The different actors should be linked through participatory processes, and by national networks.

Future perspectives for mechanisation in the context of free trade

In many African countries, the state had a monopoly in the provision of mechanisation inputs and services. Tractor schemes were subsidised and generally failed due to low operational profitability and poor management. Most government-owned implement factories were unprofitable. Much equipment was provided to farmers on credit. Credit repayment on government-run schemes was low (particularly for tractors). It was higher when given by organisations producing commodities (eg, cotton, groundnuts, cane sugar). Subsidies on government-provided machinery and services made it difficult for private enterprises to participate.

In recent years, countries have been liberalising their economies. State-owned enterprises have been privatised. Agricultural mechanisation research and extension has been cut back. Subsidies on mechanisation inputs and services have been largely removed. The immediate effect has been to increase prices, making it more difficult for farmers to acquire inputs and services. However, new companies are being established and mechanisation inputs are becoming more available. In some cases, access to credit has improved. The acquisition of mechanisation inputs is now more demand-driven, offering a more sustainable balance between supply and demand.

To assist all actors in the rapidly changing conditions, governments should formulate agricultural mechanisation policies. Low duty and tax should be charged on mechanisation inputs. Training, credit facilities and technical support should be available to farmers. Public sector services may still have an important role in equipment research and development. Local support by different organisations should be coordinated. Inter-regional exchanges between countries should be promoted. National and international networking should be encouraged.

Views of the private sector on the roles of the public and private sectors

Enabling environment

Governments should have clear mechanisation strategies, and provide a favourable environment in which the various stakeholders can operate effectively. This implies:

- Potential for profitable agricultural production, marketing and service industries.
- Affordable costs of inputs (can be affected by duties, competition and market volume).
- Availability of capital/credit for farmers and private supporting services.
- Potential for fair product marketing and fair competition (including lack of competition from donated or subsidised goods and services that interfere with sustainable local systems).

Where these favourable circumstances do not exist, governments and associated agencies may have to intervene to create the right conditions.

Training and research

Basic education is the responsibility of governments, but professional training can be undertaken by the private sector (eg, apprenticeships) or by combined public-private collaboration. All stakeholders should be involved in determining training needs and standards. Professional associations can have a role in the maintenance and evaluation of training standards.

In the past, government services undertook much research and development relating to implements, but this role has been reduced (due to budget cuts) and the responsibility is increasingly with the private sector. The state should assist private sector research and development by providing essential information and assisting with needs assessment studies. The state (and/or donor agencies) could help fund collaborative programmes involving private sector manufacturers, farmers and public sector researchers (from agricultural ministries or universities). International cooperation in such programmes should aim to enhance local skills and capacity.

Professional associations

Stakeholder groups (including manufacturers' associations and agricultural engineering societies) should be formed in response to clear needs. Their aim should be to improve information exchange as well as to defend group interests. A particular benefit could be the facilitation of technical exchanges between members and advice from outside sources. Professional associations of manufacturers can assist in market development and can promote the concept of recognised 'seals of approval' to aid marketing, quality control and consumer confidence.

Networks

National and international networks can be important for private sector producers. They provide information, contacts and forums for presenting their work and products. Activities involving local farmers are particularly valuable. Private sector participants require early and comprehensive information on network activities so they can prepare adequately. Network information, particularly the findings of seminars, needs to be disseminated widely and speedily. Databases should be developed by relevant networks to provide information on available equipment, manufacturers and supporting services.

Seminar conclusions

Mechanisation in relation to agro-ecological and socio-economic conditions

The most appropriate mechanisation technology to promote will depend on local circumstances, and a wide range of social, economic, climatic and agricultural factors. However, there are certain broad generalisations that may help prioritise planning decisions. Some of these are summarised in the following table.

Zones*	Relevant characteristics*	Recommendations*
Humid tropics	High temperature and rainfall. Cultivation of perennial crops often profitable. De-stumping difficult (many roots). Significant erosion risk on slopes. Animal disease problems may exist (eg, <i>trypanosomiasis</i>). Scarcity of animals for traction.	Promote motor-powered mechanisation for transport, crop husbandry and post-harvest work. Undertake research and development work on agricultural equipment. Undertake training and extension work, using technical centres and mass-media.
Irrigated areas	Existence of levelled land. Water availability and control. High agricultural potential. Farmers associations may exist.	Promote private sector machinery services for land-levelling, pumping, tillage and post-harvest operations. Motor power and animal traction may be complementary.
Humid savannah (700-1200 mm rain)	Climate favourable for large livestock. Cattle ownership by farmers common. Natural vegetation not dense. De-stumping is practicable. Cultivation of various annual crops favours mechanisation. Land pressure from growing populations.	Promote animal traction (training, credit, etc). Promote blacksmith services (training, credit, etc). Promote crop-livestock integration, use of manures and residues and soil conservation measures.
Dry savannah (400-700 mm rain)	Rainfall poor and badly distributed. Short cropping season. Light soils. Cereal crops often give low yields.	Promote animal traction (training, credit, etc). Promote blacksmith services for simple tools. Forage management systems
* <i>Note: This table is not prescriptive, but illustrates how agro-ecological information can assist planning. Within countries, much more detailed information would be required on which recommendations can be based, including local ecological, economic, social, demographic and political factors.</i>		

As noted, the above table is illustrative, not prescriptive. It contains some important generalisations. Several agro-ecological and social conditions in the savannah/semi-arid zones favour the use of animal power. In the foreseeable future, animal traction is likely to continue to be the mechanisation system of choice in rain-fed, smallholder farming systems in African savannah zones. Conditions that support sustainable motorised mechanisation include large farms, presence of irrigation, operations requiring high power and the potential to market crops profitably. Thus motor power may be more appropriate than animal traction in humid zones, irrigated areas and large-scale farming systems. In all cases, the decision of what technologies to encourage and/or promote should be based on detailed analysis of the local climatic, agricultural, environmental, infrastructural, social and economic conditions prevailing.

Roles of the public and private sectors in sustainable agricultural mechanisation

Conditions for a favourable environment

Sustainable agricultural mechanisation needs a socio-economic and policy environment in which all those involved in agricultural production and its supporting services are able to make a profit. This implies:

- Stable government and the political will to ensure appropriate and sustainable development.
- Sufficient security to justify agricultural investment (human safety, protection of property, security of tenure, effective legal system, etc).
- Competitive marketing and agricultural support services.
- Basic infrastructure (markets, roads, etc).
- Existence of systems and/or infrastructure for soil and water conservation.
- Effective agricultural strategies and action plans and policy relating to agricultural incomes.
- Existence of information networks and training systems.
- Public and/or private sector applied research systems adapted to local conditions.

The role of governments

The main role of governments and development organisations should be the creation of a climate favourable to all categories of stakeholders (farmers, manufacturers, traders, etc.) in order that mechanisation inputs and services can be efficiently acquired and used in sustainable, free-market systems.

It is expected that governments will continue to scale down public sector services, changing from interventionism towards regulation. There is need for a climate of confidence and mutual trust between government and private sector organisations. This can be greatly affected by government policies and actions (one example is land tenure and security). While the private sector will have increasing responsibilities, certain tasks will have to remain in the public sector, including:

- Economic, fiscal and customs regulation and control.
(regulation of fair trade, competition, duties, taxes, etc).
- Legal rights; Land tenure regulations; Health and safety controls and regulations.
- Development infrastructure (including roads).
- Education, training and development research (priority areas); Collection and dissemination of important information and advice.
- Formulation of national strategies (agriculture, transport and rural development, in cooperation with stakeholders).
- Special assistance programmes for zones at risk and vulnerable groups (including agricultural investment funds for such categories).

The role of private sector and stakeholder associations

The role of the private sector is to facilitate the delivery of inputs and services so that farmers may engage in sustainable and profitable agricultural production. The scaling down of public-sector services should favour private sector organisations and the development of effective stakeholder associations of various types.

Role of development agencies and financial institutions (including international agencies)

Development agencies should provide funding and related advice, giving increasing freedom of action to the recipients of funding. They should show respect for national strategies. They should also assist with enhancing national capacity, information exchange and international exchanges (visits, training, networking).

Networks and networking activities

A network is a group of individuals or organisations that voluntarily exchange information and undertake joint activities without reducing their individual autonomy. Networks link people who would not otherwise be linked. Networks can lead to reduced duplication, faster progress, increased competence, peer support and recognition and a critical mass for action and policy change. Networks operate through the independent interaction of members, and their joint activities. A professional association can be a network, but not all associations are networks.

Successful national and international information exchange can be effectively achieved through strong demand-driven, end-user-orientated networks linking practitioners (farmers, transporters etc) with professionals of various disciplines (agricultural engineers, veterinarians, socio-economists, etc), private sector actors (artisans, workshops), research and educational institutions and development organisations (projects, NGOs, ministries).

Networks need clear objectives and concrete activities, involving end-users. They need links with other networks and some source of funding. Various organisational structures are possible, depending on local conditions. Networks can be formally established as NGOs or can be less formal groups of people and organisations that are linked through common planning and activities. The first step in national network formation is generally the calling of a meeting of all interested parties to discuss improved information exchange and to plan joint actions.

Network examples and requirements

The West Africa Animal Traction Network (WAATN) arranged a programme of multidisciplinary workshops between 1984 and 1992. These linked end-users, organisations and professionals working in many countries. Since 1990, the Animal Traction Network for Eastern and Southern Africa (ATNESA) has implemented an ambitious international programme. This has been based on active national networks, voluntary work and delegated actions. National networks are operating in several countries, including Guinea, Kenya, Tanzania, Zimbabwe and South Africa. The Network for Agricultural Mechanisation in Africa (NAMA) arranged one workshop and has published some newsletters. It has not yet become an active, Africa-wide network. There are several professional associations concerned with mechanisation (eg, Southern and Eastern African Society of Agricultural Engineers, SEASAE). Such professional associations are valuable, but they cannot replace multi-disciplinary, multi-functional networks.

There is scope for complementary national and international networks on specific mechanisation issues including animal traction, post-harvest processing, rural transport and soil and water engineering. Existing animal traction and rural transport networks are multidisciplinary, enthusiastic and effective. They will continue to be important. General mechanisation networks cover a broader range of technologies, but attract a narrow range of disciplines (mainly agricultural engineers). Provided there is clear collaboration and joint activities, sustainable mechanisation processes can be assisted by a range of specialised national and international networks.

Network revival

If NAMA is to be an active network, it should prepare a programme of specific national and international activities of value to its members. Joint activities could be arranged with other networks and associations. WAATN should be revived, with initial emphasis on developing and/or strengthening national animal traction networks. Strong national networks should arrange joint activities in their areas of greatest interest. Initially this may involve a few neighbouring countries. Larger activities will be feasible when national networks are strong. Donors should support well-planned participatory network actions and activities that are orientated to the needs of the end-users.

Summary of specific recommendations

The complementary roles of the various stakeholders

- 1 Governments, the private sectors (formal and informal) and stakeholder groups all have important and complementary roles to play in the development of mechanisation for sustainable agricultural production.
- 2 Governments should allow the development of dynamic private sector agricultural engineering enterprises and support services that are able to meet the needs of farmers. Private ventures supporting mechanisation may involve the formal and/or artisanal sectors. Services may include manufacturing and/or importing equipment and spares, its sale or hire and its maintenance.
- 3 Stakeholder groups (including farmers' associations) should be capable of effective advocacy to defend their economic interests and to help solve their common problems, including equipment supply, marketing, access to finance and training needs. Governments should allow and/or encourage the development of such groups, and listen to them as mechanisation strategies are planned and implemented.

Responsibilities of the public sector

(governments, international institutions, donor agencies)

- 4 Enable the development of agricultural mechanisation appropriate to the agro-ecological conditions and the socio-economic situation of the farmers.
- 5 Provide (and/or facilitate access to) education, training, extension and information exchange relating to agricultural mechanisation.
- 6 Finance and conduct participative research relating to agricultural mechanisation and sustainable agriculture.
- 7 Regulate fiscal policies to promote sustainable agricultural mechanisation.
- 8 Formulate and implement agricultural mechanisation strategies, ensuring the participation of all the stakeholders throughout the processes.
- 9 Provide and/or encourage special programmes for resource-poor people and disadvantaged areas.
- 10 Provide equitable land tenure legislation so that investment in sustainable production and soil-conservation systems is encouraged by land security.
- 11 Create a climate favourable to all categories of stakeholders (manufacturers, traders, farmers, etc.) to allow them to make, acquire, distribute and utilise mechanisation inputs and services.
- 12 Promote credit systems that facilitate access to mechanisation.
- 13 Put in place the infrastructure necessary for sustainable agricultural production, with emphasis on decentralised investment (rural feeder roads, communications, services).
- 14 Create the conditions for fair trade within and between countries, controlling both unfair competition and subsidies that destabilise markets.
- 15 Create an atmosphere of confidence between the government and the private sector.

Responsibilities of the private sector and stakeholder groups

(manufacturers, farmers' associations, artisan circles, producer groups, etc)

- 16 Facilitate the delivery of inputs and services in order to ensure sustainable agricultural production.
- 17 Facilitate the participation of stakeholder group members in the formulation and implementation of agricultural mechanisation strategies at local and national level.
- 18 Assist stakeholder group members through information provision and training.
- 19 Facilitate participation of manufacturers, artisan groups, farmers associations and other stakeholders in national networking activities to achieve an efficient balance between supply and demand.

The enabling role of international organisations

(CTA, FAO, etc)

- 20 Assist the planning and implementation of studies to help in the formulation and development of national agricultural mechanisation strategies.
- 21 Compile and distribute widely seminar outputs and related publications as quickly as possible. (CTA to publish the agricultural mechanisation study and workshop proceedings).

The role of national and international networks

(ATNESA, NAMA, WAATN, etc)

- 22 Provide valuable mechanisms for information exchange at national and international levels through multidisciplinary, demand-driven and end-user-orientated programmes of action.
- 23 Reactivate important regional networks (eg, WAATN, NAMA) by encouraging the activities of strong national networks and inter-network collaboration.
- 24 Support to the development of national and/or international networks should be given by all organisations and individuals concerned with agricultural mechanisation (including participants of this seminar). Donors should support well-planned participatory network activities orientated to the needs of the end-users.

Following up the seminar

Mechanisation in the perspective of sustainable development

This seminar was not actually about mechanisation. This may seem a surprising statement, given the preceding list of recommendations and the mechanisation-related employment of most participants. The seminar was really concerned with sustainable agricultural development, and the role that mechanisation may play in achieving that goal. This point was made on several occasions during the week, and any follow-ups to this seminar must be seen in this perspective.

The need for governments to formulate agricultural mechanisation strategies has been stressed. These will only have value in the context of much broader strategies for sustainable agricultural development. Agricultural mechanisation strategies provide a valuable focus for agricultural engineering departments, but the goal of governments and rural people is sustainable agricultural production in general, and not mechanisation in particular. There should be no implicit conflict here. It is reasonable to consider the role of mechanisation in farming systems and to work on component technologies such as animal traction, crop irrigation and soil conservation. However, it must always be remembered that mechanisation is only one means to an end, and there may be socio-economic or agro-ecological limiting factors of greater priority.

Some issues still to be covered

Although many topics were covered during the week, it was not possible to cover all relevant issues in depth. The whole subject of post-harvest mechanisation has still to be addressed.

Environmental questions were repeatedly raised, and although they were implicit in much of the analysis, they do not figure explicitly in the conclusions. Little was said about conservation tillage systems. Adequate soil nutrients are essential for profitable, sustainable agriculture. The low crop yields that are widespread in Africa are associated with low inputs of organic and chemical fertilisers. Since the benefits of mechanisation often depend on fertiliser use, it may be necessary to focus on soil fertility issues (including economically viable fertiliser supplies and crop-livestock integration).

Gender issues did not figure highly in workshop discussions. The promotion, adoption and benefits of mechanisation in sub-Saharan Africa are not gender-neutral. Women provide a high proportion of agricultural labour, yet it was clear from workshop deliberations that mechanisation is still a male-dominated subject. Rural transport is crucial to agricultural development, and for improving the quality of life and work for women and men. While the significance of transport systems was noted during the seminar, there was insufficient time to debate all the issues adequately. The importance of land security for long-term agricultural investment was mentioned in the recommendations, but the complex issues of land tenure were not discussed in detail. These, and other issues that were only touched on during this seminar, will have to be considered during follow-up activities at both national and international levels.

Follow-up processes and actions

The results and conclusions of this seminar will go to a wide range of organisations and institutions, including government departments, universities, non-governmental organisations and development agencies. The impact of the seminar and the implementation of the recommendations will depend to a large extent on these recipients. The workshop participants themselves agreed to follow-up the many ideas exchanged.

The task of following-up this seminar could seem daunting since there are many recommendations: some are broad, some are specific, but each one is highly significant. Most recommenda-

tions have been phrased in quite general terms. This will allow them to be interpreted and implemented in a variety of country-specific circumstances.

Four inter-related processes can be applied at local, national or international level to help implement the recommendations. These can take place concurrently and build on each other whenever applicable.

There will be need for inclusive, participatory processes to learn more of existing situations. A priority may be **participatory rural appraisal** of local farming systems, their environment, their potential and their constraints. These should try to involve all relevant actors including:

- farming families (men, women and children)
- informal sector (artisans, traditional livestock experts, farmers' and women's groups)
- private sector service providers (manufacturers, engineers, transporters, traders, banks)
- public sector services (agriculture, veterinary, education, etc).

Such processes should ascertain previous agricultural mechanisation experiences, both local and in other comparable areas. Priority domains for future investment should be identified, together with the necessary inputs and services needed from the private and public sectors.

There will be need to develop and implement **mechanisation strategies**. Again participatory processes are essential so that all stakeholders are involved. The topics in the list of recommendations give some idea of the range of private- and public-sector interests that may be involved. Goals must be defined, priorities established and specific actions initiated. Participatory strategic planning can take place at other levels too (district, NGO forum, cross-border area, etc).

Stakeholder groups need to be established (or activated) to influence the processes. The number and type will depend on local circumstances, but they may include farmers (perhaps with specialist groups relating to main crops, special interests or gender), blacksmiths, transporters and NGOs. They should be formed in response to common interests. Light encouragement and facilitation may be needed but not top-down interference.

Enhanced **networking** will be required at both national and international level to promote valuable information exchange on all the issues covered. Networking is also important to ensure that all the stakeholders are able to express their opinions and needs, and so influence the processes. Unlike stakeholder groups that may be homogenous, networks should be multi-disciplinary and multi-functional. Members can be farmers (or farmers' representatives), members of other stakeholder groups, agricultural engineers, government officials, university staff and students, private manufacturers, NGO field staff or the employees of international organisations. Provided people are concerned about the issues, they may actively participate in national or international networks, including those mentioned in this report. Where there is no obvious national or international network to join, there may be scope for contacting other concerned people: this could even lead to the formation of new networks, whether formal or informal.

It is envisaged that all workshop participants and the readers of this report will be able to influence one or more of these processes in their own country and organisation. Resource materials relating to agricultural mechanisation technologies, mechanisation strategy formulation, participatory processes, stakeholder groups and networking are available from several organisations (including CTA and FAO). It is up to everyone who is concerned with agricultural mechanisation and sustainable rural development to help stimulate and develop these important processes in their own way.

Workshop planning and implementation schedule



